# DEPARTMENT OF MINING ENGINEERING

**Revised NEP Course Book for**

**Bachelor of Technology (B.Tech) in Mining Engineering**

**For**

**Students admitted from 2025 onwards.**

**VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY,**

**NAGPUR – 440 010**

## Institute Vision Statement

To contribute effectively to the National and International endeavour of producing quality human resource of world class standard by developing a sustainable technical education system to meet the changing technological needs of the Country and the World incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

## Institute Mission Statement

The mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. VNIT is committed to providing an education that combines rigorous academics with joy of discovery. The Institute encourages its community to engage in a dialogue with society to be able to effectively contribute for the betterment of humankind.

## Department Vision Statement

To create an environment conducive for attaining professional competence in the field of Mining Engineering and to provide specialized training for developing need-based human resource, while fostering within students and staff committed to academic, social and professional development.

## Department Mission Statement

To maintain the standard of mining education and commitment for basic research and applied research in the diverse fields of mining, excavation engineering and other interdisciplinary areas and continuously striving to be recognized internationally for education, research and service to the mining and allied industry.

## BRIEF ABOUT MINING DEPARTMENT

The Department of Mining Engineering was established in the year 1982-83. The Department offers the undergraduate degree of Bachelor of Technology (B.Tech) in Mining Engineering. The course has been accredited by National Board of Accreditation (NBA) earlier in 1996, 2001, 2008 and 2016 and was granted Grade "A". Recently in 2022, both the UG and PG courses have been accredited by NBA for 3 years up to 2025. In its 41 years of existence 37 UG batches have passed out with over 700 students graduating. The performance of present and past students is comparable with that of international standards. The undergraduate degree is a 4-year course conducted on a semester pattern. The degree is offered if a student fulfils a minimum credit requirement of 160. The course is regularly upgraded, and presently relative grading is in operation. Female candidates have been permitted get admitted in B.Tech (Mining). The Department also offers a postgraduate degree of Master of Technology (M.Tech) in Excavation Engineering and doctoral degree (PhD). The Department is housed in an independent building housing classrooms, laboratories, workshop, seminar and audio-visual rooms, office, stores and other facilities in about 1600 $m^2$ area. The Department has implemented several growth programmes funded by various National and International agencies and has acquired good laboratory and computational facilities. A central library caters to the needs of the Department. Department enjoys an excellent rapport with the industry and offers variety of testing and consultancy services to them. Faculty members of the Department are actively involved in student activities, curriculum development, departmental and institutional planning, development and administrative activities, service to industry and society, implementation of growth programs research and development and in creating an enriching work culture. The Department aspires to create an internationally competitive teaching and research environment through faculty development, creation of advanced research facilities, acquiring collaborative projects and attracting scholars, increasing liaison with industry and maintaining a creative work culture. Keeping in view the implementation of new National Education Policy-2020 (NEP 2020), the syllabus along with the credit scheme had been revised initially in 2022. Further guidelines on the inclusion of Internship, have led to revision of the NEP syllabus as presented herein.

## OBJECTIVES OF THE B.TECH PROGRAM:

1. To train students to acquire knowledge in the areas of mining engineering processes, systems and technologies.
2. To develop curriculum and instructional programs in mining engineering in tune with need of the time.
3. To generate new knowledge through research and development and to disseminate it.
4. To modernise laboratories and to establish research facilities in the emerging areas.
5. To promote faculty and staff development for updating and acquiring new knowledge and improving professional competence.
6. To provide technical services to the mining industry.
7. To provide guidance and counselling to students and to establish fruitful linkage with alumni.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Demonstrate the knowledge in the areas of mining engineering processes, systems and technologies looking into industry and research needs by exposing them to the latest technology.
2. Understand the practical aspects of the mining industry and an appreciation for mining as a profession with regards to safety, technology, blasting, and environment looking into economics and production.
3. Apply knowledge in the application of engineering principles pertaining to mine planning, decision making and systems and invoke the desire for continuing education, research, intellectual and professional development, and creativity.

## PROGRAMME OUTCOMES (POs)

At the end of the program B.Tech Mining Engineering, the student will be able to:

1. Exhibit knowledge of mining engineering and allied with basic sciences.
2. Identify, formulate, analyse and optimize mining engineering problems of various domains.
3. Plan Design and solve various mining engineering components with environmental, social and safety considerations.
4. Comprehend and solve interdisciplinary engineering problems through system approach.
5. Select and apply modern and virtual engineering tool, Design and analysis software and state of art equipment to solve mining engineering problems.
6. Demonstrate the understanding of social, cultural, environmental and sustainable, land usages and legal issues in professional activities for the overall sustainable growth of the mineral industry.
7. Integrate the knowledge of ethics and professional values for inclusive growth of a diverse society.
8. Demonstrate the ability to work as individual and participatory learning through collaborative work and working in group as a member or leader to accomplish target for industrial project.
9. Prepare reports to present and communicate inclusive technical information effectively by way of seminars.
10. Adopt and adapt technological changes through skill up gradation for lifelong learning.
11. Plan, organize and manage mining engineering projects for feasibility, adaptability and effective use of new-age technical, financial and human resources.

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the program B.Tech Mining Engineering,

1. Students will possess specialized knowledge and skills to be industry-ready personnel for the further development of mining industry.
2. Students will acquire technical & managerial skills and know-how of modern design and planning tools to address present and future complex mining problems.
3. Students will develop capacity by handling live mining industry case studies through the industrial oriented projects.
4. Students will develop the perspective towards eco-friendly, sustainable, and safe mining to address the economical & social issues.

## LIST OF FACULTY MEMBERS

| SN | Name | Area of Specialization |
|---|---|---|
| 1 | **Dr. R. R. Yerpude** | Mine Planning, System Engineering, Mine Safety Engineering, Computer applications, Mine Economics |
| 2 | **Dr. N. R. Thote** | Rock Blasting and Rock Mechanics, Opencast Mining, Mine Environment |
| 3 | **Dr. A. K. Agarwal** | Mine system Engineering, Slope and dump design, Water pollution |
| 4 | **Dr. R. D. Lokhande** | Ground control, Design of underground mine working, Slope and dump design, Instrumentation & Monitoring, Subsidence |
| 5 | **Dr. S. Panchal** | Rock Mechanics, Underground Coal Mining, Mine Back filling, Mine Surveying |
| 6 | **Dr. N. N. Sirdesai** | Geomechanics, Novel Mining Methods, Tunnelling |
| 7 | **Dr. A. A. Kher** | Safety in mines, Mine ventilation Planning |
| 8 | **Dr. S. Mohanto** | Geomechanics, Underground Metal Mining, Blasting, Soft Computing |
| 9 | **Dr. N. V. Bhagade** | Excavation Engineering, Blast Dynamics. Fragmentation Enhancement, Excavation Damage Zone, Surface Mining |

## CREDIT SYSTEM AT VNIT

Education at the Institute is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance / progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation. A student's performance/progress is measured by the number of credits he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum number of credits and a minimum grade point average must be acquired by a student in order to qualify for the degree.

## COURSE CREDITS ASSIGNMENT

Each course, except a few special courses, has certain number of credits assigned to it depending on lecture, tutorial, and laboratory contact hours in a week.

**For Lectures and Tutorials**: One lecture hour per week per semester is assigned one credit and

**For Practical/ Laboratory/ Studio**: One hour per week per semester is assigned half credit.

**Example**: Course XXXXXX with (3-0-2) as (L-T-P) structure, i.e., 3 hr. Lectures + 0 hr. Tutorial + 2 hr. Practical per week, will have $(3 \times 1) + (0 \times 1) + (2 \times 0.5) = 4$ credits.

# GRADING SYSTEM

The grading reflects a student's own proficiency in the course. While relative standing of the student is clearly indicated by his/her grades, the process of awarding grades is based on fitting performance of the class to some statistical distribution. The course coordinator and associated faculty members for a course formulate appropriate procedure to award grades. These grades are reflective of the student's performance vis-à-vis instructor's expectation. If a student is declared pass in a subject, then he/she gets the credits associated with that subject.

For example, in (3-0-2) type of subjects, in order to pass the subject, a student will have to score marks above threshold set by the faculty in theory part and laboratory part separately. If student scores less than the threshold in any part, then he/she will be given FF grade with one mark less than the passing grade cut-off. Student will have to appear for both theory and practical exam again if failed.

Depending on marks scored in a subject, a student is given a Grade. Each grade has got certain grade points as follows:

| Grade | Grade points | Description |
|---|---|---|
| AA | 10 | Outstanding |
| AB | 9 | Excellent |
| BB | 8 | Very good |
| BC | 7 | Good |
| CC | 6 | Average |
| CD | 5 | Below average |
| DD | 4 | Marginal (Pass Grade) |
| FF | 0 | Poor (Fail) /Unsatisfactory / Absence from end-semester exam |
| NP | - | Audit pass |
| NF | - | Audit fail |
| SS | - | Satisfactory performance in zero credit core course |
| ZZ | - | Unsatisfactory performance in zero credit core course |
| W | - | Insufficient attendance |

## PERFORMANCE EVALUATION

The performance of a student is evaluated in terms of two indices, viz, the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. CGPA is rounded up to second decimal.

The Earned Credits (ECR) are defined as the sum of course credits for courses in which students have been awarded grades between AA to DD. Grades obtained in the audit courses are not counted for computation of grade point average.

**Earned Grade Points in a semester (EGP)** = $\sum(\textbf{Course credits} \times \textbf{Grade point})$ for courses in which AA- DD grade has been obtained.

**Semester Grade Point Average (SGPA)** = $\sum \frac{\textbf{EGP}}{\textbf{Course } \boldsymbol{Credits}}$ for courses registered in a semester in which AA- FF grades are awarded.

**Cumulative Grade Point Average (CGPA)** = $\sum \frac{\textbf{EGP}}{\textbf{Course } \boldsymbol{Credits}}$ for courses passed in all completed semesters in which AA- DD grades are awarded.

## ATTENDANCE RULES

1. All students must attend every class, and 100% attendance is expected from the students. However, in consideration of the constraints/ unavoidable circumstances, the attendance can be relaxed by course coordinator only to the extent of not more than 25%.
2. Every student must attend minimum of 75% of the classes held for that course.
3. A student with less than 75% attendance in a course during the semester will be awarded **W Grade**. Such a student will not be eligible to appear for the end semester and re-examination of that course. Even if such a student happens to appear for these examinations, then, answer books of such students will not be evaluated.
4. A student with **W grade** is not eligible to appear for end semester examination, re-examination & summer term.

# Department of Mining Engineering

## Program Credit Structure (160 Credits)

Bachelor of Technology (B.Tech) in Mining Engineering

**(From academic session 2025-26)**

**1st Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | SAA101 | Health Information and Sports Part 1 | 0-0-2 | 0 | MNC | |
| 2 | MAL101 | Mathematics I | 3-1-0 | 4 | BS | |
| 3 | CHL102 | Chemistry I | 3-1-0 | 4 | BS | |
| 4 | CHP102 | Chemistry Laboratory | 0-0-2 | 1 | BS | |
| 5 | AML1XX | Engineering Mechanics | 3-1-0 | 4 | ES | |
| 6 | AMP1XX | Engineering Mechanics Laboratory | 0-0-2 | 1 | ES | |
| 7 | MEL103 | Engineering Drawing | 3-0-0 | 3 | ES | |
| 8 | MEP103 | Engineering Drawing Practical | 0-0-2 | 1 | ES | |
| 9 | CEL284 | Mining Geology | 3-0-0 | 3 | DC | |
| 10 | CEP284 | Mining Geology | 0-0-2 | 1 | DC | |

| Credits | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **Cumulative** | **9** | **9** | **4** | **0** | **0** | **0** | **0** | **0** | **22** |

**2nd Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | SAA102 | Health Information and Sports Part 2 | 0-0-2 | 0 | MNC | |
| 2 | MAL102 | Mathematics II | 3-1-0 | 4 | BS | |
| 3 | CSL101 | Computer Programming | 3-0-2 | 4 | ES | |
| 4 | MNL209 | Principles and Concepts of Mining Technology | 3-1-0 | 4 | DC | |
| 5 | MNL202 | Mine Surveying | 3-1-0 | 4 | DC | |
| 6 | MNP202 | Mine Surveying | 0-0-2 | 1 | DC | |
| 7 | HUL1XX | English and Corporate Communication | 2-0-2 | 3 | HU | |
| 8 | ICL1XX | Environmental Studies | 2-0-0 | 2 | IC | |
| **Certificate Exit Additional Course** | | | | | | |
| 9 | MNDXXX | Advanced Survey Training | 0-0-2 | 1 | DC | |

| Credits | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **Cumulative** | **13** | **13** | **13** | **3** | **2** | **0** | **0** | **0** | **44** |

**3rd Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MNL212 | Underground Coal Mining Methods | 3-1-0 | 4 | DC | MNL209 |
| 2 | MNL213 | Surface Mining Methods | 3-1-0 | 4 | DC | |
| 3 | MNL214 | Underground Metalliferous Mining Methods | 3-1-0 | 4 | DC | |
| 4 | MNPXXX | Survey Camp | 0-0-2 | 1 | DC | MNL202; MNP202 |
| 5 | MNC-1 | Mandatory Non-Credit Course -1 | | 0 | MNC | |
| **Program Elective** | | | | | | |
| 6 | MAL208 | Probability Theory and Statistics | 3-0-0 | 3 | DE | |
| 7 | MNL461 | Drilling Technology | 3-0-0 | 3 | DE | |
| 8 | - | OC/HM/IE | 3-0-0 | 3 | DE | |
| **Minor Courses (*For students of other departments*)** | | | | | | |
| | MNL453 | Introductory Safety Engineering | 3-1-0 | 4 | MINOR 1 | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **Cumulative** | **Without Internship** | **13** | **13** | **26** | **3** | **2** | **3** | **4*** | **3*▲** | **60** |
| | **With Internship** | | | | | | **6** | **4*** | **3*▲** | **63** |

*** Not included in total credits as Minor and Honours degrees are Optional and over-and-above the requirement of 160 credits for B.Tech in Mining Engineering**

▲ For the fulfilment of the required 15 credits for the award of Honours, student can opt **MNL534 Grouting Technology** in any odd semester (3rd/5th/7th). **MNL534 Grouting Technology** is offered in the 1st semester of the PG program **Excavation and Tunnel Engineering** and the syllabus has been included at the end of the course book.

**4th Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MNL211 | Rock Mechanics | 3-1-0 | 4 | DC | |
| 2 | MNP211 | Rock Mechanics | 0-0-2 | 1 | DC | |
| 3 | MNL210 | Mine Transportation Machinery | 3-1-0 | 4 | DC | |
| 4 | MNP210 | Mine Transportation Machinery | 0-0-2 | 1 | DC | |
| 5 | MNL205 | Mine Ventilation & Climate Engineering | 3-1-0 | 4 | DC | |
| 6 | MNP205 | Mine Ventilation & Climate Engineering | 0-0-2 | 1 | DC | |
| 7 | MNC-2 | Mandatory Non-Credit Course - 2 | | 0 | MNC | |
| **Program Elective** | | | | | | |
| 8 | MNL428 | Mine Management Information System | 3-0-0 | 3 | DE | |
| 9 | CEL384 | Advanced Mining Geology | 3-0-0 | 3 | DE | CEL284 |
| 10 | MNL459 | Reliability Engineering | 3-0-0 | 3 | DE | |
| 11 | - | OC/HM/IE | 3-0-0 | 3 | DE | |
| **Additional Course for Exit with Diploma** | | | | | | |
| 12 | MNDXXX | Mini Project (D) | 0-0-4 | 2 | DC | |
| **Minor Courses (*For students of other departments*)** | | | | | | |
| | MNL454 | Risk Assessment and Management | 3-1-0 | 4 | MINOR 2 | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **4th Sem** | **Without Internship** | 0 | 0 | 15 | 0 | 0 | 6 | 4* | 0 | 21 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 24 |
| **Cumulative** | **Without Internship** | **13** | **13** | **41** | **3** | **2** | **9** | **8*** | **3*▲** | **81** |
| | **With Internship** | | | | | | **15** | **8*** | **3*▲** | **87** |

*** Not included in total credits as Minor and Honours degrees are Optional and over-and-above the requirement of 160 credits for B.Tech in Mining Engineering**

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**5th Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MNL316 | Mine Hazards and Pollution | 3-1-0 | 4 | DC | |
| 2 | MNP316 | Mine Hazards and Pollution | 0-0-2 | 1 | DC | |
| 3 | MNL315 | Mine Excavation Machinery | 3-1-0 | 4 | DC | |
| 4 | MNL322 | Ground Control and Instrumentation | 3-1-0 | 4 | DC | MNL211; MNP211 |
| 5 | MNP322 | Ground Control and Instrumentation | 0-0-2 | 1 | DC | |
| 6 | MNC-3 | Mandatory Non-Credit Course -3 | | 0 | DC | |
| **Program Elective** | | | | | | |
| 7 | MNL434 | Advanced UG Metal Mining & Design | 3-0-0 | 3 | DE | MNL214 |
| 8 | MNL425 | Mass Production Technology for Underground Coal | 3-0-0 | 3 | DE | MNL212 |
| 9 | MNL426 | Underground Space Technology | 3-0-0 | 3 | DE | |
| 10 | MML291 | Mineral Processing | 3-0-0 | 3 | DE | |
| 11 | | OC/HM/IE | 3-0-0 | 3 | DE | |
| **Minor Courses (*For students of other departments*)** | | | | | | |
| | MNL455 | Ergonomics and Training in Safety | 3-1-0 | 4 | MINOR 3 | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **4th Sem** | **Without Internship** | 0 | 0 | 15 | 0 | 0 | 6 | 4* | 0 | 21 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 24 |
| **5th Sem** | **Without Internship** | 0 | 0 | 14 | 0 | 0 | 6 | 4* | 3*▲ | 20 |
| | **With Internship** | | | | 0 | | 9 | 4* | 3* | 23 |
| **Cumulative** | **Without Internship** | **13** | **13** | **55** | **3** | **2** | **15** | **12*** | **6*▲** | **101** |
| | **With Internship** | | | | | | **24** | **12*** | **6*▲** | **110** |

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**6th Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MNL401 | Mine Legislation and Safety | 3-1-0 | 4 | DC | |
| 2 | MNL429 | Blasting Technology for Mining & Construction | 3-1-0 | 4 | DC | |
| 3 | MNL404 | Mine Planning | 3-1-0 | 4 | DC | |
| 4 | MNP314 | Mine Training and Study Tours | 0-0-4 | 2 | DC | |
| 5 | MND319 | Mini Project* | 0-0-6 | 3 | DC | |
| 6 | MNC-4 | Mandatory Non-Credit Course -4 | | 0 | DC | |
| **Program Elective** | | | | | | |
| 7 | MNL320 | Advanced Surveying & Remote Sensing | 3-0-0 | 3 | DE | MNL202; MNP202 |
| 9 | MNL431 | Novel Mining Methods | 3-0-0 | 3 | DE | |
| 10 | MNL423 | Geostatistics | 3-0-0 | 3 | DE | |
| 11 | | OC/HM/IE | 3-0-0 | 3 | DE | |
| **Advanced Diploma Exit is permitted without additional course** | | | | | | |
| **Minor Courses (*For students of other departments*)** | | | | | | |
| | MNL457 | Emergency Management and Safety Audit | 3-1-0 | 4 | MINOR 4 | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **4th Sem** | **Without Internship** | 0 | 0 | 15 | 0 | 0 | 6 | 4* | 0 | 21 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 24 |
| **5th Sem** | **Without Internship** | 0 | 0 | 14 | 0 | 0 | 6 | 4* | 3*▲ | 20 |
| | **With Internship** | | | | 0 | | 9 | 4* | 3*▲ | 23 |
| **6th Sem** | **Without Internship** | 0 | 0 | 17 | 0 | 0 | 6 | 4* | 0 | 23 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 26 |
| **Cumulative** | **Without Internship** | **13** | **13** | **72** | **3** | **2** | **21** | **16*** | **6*▲** | **124** |
| | **With Internship** | | | | | | **33** | **16*** | **6*▲** | **136** |

*** Not included in total credits as Minor and Honours degrees are Optional and over-and-above the requirement of 160 credits for B.Tech in Mining Engineering**

▲ For the fulfilment of the required 15 credits for the award of Honours, student can opt **MNL534 Grouting Technology** in any odd semester (3rd/5th/7th). **MNL534 Grouting Technology** is offered in the 1st semester of the PG program **Excavation and Tunnel Engineering** and the syllabus has been included at the end of the course book.

**7th Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MND456 | Major Project Phase - 1 | 0-0-6 | 3 | DC | |
| **Program Elective** | | | | | | |
| 2 | MNL421 | Mine System Engineering | 3-0-0 | 3 | DE | |
| 3 | MNL402 | Surface Mine Environment | 3-0-0 | 3 | DE | |
| 4 | MNL430 | Rock Slope Engineering | 3-0-0 | 3 | DE | |
| 5 | MNL432 | Mine Automation | 3-0-0 | 3 | DE | |
| 6 | MNL458 | Instrumentation & Non-destructive Testing | 3-0-0 | 3 | DE | |
| 7 | MNL462 | Mine Waste Management | 3-0-0 | 3 | DE | |
| 9 | MNL321 | Artificial Intelligence and IoT in Mining | 3-0-0 | 3 | DE | |
| 10 | | OC/HM/IE | 3-0-0 | 3 | DE | |
| **Credits to be Earned Through Internship** | | | | | | |
| 11 | XXXXXX | One Semester Internship | ---- | 6 | DE | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **4th Sem** | **Without Internship** | 0 | 0 | 15 | 0 | 0 | 6 | 4* | 0 | 21 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 24 |
| **5th Sem** | **Without Internship** | 0 | 0 | 14 | 0 | 0 | 6 | 4* | 3*▲ | 20 |
| | **With Internship** | | | | 0 | | 9 | 4* | 3*▲ | 23 |
| **6th Sem** | **Without Internship** | 0 | 0 | 17 | 0 | 0 | 6 | 4* | 0 | 23 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 26 |
| **7th Sem** | **Without Internship** | 0 | 0 | 3 | 0 | 0 | 15 | 0 | 6*▲ | 18 |
| | **With Internship** | | | | 0 | | 6 | 0 | 6*▲ | 9 |
| **Cumulative** | **Without Internship** | **13** | **13** | **75** | **3** | **2** | **36** | **16*** | **15*▲** | **142** |
| | **With Internship** | | | | | | **39** | **16*** | **15*▲** | **145** |

*** Not included in total credits as Minor and Honours degrees are Optional and over-and-above the requirement of 160 credits for B.Tech in Mining Engineering**

▲ For the fulfilment of the required 15 credits for the award of Honours, student can opt **MNL534 Grouting Technology** in any odd semester (3rd/5th/7th). **MNL534 Grouting Technology** is offered in the 1st semester of the PG program **Excavation and Tunnel Engineering** and the syllabus has been included at the end of the course book.

**8th Semester**

| SN | Course Code | Course Title | L-T-P | Credits | Course Type | Pre-requisites |
|---|---|---|---|---|---|---|
| **Program Core** | | | | | | |
| 1 | MND460 | Major Project Phase - 2 | 0-0-6 | 3 | DC | MND456 |
| **Program Elective** | | | | | | |
| 2 | MNL317 | Smart & Clean Mining Technologies | 3-0-0 | 3 | DE | |
| 3 | MNL427 | Mine Safety Engineering | 3-0-0 | 3 | DE | |
| 4 | MNL433 | Advanced Surface Mining & Design | 3-0-0 | 3 | DE | MNL213 |
| 5 | MNL406 | Mining Economics | 3-0-0 | 3 | DE | |
| 6 | MNL464 | Project Management and Evaluation | 3-0-0 | 3 | DE | |
| 7 | MNL422 | Rock Excavation Engineering | 3-0-0 | 3 | DE | |
| 9 | MNL405 | Computer Application in Mining | 3-0-0 | 3 | DE | |
| 10 | MNL403 | Mine Management | 3-0-0 | 3 | DE | |
| 11 | | OC/HM/IE | 3-0-0 | 3 | DE | |

| Credits | | BS | ES | DC | HU | IC | IE/DE/HM/OC | Minor (Optional) | Honour (Optional) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1st Sem** | | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 22 |
| **2nd Sem** | | 4 | 4 | 9 | 3 | 2 | 0 | 0 | 0 | 22 |
| **3rd Sem** | **Without Internship** | 0 | 0 | 13 | 0 | 0 | 3 | 4* | 3*▲ | 16 |
| | **With Internship** | | | | 0 | | 6 | 4* | 3*▲ | 19 |
| **4th Sem** | **Without Internship** | 0 | 0 | 15 | 0 | 0 | 6 | 4* | 0 | 21 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 24 |
| **5th Sem** | **Without Internship** | 0 | 0 | 14 | 0 | 0 | 6 | 4* | 3*▲ | 20 |
| | **With Internship** | | | | 0 | | 9 | 4* | 3*▲ | 23 |
| **6th Sem** | **Without Internship** | 0 | 0 | 17 | 0 | 0 | 6 | 4* | 0 | 23 |
| | **With Internship** | | | | 0 | | 9 | 4* | 0 | 26 |
| **7th Sem** | **Without Internship** | 0 | 0 | 3 | 0 | 0 | 15 | 0 | 6*▲ | 18 |
| | **With Internship** | | | | 0 | | 6 | 0 | 6*▲ | 9 |
| **8th Sem** | **Without Internship** | 0 | 0 | 3 | 0 | 0 | 15 | 0 | 0 | 18 |
| | **With Internship** | | | | 0 | | 12 | 0 | 0 | 15 |
| **Cumulative** | **Without Internship** | **13** | **13** | **78** | **3** | **2** | **51** | **16*** | **15*▲** | **160** |
| | **With Internship** | | | | | | **51** | **16*** | **15*▲** | **160** |

*** Not included in total credits as Minor and Honours degrees are Optional and over-and-above the requirement of 160 credits for B.Tech in Mining Engineering**

▲ For the fulfilment of the required 15 credits for the award of Honours, student can opt **MNL534 Grouting Technology** in any odd semester (3rd/5th/7th). **MNL534 Grouting Technology** is offered in the 1st semester of the PG program **Excavation and Tunnel Engineering** and the syllabus has been included at the end of the course book.

## DETAILS OF MINOR DEGREE

**MINOR NAME**: **SAFETY ENGINEERING**

**Minor degree in Safety Engineering is offered ONLY to the students of other departments and is OPTIONAL in nature.**

Industrial Safety Engineering is concerned with the development of novel engineering and managerial solutions to safety problems so that the consequences of accidents can be minimised in human, environmental and financial terms. The development and application of emerging technologies within the often-contradictory constraints of safety, economy and the law are addressed within this course.

Students will gain a thorough grasp of the fundamentals of Safety Engineering and practical experience in the use of state-of-the-art techniques for the development of safety engineering systems.

To get an understanding of the necessary scientific, engineering, and technological principles, will enable them to make sound engineering judgments during the design, management, and decommissioning of engineering projects.

| SN | Course Code | Course Name | L-T-P | Credits | Semester |
|---|---|---|---|---|---|
| 1 | MNL453 | Introductory Safety Engineering | 3-1-0 | 4 | 3 |
| 2 | MNL454 | Risk Assessment and Management | 3-1-0 | 4 | 4 |
| 3 | MNL455 | Ergonomics and Training in Safety | 3-1-0 | 4 | 5 |
| 4 | MNL457 | Emergency Management and Safety Audit | 3-1-0 | 4 | 6 |

## DETAILS OF HONOURS PROGRAM

NAME OF HONOURS PROGRAM: **B.Tech Honours in Rock Mechanics (OPTIONAL)**

As per the NEP guidelines approved by the Senate body of VNIT, the Department of Mining Engineering is offering its students the opportunity to earn an Honours degree in Rock Mechanics. This honours program has been developed such that the student would receive the fundamental and advanced knowledge of the recent advances in rock mechanics with regards to the mining, excavation and tunnelling industry.

Enrolment to the honours program would involve choosing the courses listed below in the appropriate semesters. Honours Degree in Rock Mechanics would be awarded on the successful completion of the required credits 15 credits **in addition** to the minimum 160 credits required for the B.Tech Degree.

| HONOURS IN ROCK MECHANICS | | | | | |
|---|---|---|---|---|---|
| **SN** | **Course Code** | **Course Name** | **Structure** | **Credits** | **Semester** |
| 1 | MNL461 | Drilling Technology | 3-0-0 | 3 | 3 |
| 2 | MNL426 | Underground Space Technology | 3-0-0 | 3 | 5 |
| 3 | MNL430 | Rock Slope Engineering | 3-0-0 | 3 | 7 |
| 4 | MNL458 | Instrumentation & Non-destructive Testing | 3-0-0 | 3 | 7 |
| 5 | MNL534 | Grouting Technology | 3-0-0 | 3 | 3 / 5 / 7 |

It is to be noted that while courses 1-4 listed above are from the UG syllabus, **MNL534 Grouting Technology** is offered in the 1st semester of the PG program **Excavation and Tunnel Engineering**. Students wishing to opt for the Honours Program can choose this course in any odd semester (3rd/5th/7th) along with the courses mentioned above. The syllabus of **MNL534 Grouting Technology** has been included at the end of the course book

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MAL101 - MATHEMATICS-I** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech.(CME, CIV, CSE, ECE, EEE, MIN) | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| | |
|---|---|
| **1.** | **Course Objective:** The objective of this subject is to expose students to understand the basic importance of Differential calculus, Integral calculus, Infinite series, and Matrix theory in science and engineering. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** After completing this course, students will be able to |
|---|---|
| **CO1** | Test the convergence of sequence and series. |
| **CO2** | Deal with differential calculus of functions of single variable and its applications. |
| **CO3** | Understand concepts of integration of functions of single variables and their applications. |
| **CO4** | Understand basic concepts of matrix theory and can apply it to solve problems of Engineering |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Sequences and Series:**<br>Sequences of real and complex numbers, Monotonic sequence, Bounded Sequences, Convergence of Sequence.<br>Infinite series, tests of convergence (Comparison test, Ratio test, Root test, Raabe's test, Logarithm test and Integral test statements only), absolute and conditional convergence, power series, radius of convergence. | CO 1 | 3-4 weeks |
| | **Differential Calculus of function of single variable:**<br>Review of limit, continuity, and differentiability. Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem, Taylor's theorem with Lagrange's form of remainder, curve tracing. | CO 2 | 3-4 weeks |
| | **Integral Calculus:**<br>Fundamental theorem of Integral calculus, mean value theorems, evaluation of definite integrals. Differentiation under integral sign including variables limits-Leibnitz rule (without proof). Applications in area, length, volumes, and surface of solids of revolutions. Improper integrals and tests for convergence, Beta and Gamma functions, | CO 3 | 3-4 weeks |
| | **Matrices:**<br>Gauss-Elimination and Gauss-Jordan Elimination methods for solving system of linear equations, Rank of matrix, consistency of a system of equations, linear dependence and independence, linear and orthogonal transformations, Eigenvalues and eigenvectors, Cayley-Hamilton theorem, reduction to diagonal form, Hermitian and skew Hermitian matrices, Quadratic forms. | CO 4 | 3-4 weeks |

| 4. | Textbooks |
|---|---|

i) Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics; Narosa Publishers.

ii) James Stewart, Calculus-Early transcendentals, 5th edition, Thomson™ Brooks/Cole -Indian Edition, 2007

iii) Kreyszig, E, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons.

iv) Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, 9th Edition, Addison-Wesley Longman, Inc.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Piskunov, N., Differential and Integral calculus, Vol.1, Vol.2 MIR Publishers, Moscow – CBS Publishers and Distributors (India).

ii) Sudhir R. Ghorpade, Balmohan V. Limaye, A Course in Calculus and Real Analysis, 2nd Edition, Springer, New York, NY. 2018.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | |
| CO5 | | | | | | | | | | | | | | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): NA |
|---|---|

Not applicable for this course

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **Chemistry I** | | |
| **Course Type:** | BS | | |
| **Name of the programme(s):** | | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **CHL102** | | |

| | |
|---|---|
| **1.** | **Course Objectives:**<br>i. To present sound knowledge of chemistry fundamentals as a strong foundation for enriching students to understand the role of chemistry in the field of science and engineering.<br>ii. To develop ability to understand, plan and implement various processes like corrosion control, catalytic cracking, water softening, including modern approaches.<br>iii. To inculcate habit of scientific reasoning to do the task rationally. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Ability to explain the basic theories and principles of chemistry for engineering practices. |
| **CO2** | Exposure to chemical aspects of various kind of materials for industrial applications. |
| **CO3** | Ability to apply the chemical concepts to solve the industrial issues. |
| **CO4** | Ability to employ critical thinking and efficient numerical problem-solving skills. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| **Water Chemistry:** Sources, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Chemistry involved in sedimentation, coagulation and sterilization. Softening of water, lime-soda, ion-exchange process and numerical problem. Boiler troubles, causes and effects, methods of prevention. | | CO1 | 2 |
| **Electrochemical Phenomenon, Corrosion and Battery Technology:** Electrochemical and galvanic series, polarization, decomposition potential, over voltage. Theories of corrosion. Differential aeration theory. Factors influencing corrosion. Types of corrosion Control of corrosion: Design and material selection, anodic and cathodic protection, protective coatings, corrosion inhibitors. Introduction types and properties of batteries: Primary cells, Secondary cells (Lithium-ion battery: Chemistry involved, Cathode materials, Anode materials, Electrolytes and Separators used. Reason why batteries explode) and Reserve cell (Water activated batteries, Electrolyte activated batteries, Gas activated batteries, Heat activated batteries), Fuel Cells, Solar cells. | | CO1 | 2 |
| **Fuels and Lubricants:** Fuels: Introduction and classification of fuels, solid fuels CV, proximate and ultimate analysis, carbonization. Liquid fuels, Knocking in I/C engine, Octane no, Cetane no., combustion problems.<br>Lubricants: Mechanism of friction, Classification: solid semisolid, liquid with examples. Properties and applications of lubricants. | | CO1 | 2 |
| **Spectroscopy:** Interaction of radiation with matter, Molecular/Atomic Spectroscopy: Principles and applications of optical (UV-Vis) spectroscopy, Atomic absorption spectroscopy, Flame photometry, vibrational (IR) spectroscopy and interpretation. Interaction of α-, β- and γ-radiation with matter. | | CO2 | 1 |
| **Industrially relevant processes:** Skraup synthesis, Beckman reaction, Friedel-craft acylation, Suzuki reaction, Heck reaction, Introduction to coordination chemistry, Chelate effect and applications. Chemical methods of material synthesis: Chemistry in Sol-gel synthesis, co-precipitation technique, Pechini's method, emulsions, CVD, thin films, polymerization. Topics in Chemistry of Metallurgical Analysis. | | CO3 | 2 |

| | | |
|---|---|---|
| **Chemistry of Engineering Materials:** Cement: Introduction, manufacturing and properties, Fly ash utilization; Polymers: Structure property relationship of polymers - Characterization. Synthesis, properties and applications of industrial grade polymers [polyester, poly(ethylene terephthalate) (PET), silicone, nylon, polyurethane, isoprene and Bakelite]. Conducting polymers; Glass and Ceramics: Introduction, properties and applications; Explosives: Introduction, Introduction to Analytical techniques: trace and bulk level, requisites, oxygen balance, Classification, properties and applications. Rocket propellants | CO3 | 2 |
| **Adsorption and catalysis:** Physical adsorption, chemisorption, Freundlich's expression, Langmuir adsorption isotherm, BET isotherm, industrial applications of adsorption. Heterogeneous catalysis: Materials' perspective in adsorption, ion conduction/exchange, gas separation, catalysts, sensors, pollution abatement, and sustainable energy applications. | CO4 | 2 |

**4. Textbooks**

i. Dara, S. S. and S.S. Umare, A Textbook of Engineering Chemistry (Twelfth edition); S. Chand, 2014. ISBN-13: 978-8121903592
ii. Jain and Jain, Engineering Chemistry, 17th Eds; Dhanpat Rai publishing. ISBN-13: 978-9352165728
iii. Shashi Chawla, A Textbook of Engineering Chemistry. ISBN-13: 978-8177001938

**5. Reference Book(s) and Other Required Material**

i. An Introduction to Electrochemistry, S. Glasstone, 2nd Edition, East west press (Pvt.) Limited. ISBN-13: 978-8176710138
ii. P.W. Atkins, Physical Chemistry, Oxford University Press. ISBN-13: 978-0198814740
iii. Bradley D. Fahlman, Materials Chemistry, 4th Eds; Springer, 2023. ISBN-13: 978-3031187834

**6. Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]**

Mid Term Examination: 30 Marks
Continuous Assessment: 20 Marks
End Term Examination: 60 Marks
Total Marks: 100

**7. Relationship of Course Outcomes to Program Outcomes:**

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | - | 2 | 1 | - | - | - | 1 | | | |
| CO2 | 3 | 1 | 1 | 1 | - | 1 | 2 | - | - | - | 1 | | | |
| CO3 | 3 | 3 | 1 | 2 | - | 1 | 1 | 1 | - | - | 1 | | | |
| CO4 | 3 | 3 | 2 | 1 | - | 2 | 1 | - | - | - | 1 | | | |

*High - 3; Medium – 2; Low – 1;*

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **Chemistry Lab** | | |
| **Course Type:** | BS | | |
| **Name of the programme(s):** | | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **CHP102** | | |

| | |
|---|---|
| **1.** | **Course Objectives:**<br>i. To develop fundamental laboratory skills in chemical analysis through experiments related to water quality, ores and alloys, fuels, lubricants, and environmental samples using classical analytical techniques.<br>ii. To introduce students to basic instrumental and physicochemical methods such as pH-metric and conductometric titrations, colorimetry, flame photometry, and nephelometry for quantitative chemical analysis.<br>iii. To provide hands-on experience in chemical synthesis and applied chemistry experiments, including kinetics, adsorption studies, pharmaceutical synthesis, and electrochemical systems, while promoting safe laboratory practices and data interpretation. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Perform quantitative chemical analysis of water, wastewater, ores, and alloys using standard laboratory techniques and interpret the analytical results. |
| **CO2** | Apply instrumental methods such as pH-metric and conductometric titrations, colorimetry, flame photometry, nephelometry, and ion-selective electrodes for chemical measurements. |
| **CO3** | Conduct experiments related to fuels, lubricants, chemical kinetics, and adsorption, and analyze the experimental data to determine relevant physicochemical parameters. |
| **CO4** | Demonstrating of safe laboratory practices and proper reporting of experimental observations. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **List of Experiments** | | **CO(s) Addressed** | **Duration in weeks** |
| **1. Water and wastewater analysis:**<br>Determination of<br>i. Hardness and alkalinity,<br>ii. Dissolved oxygen and free chlorine,<br>iii. Chlorides, fluorides and COD,<br>iv. Trace metal in water using Ion-selective electrodes, | | CO1, CO4 | 4 |
| **2. Determination of capacity of Ion exchange resins** | | CO1, CO4 | 1 |
| **3. Demonstration Experiments on Instrumental methods of analysis:**<br>i. pH-Metric and conductometric titration,<br>ii. Colorimetric determination,<br>iii. Turbidity by Nephelometer<br>iv. Flame photometry<br>v. Flash point of lubricants<br>vi. Viscosity of lubricants<br>vii. Calorific value of solid fuels | | CO2, CO4 | 4 |
| **4. Chemical Kinetics / Adsorption:**<br>i. Rate constant of acid hydrolysis of ester,<br>ii. To study the adsorption of acetic acid on activated charcoal. | | CO3, CO4 | 2 |
| **5. Synthesis of paracetamol and aspirin, and their characterization** | | CO3, CO4 | 1 |

| 4. | Textbooks |
|---|---|

i. Dara, S.S.; A text book on Experiments and Calculations in Engineering Chemistry (ninth edition); S. Chand, 2003.
ii. Rattan, S.; Experiments in Applied Chemistry (second edition); S.K. Kataria &Sons, 2003.
iii. Rani, S.; Laboratory Manual on Engineering Chemistry; Dhanpat Rai, 1998.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i. Vogel's Text book of Quantitative Inorganic Analysis (fifth edition); Pearson, 2000

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

Continuous Assessment: 50 Marks
End Term Examination: 50 Marks
Total Marks: 100

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | 2 | 1 | 1 | 1 | 1 | – | 1 | – | 1 | – | 2 |
| CO2 | 3 | 2 | – | 3 | 3 | – | – | 1 | – | 1 | – | 1 | 1 | – |
| CO3 | 2 | 3 | – | 3 | 2 | 1 | 1 | 1 | – | 1 | – | 1 | – | – |
| CO4 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | – | 1 | 1 | – |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**1.** Water and wastewater analysis:
   i. Determination of Hardness and alkalinity,
   ii. Determination of Dissolved oxygen and free chlorine,
   iii. Determination of Chlorides, fluorides and COD,
   iv. Determination of Trace metal in water using Ion-selective electrodes,
**2.** Determination of capacity of Ion exchange resins
**3.** Demonstration Experiments on Instrumental methods of analysis:
   i. pH-Metric and conductometric titration,
   ii. Colorimetric determination,
   iii. Turbidity by Nephelometer
   iv. Flame photometry
   v. Flash point of lubricants
   vi. Viscosity of lubricants
   vii. Calorific value of solid fuels
**4.** Chemical Kinetics / Adsorption:
   i. Rate constant of acid hydrolysis of ester,
   ii. To study the adsorption of acetic acid on activated charcoal.
**5.** Synthesis of paracetamol and aspirin, and their characterization

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **AML1XX** ENGINEERING MECHANICS | | |
| **Course Type:** | **ES** | | |
| **Name of the programme(s):** | B.Tech. in Mining Engineering | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | **04** |
| **Pre-requisites: Course Code(s) & Name(s)** | **NIL** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **-** | | |

| | |
|---|---|
| **9.** | **Course Objective:** *To expose the students to the basic concepts of mechanics such as force, moment, static equilibrium, etc. to analyse basic force systems, and introduce basic concept of stress and strain.* |

| **10.** | **Course Outcomes:** |
|---|---|
| **After completion of this course, students shall acquire:** | |
| **CO1** | Knowledge of basic theory and principles of forces and their engineering applications. |
| **CO2** | Knowledge of equilibrium of structures. |
| **CO3** | Ability to draw internal forces for beams with various boundary conditions under given set of loading. |
| **CO4** | Knowledge of the concepts of stresses and strains and their importance for engineering analysis and design. |

| **11.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Force Systems and Equilibrium:** 2-D Force System, Moment of a Force about a Point and about an Axis; Free Body Diagram, Reactions at Supports, Equilibrium of Planar Force System, Friction: inclined plane, wedge, ladder friction, Analysis of Statically Determinate Systems i.e., Beams and Trusses | | CO1 | 04 |
| **Properties of Area:** First (Centroid) and Second Moment of Areas, Parallel Axis Theorem, Perpendicular Axis Theorem | | CO2 | 02 |
| **Internal Forces in Member:** Determination of variation of Axial force (Axial Force Diagram), Shear Force (Shear Force Diagram), Bending Moment (Bending Moment Diagram) | | CO3 | 02 |
| **Concept of Stress and Strain:** Normal and Shear Stress and Strain, State of Stress at a Point, Stress Strain Curve, Hook's Law, Modulus of Elasticity, Poisson's Ratio, Modulus of Rigidity, Bulk Modulus, Thermal Stresses, Shear Stress and Bending Stress for Rectangular Section | | CO4 | 04 |
| **Work and Energy:** Virtual Work and Potential Energy Principles | | CO4 | 02 |

| **12.** | **Textbooks** |
|---|---|


i. Beer, F. P., Johnston, E. R., Jr., Cornwell, P. J., Mazurek, D. F., & Sanghi, S., Vector Mechanics for Engineers: Statics and Dynamics. 10th ed., McGraw-Hill Education, 2019.
ii. Beer, F.P., Johnston, E.R., DeWolf, J.T., and Mazurek, D.F., Mechanics of Materials. 6th ed., McGraw-Hill, 2012


| **13.** | **Reference Book(s) and Other Required Material** |
|---|---|


i. Hibbeler, R. C. Engineering Mechanics. 7th ed., Pearson Education, 2004.
ii. Meriam, J. L., and L. G. Kraige. Engineering Mechanics: Dynamics. 7th ed., John Wiley & Sons, 2012.
iii. Popov, E. P. Engineering Mechanics of Solids. Prentice Hall, 1990.
iv. Pytel, Andrew, and Ferdinand L. Singer. Strength of Materials. Harper & Row Publishers, 1987.
v. Shames, I. H. Engineering Mechanics: Statics and Dynamics. Pearson Education Asia Pvt. Ltd., 1996.
vi. Timoshenko, S. Strength of Materials, Part 1: Elementary Theory and Problems. CBS Publishers and Distributors, 2021.

| 14. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| 15. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | 2 | | | 1 | | | 2 | | | 1 | 2 | 1 | |
| CO2 | 2 | 1 | 1 | 1 | 1 | 1 | | | 2 | | | 2 | 2 | 2 | |
| CO3 | 2 | 2 | 1 | 1 | 1 | 1 | | | 2 | | | 1 | 1 | 1 | |
| CO4 | | | | | | 1 | | 1 | 1 | 2 | | 3 | 2 | 2 | |

*High - 3; Medium – 2; Low – 1;*

| 16. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **AMP1XX** ENGINEERING MECHANICS LABORATORY | | |
| **Course Type:** | **ES** | | |
| **Name of the programme(s):** | B.Tech. in Mining Engineering | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | **1** |
| **Pre-requisites: Course Code(s) & Name(s)** | **Nil** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **-** | | |

| | |
|---|---|
| **1.** | **Course Objective:** To expose the students to simple practical experiments based on fundamental concept of mechanics |

| **2.** | **Course Outcomes:** |
|---|---|
| **After completion of this course, students shall acquire:** | |
| **CO1** | Knowledge of basic theory and principles of forces and their engineering applications. |
| **CO2** | Knowledge of equilibrium of structures. |
| **CO3** | Ability to draw internal forces for beams with various boundary conditions under given set of loading. |
| **CO4** | Knowledge of the concepts of stresses and strains and their importance for engineering analysis and design. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics (Any Eight)** | | **CO(s) Addressed** | **Duration in weeks** |
| Verification of Law of Polygon of Forces | | CO1, CO2 | 1 |
| Verification of Lami's Theorem | | CO1, CO2 | 1 |
| Determination of forces in truss | | CO2 | 1 |
| Determination of Reactions of a Simply Supported Beam | | CO1, CO2 | 1 |
| Determination of Coefficient of Static Friction | | CO3 | 1 |
| Determination of centroid of Planar Figures | | CO1, CO2 | 1 |
| Tension Test on Metal Specimen | | CO1, CO4 | 1 |
| Bending Test on Wooden Beam | | CO1, CO4 | 1 |
| Shear test on metal specimen | | CO1, CO4 | 1 |

| **4.** | **Textbooks** |
|---|---|


i. Beer, F. P., Johnston, E. R., Jr., Cornwell, P. J., Mazurek, D. F., & Sanghi, S., Vector Mechanics for Engineers: Statics and Dynamics. 10th ed., McGraw-Hill Education, 2019.

ii. Beer, F.P., Johnston, E.R., DeWolf, J.T., and Mazurek, D.F., Mechanics of Materials. 6th ed., McGraw-Hill, 2012


| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|


i. Hibbeler, R. C. Engineering Mechanics. 7th ed., Pearson Education, 2004.

ii. Meriam, J. L., and L. G. Kraige. Engineering Mechanics: Dynamics. 7th ed., John Wiley & Sons, 2012.

iii. Popov, E. P. Engineering Mechanics of Solids. Prentice Hall, 1990.

iv. Pytel, Andrew, and Ferdinand L. Singer. Strength of Materials. Harper & Row Publishers, 1987.

v. Shames, I. H. Engineering Mechanics: Statics and Dynamics. Pearson Education Asia Pvt. Ltd., 1996.

vi. Timoshenko, S. Strength of Materials, Part 1: Elementary Theory and Problems. CBS Publishers and Distributors, 2021.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | 2 | | | 1 | | | 2 | | | 1 | 2 | 1 | |
| CO2 | 2 | 1 | 1 | 1 | 1 | 1 | | | 2 | | | 2 | 2 | 2 | |
| CO3 | 2 | 2 | 1 | 1 | 1 | 1 | | | 2 | | | 1 | 1 | 1 | |
| CO4 | | | | | | 1 | | 1 | 1 | 2 | | 3 | 2 | 2 | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

Any eight (08) to be performed:

1. Verification of Law of Polygon of Forces
2. Verification of Lami's Theorem
3. Determination of forces in truss
4. Determination of Reactions of a Simply Supported Beam
5. Determination of Coefficient of Static Friction
6. Determination of centroid of Planar Figures
7. Tension Test on Metal Specimen
8. Bending Test on Wooden Beam
9. Shear test on metal specimen

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MEL 103 Engineering Drawing** | | |
| **Course Type:** | **ES** | | |
| **Name of the programme (s):** | **B.Tech** | | |
| **L – T – P** | **3-0-0** | **No. of Credits** | **03** |
| **Pre-requisites: Course Code(s) & Name(s)** | **NIL** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **NIL** | | |

| **1.** | **Course Objective:** |
|---|---|

1. To understand the principles and methods of projections as per the National Standards.
2. To develop the visualization skills for the interpretation of the use of various objects like lines, planes, solids, sections of solids & development of lateral surfaces.
3. To acquire skills to interpret and convert multi-view drawings into single-view drawings and vice versa.
4. To understand and acquire basic skills in Computer-Aided Drafting.

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will be able to understand the conventions and standards for engineering drawing. |
| **CO2** | Students will be able to apply the knowledge of projections and methods to prepare the drawing for lines, planes, solids, sections of solids and development of lateral surfaces. |
| **CO3** | Students will be able to visualize and convert 2D to 3D drawing and vice versa. |
| **CO4** | Students will be able to understand and apply Computer Aided Drafting in real practice |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction to BIS SP-46-2003, Use of various drawing instruments, Concept of scales, Representative Fraction (RF) and dimensioning. | | CO1 | 01 |
| Conversion of Pictorial views to orthographic/ profile views | | CO3 | 02 |
| Projections of points, lines, plane on principle planes/Profile planes. | | CO2 | 03 |
| Projection of right regular solids inclined to both the planes. Section and development of surfaces of solids. (Preferably in normal position/ Inclined to one plane). | | CO2 | 03 |
| Drawing isometric views and projection from orthographic projection. | | CO3 | 02 |
| Introduction to Computer Aided Drafting (CAD)- Basic commands for Setting, Drawing, Editing, Writing, Dimensioning and other features. | | CO4 | 02 |

| **4.** | **Textbooks** |
|---|---|


i) Bhatt, N. D., Panchal, V. M., & Ingle, P. R., *Engineering Drawing (Plane and Solid Geometry)*, 53rd Edition, Charotar Publishing House Pvt. Limited, 2013, ISBN 978-93-80358-83-3.

ii) Dhananjay, A. J., *Engineering Drawing: With An Introduction To Auto Cad*. Tata McGraw-Hill Education Private Limited, 2010, ISBN 978-0-07-064837-1.


| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|


i) Engineering Drawing Practices for School & Colleges SP46:2003, Bureau of Indian Standards, 2003, ISBN 81-7061-019-2

ii) Kuthe A.M., Computer Graphics including CAD, AutoCAD & C, 1st Edition, S.Chand, 2005, ISBN 9788121924610.

iii) Zeid I., CAD / CAM Theory & Practice, 3rd Edition, Tata McGraw-Hill, 1991, ISBN-0070728577.

| 6. | Evaluation Details: |
|---|---|

**Assessment:** Mid Sem 30 % + TA 10 to 20% + End Sem 50 to 60%

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 3 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 9. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MEP103 Engineering Drawing** | | |
| **Course Type:** | **ES** | | |
| **Name of the programme(s):** | **B.Tech** | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | **01** |
| **Pre-requisites: Course Code(s) & Name(s)** | **NIL** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **NIL** | | |

| **1.** | **Course Objective:** |
|---|---|

i. To understand the principles and methods of projections as per the National Standards.
ii. To develop the visualization skills for the interpretation of the use of various objects like lines, planes, solids, sections of solids and the development of lateral surfaces.
iii. To acquire skills to interpret and convert multi-view drawings into single-view drawings and vice versa.
iv. To understand and acquire basic skills in Computer-Aided Drafting.

| **2.** | **Course Outcomes:** |
|---|---|
| **CO1** | Students will be able to understand the conventions and standards for engineering drawing. |
| **CO2** | Students will be able to apply the knowledge of projections and methods to prepare the drawing for lines, planes, solids, sections of solids and development of lateral surfaces. |
| **CO3** | Students will be able to visualize and convert 2D to 3D drawing and vice versa. |
| **CO4** | Students will be able to understand and apply Computer Aided Drafting in real practice. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction to BIS SP-46-2003. Explanation of various drawing instruments, symbols, dimensioning, line types, concept of scales and Representative Fraction (RF). | | CO1 | 02 |
| Conversion of pictorial views to orthographic / profile views. | | CO3 | 01 |
| Projections of points and lines | | CO2 | 01 |
| Projections of planes | | CO2 | 01 |
| Projections of solids. | | CO2 | 01 |
| Section and development of solids. | | CO2 | 02 |
| Isometric Projections | | CO3 | 01 |
| Computer Aided Drafting (CAD) assignments. | | CO4 | 02 |

| **4.** | **Textbooks** |
|---|---|


i) Bhatt, N. D., Panchal, V. M., & Ingle, P. R., *Engineering Drawing (Plane and Solid Geometry)*, 53rd Edition, Charotar Publishing House Pvt. Limited, 2013, ISBN 978-93-80358-83-3.

ii) Dhananjay, A. J., *Engineering Drawing: With an Introduction to AutoCad*. Tata McGraw-Hill Education Private Limited, 2010, ISBN 978-0-07-064837-1.

| 5. | Reference Book(s) and Other Required Material |
|---|---|


i) Engineering Drawing Practices for School & Colleges SP46:2003, Bureau of Indian Standards, 2003, ISBN 81-7061-019-2

ii) Kuthe A.M., Computer Graphics including CAD, AutoCAD & C, 1st Edition, S.Chand, 2005, ISBN 9788121924610.

iii) Zeid I., CAD / CAM Theory & Practice, 3rd Edition, Tata McGraw-Hill, 1991, ISBN-0070728577.


| 6. | Evaluation Details: |
|---|---|

**Assessment:** Continuous evaluation up to Mid-term 40% and then to End Term 60%

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 3 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment: |
|---|---|

10. Orthographic Projection of objects
11. Projection of points and lines
12. Projections of planes
13. Projection of regular solids
14. Projection of sections of a solid
15. Development of the lateral surfaces of a solid
16. Isometric projection of objects.
17. Orthographic projections using AutoCAD.
18. Isometric Projections using AutoCAD.

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **CEL284 Mining Geology** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| 1. | Students will be introduced to concepts of geology in general and mining in particular. |
| 2. | Learn properties of minerals and rocks and deformation within them |
| 3. | Know the types of mineral deposits and stratigraphic groups |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the Internal structure of earth and its dynamics. |
| **CO2** | Know about the minerals and rocks and their properties. |
| **CO3** | Understand various geological structures, and its impacts on mining. |
| **CO4** | Generate the knowledge on stratigraphy and generating sub-surface profiles from geological maps and plotting structures. |
| **CO5** | Know the process of prospecting, exploration and economic mineral deposits |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction to science of Geology; its various branches and its application in mining engineering. Geotectonics: Internal structure of earth, Continental Drift theory and Plate Tectonics, Isostacy, Earthquakes, Earthquake and seismic zones in India and Volcanism. | | CO1 | 2 |
| Structural Geology: Mode of rock failure and mechanism of deformation. Attitude of strata, Dip; True and apparent, Strike. Folds: Elements, terminology, descriptive, morphological and genetic classification. Joints: Classification, joint mapping, frequency diagrams. Faults: Mechanism of formation, elements, terminology, geometric and genetic classification. | | CO3 | 2 |
| Mineralogy: Definition and classification of Minerals. Silicate structures. Structure, chemical and physical properties of following mineral groups; Silica, Felspar, Pyroxene, Amphibole, Mica and Clay minerals. | | CO2 | 2 |
| Petrology: Introduction to Petrology, Rock Cycle, Rock forming Minerals. Igneous petrology; Elementary knowledge of Magma and its consolidation & rock formation. Mode of occurrence, textures, structure, classification of Igneous, Sedimentary and Metamorphic rocks. Hydrological Properties of rocks and groundwater management. | | CO2 | 3 |
| Stratigraphy: Principles of stratigraphic Correlation, Stratigraphic units and Geological Time Scale.<br>Principles of Prospecting and Exploration, Geophysical and geochemical prospecting Economic Geology, Study of important metallic and non-metallic deposits of India. Introduction to geology of Indian Coalfields | | CO4, CO5 | 3 |

| 4. | Textbooks |
|---|---|

i) Courses In Mining Geology (2017) by Arogyaswamy RNP, Oxford and IBH Publishing, 735 pages.

ii) Economic Mineral Deposits, (2013) by Mead L. Jensen and Alan M. Bateman, Publisher: Book Selection Centre.

iii) Engineering and General Geology by Parbin Singh, S K Kataria and Sons, 2013, 600 Pages.

iv) Engineering Geology by BS Sathya Narayanswami, Publisher. VISIONIAS · Publication date. 1 January 2020 · 396 pages.

v) Fundamentals of Historical Geology and Stratigraphy of India by Ravindra Kumar (2022) New Age International Publisher, Pages 458.

vi) Principles of Engineering Geology, K. V. G. K. Gokhale, BS Publications (2016) 268 pages

vii) Structural Geology, (2016), by Marland P. Billings, Pearson Publication.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Fundamentals of Engineering Geology: F. G. Bell, Published by Wiley–Blackwell.

ii) Principles of Petrology Paperback (2012) by G W Tyrrell, AITBS Publishers and Distributors, India

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | **L: 3 T: 0 P: 0** | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 0 | 3 | 3 | 0 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 1 | 0 | 0 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 2 |
| CO5 | 2 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **CEP 284 Mining Geology** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| 1. | Students will be introduced to concepts of geology in general and mining in particular. |
| 2. | Learn properties of minerals and rocks and deformation within them |
| 3. | Know the types of mineral deposits and stratigraphic groups |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the Internal structure of earth and its dynamics. |
| **CO2** | Know about the minerals and rocks and their properties. |
| **CO3** | Understand various geological structures, and its impacts on mining. |
| **CO4** | Generate the knowledge on stratigraphy and generating sub-surface profiles from geological maps and plotting structures. |
| **CO5** | Know the process of prospecting, exploration and economic mineral deposits |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction to science of Geology; its various branches and its application in mining engineering. Geotectonics: Internal structure of earth, Continental Drift theory and Plate Tectonics, Isostacy, Earthquakes, Earthquake and seismic zones in India and Volcanism. | | CO1 | 2 |
| Structural Geology: Mode of rock failure and mechanism of deformation. Attitude of strata, Dip; True and apparent, Strike. Folds: Elements, terminology, descriptive, morphological and genetic classification. Joints: Classification, joint mapping, frequency diagrams. Faults: Mechanism of formation, elements, terminology, geometric and genetic classification. | | CO3 | 2 |
| Mineralogy: Definition and classification of Minerals. Silicate structures. Structure, chemical and physical properties of following mineral groups; Silica, Felspar, Pyroxene, Amphibole, Mica and Clay minerals. | | CO2 | 2 |
| Petrology: Introduction to Petrology, Rock Cycle, Rock forming Minerals. Igneous petrology; Elementary knowledge of Magma and its consolidation & rock formation. Mode of occurrence, textures, structure, classification of Igneous, Sedimentary and Metamorphic rocks. Hydrological Properties of rocks and groundwater management. | | CO2 | 3 |
| Stratigraphy: Principles of stratigraphic Correlation, Stratigraphic units and Geological Time Scale.<br>Principles of Prospecting and Exploration, Geophysical and geochemical prospecting Economic Geology, Study of important metallic and non-metallic deposits of India. Introduction to geology of Indian Coalfields | | CO4, CO5 | 3 |

| 4. | Textbooks |
|---|---|

i) Courses In Mining Geology (2017) by Arogyaswamy RNP, Oxford and IBH Publishing, 735 pages.

ii) Economic Mineral Deposits, (2013) by Mead L. Jensen and Alan M. Bateman, Publisher: Book Selection Centre.

iii) Engineering and General Geology by Parbin Singh, S K Kataria and Sons, 2013, 600 Pages.

iv) Engineering Geology by BS Sathya Narayanswami, Publisher. VISIONIAS · Publication date. 1 January 2020 · 396 pages.

v) Fundamentals of Historical Geology and Stratigraphy of India by Ravindra Kumar (2022) New Age International Publisher, Pages 458.

vi) Principles of Engineering Geology, K. V. G. K. Gokhale, BS Publications (2016) 268 pages

vii) Structural Geology, (2016), by Marland P. Billings, Pearson Publication.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Fundamentals of Engineering Geology: F. G. Bell, Published by Wiley–Blackwell.

ii) Principles of Petrology Paperback (2012) by G W Tyrrell, AITBS Publishers and Distributors, India

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | **L: 0 T: 0 P: 2** | 1 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 0 | 3 | 3 | 0 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 1 | 0 | 0 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 2 |
| CO5 | 2 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Megascopic study of Minerals
2. Megascopic study of Igneous, sedimentary and Metamorphic Rocks
3. Study of Geological maps and drawing geological profiles
4. Three point and Dip Strike problems
5. Electrical Resistivity Survey

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MAL102 – Mathematics II** | | |
| **Course Type:** | BS (Basic Science) | | |
| **Name of the programme(s):** | B.Tech.(CME, CIV, CSE, ECE, EEE, MIN) | | |
| **L – T – P** | (3 – 1 – 0) | **No. of Credits** | **4** |
| **Pre-requisites: Course Code(s) & Name(s)** | - | | |
| **Course Equivalence: Course Code(s) & Name(s)** | Nil | | |

| | |
|---|---|
| **1.** | **Course Objective:** To expose students to multivariable calculus (differential and integral), vector calculus, and ordinary differential equations with an emphasis on engineering applications. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Deal with differential calculus of functions of several variables and their applications. |
| **CO2** | Understand concepts of multiple integrals and their applications in engineering problems. |
| **CO3** | Understand the concepts of vector calculus and its applications in engineering and science. |
| **CO4** | Solve standard classes of ordinary differential equations related to science and engineering. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Calculus of functions of several variables: Limits, continuity and differentiability; partial derivatives and geometry; tangent plane and normal line; Euler's theorem for homogeneous functions; total differential and chain rule; Jacobians; Taylor formula; extrema (maxima, minima, saddle points); Lagrange multipliers. | | CO1 | 3 |
| Multiple integrals: Double integrals; change of order and change of variables; applications to area, volume, mass, centre of gravity. Triple integrals; change of variables; applications to volume, mass, centre of mass and moments of inertia. | | CO2 | 3 |
| Vector calculus: Scalar and vector fields; gradient and directional derivative; divergence and curl; solenoidal and irrotational fields. Line, surface and volume integrals; Green's, Stokes' and Gauss' divergence theorems (statements and applications). | | CO3 | 3 |
| Ordinary differential equations: First-order equations—exact equations, integrating factors, reducible to exact, linear and Bernoulli, orthogonal trajectories; existence and uniqueness (statement), Picard's iteration (statement). Second and higher order linear ODEs with constant coefficients; linear independence; method of variation of parameters; Cauchy–Euler equations; systems of linear ODEs (overview). | | CO4 | 3 |

| **4.** | **Textbooks** |
|---|---|


i) Jain, R. K., and Iyengar, S. R. K., Advanced Engineering Mathematics, 4th ed., Narosa Publishing House, 2014.

ii) James Stewart, Calculus-Early transcendentals,5e, Thomson™ Brooks/Cole -Indian Edition, 2007

iii) Kreyszig, E., Advanced Engineering Mathematics, 10th ed., John Wiley & Sons, 2011.

iv) Thomas, G. B., and Finney, R. L., Calculus and Analytic Geometry, 9th ed., Addison-Wesley, 1996.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Ghorpade, S. R., and Limaye, B. V., A Course in Multivariable Calculus and Analysis, Springer, 2010.

ii) Greenberg, M. D., Advanced Engineering Mathematics, 2nd ed., Pearson Education, 2002.

iii) Piskunov, N., Differential and Integral Calculus (Vol. 1 & Vol. 2), Mir Publishers/CBS Publishers and Distributors (India).

| 6. | Evaluation Details: |
|---|---|

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

Not applicable for this course

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **CSL101 COMPUTER PROGRAMMING** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech. Computer Science & Engineering | | |
| **L – T – P** | 3-0-2 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | **None** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| | |
|---|---|
| **1.** | **Course Objective:** To develop students' proficiency in structured programming using C by teaching them essential constructs (variables, data types, operators, I/O, control flow), foundational problem-solving algorithms, modular and structured data handling (arrays, functions, structures), and basic file operations—empowering them to design, implement, and debug efficient, maintainable programs for real-world computational tasks. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Remember and understand the fundamental programming constructs—such as program structure, data types, operators, expressions, and formatted I/O |
| **CO2** | Implement computational logic using decision structures and loops to solve problem |
| **CO3** | Analyse and modularize solutions using arrays, strings, and user-defined functions (including recursion) to implement algorithms |
| **CO4** | Apply and design structured data and persistent storage solutions by using C structures (including nested and arrays of structs) and basic file-handling operations (text and binary I/O). |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | Introduction: Fundamentals of Computer programming, Program development and execution, basics of algorithms and flow charts and the software development lifecycle. | CO1 | 1.5 |
| | Basic constructs of C programming: Structure of Programs, Keywords and Identifiers, Variables and Data Types, Operators and Expressions (Precedence and Associativity, Type Conversions), Formatted Input/Output. | CO1 | 1.5 |
| | Control Flow: Decision Making and Branching (if, if-else), Loops (while, for). Algorithms such as swapping two variables, reversing digits, character-to-number conversion, generating primes, GCD, smallest divisor, factorial, and Fibonacci generation through loops, nested-loop pattern printing. | CO1, CO2 | 3 |
| | Data Organization & Modularity: Arrays and Strings (1-D arrays, 2-D arrays, basic string operations), Functions (user-defined functions, scope and lifetime of variables, recursive functions); Algorithms like array reversal, finding maximum number in a set, factorial computation, Fibonacci sequence generation, reversing the digits of an integer; sorting and searching techniques and comparison. | CO3 | 3 |
| | Composite Data Types: structures, defining struct types, declaring instances, accessing members using the dot operator, memory layout and padding. Array of Structures: Declaring arrays whose elements are structures; Nested Structures: Embedding one struct type within another (either defined separately or inline), accessing nested members. | CO4 | 3 |
| | File handling: Opening and creating files, Closing files, Text file reading, Text file writing, Binary file reading, Binary file writing. | CO4 | 2 |

| **4.** | **Textbooks (Theory and Practical):** |
|---|---|

i) The C Programming Language by Brian Kernighan and Dennis Ritchie. ISBN:9780131101630

ii) How to Solve It by Computer by R. G. Dromey. ISBN-13. 978-8120303881

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Algorithms in C by Robert Sedgewick ISBN-13:9780-0201314526

ii) Algorithms (4th Edition) by Robert Sedgewick & Kevin Wayne ISBN-13: 978-0321573513

iii) Introduction to Algorithms (commonly known as CLRS) by Cormen, Leiserson, Rivest & Stein ISBN-13: 978-0262033848

| 3. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture with built-in practical | **L:3 T:0 P:4** | L+0.5P | Mid Semester Exam. | 25 |
| | | | | End Semester Exam. | 50 |
| | | | | Quiz | 10 |
| | | | | Continuous Evaluation-I (Pr.) | 7.5 |
| | | | | Continuous Evaluation-II (Pr.) | 7.5 |

| 4. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | 2 | | 2 | | | 1 | 2 | | | 1 | | 2 |
| CO2 | 3 | 2 | 3 | | 1 | | 1 | 2 | | 2 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 1 | 2 | 2 | 3 | 1 | | 3 | | | 3 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |

| Sr. No. | Lab Assignments | CO Addressed |
|---|---|---|
| 1 | Basic Input-Output/Data types/data operators<br>Program to Swap two numbers.<br>Calculation of simple interest and compound interest. | CO1 |
| 2 | Conditional Statements/ Loops<br>Input month number and print number of days in a month<br>Factorial Of a given number.<br>Check the entered no is prime or not.<br>Print patterns using nested loops. | CO1, CO2 |
| 3 | Arrays: 1-D array, 2-D array, Strings: String functions, string.h library<br>Input two sorted arrays and merge to one array.<br>Search element from an array.<br>Reverse an array element. | CO2, CO3 |
| 4 | Functions, Recursion and Structures.<br>Call a simple function to find the sum of digits of a number.<br>Recursive function to generate Fibonacci series.<br>Addition of complex numbers using structure.<br>Store multiple records of student details using an array of structures. | CO3, CO4 |
| 5 | File handling.<br>Count the number of words and characters in a given text file.<br>Replace the specific line from a file.<br>Copy the content of source file into destination file | CO4 |

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL209 Principle and Concepts of Mining Technology** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objective:** |
|---|---|

Students will be made aware about the rudimentary aspects of mining engineering.

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Basic terminology of mining and study of different concepts of mining. |
| **CO2** | Various phases of underground and open cast mining. |
| **CO3** | Various operations involved in drifting and shaft sinking. |
| **CO4** | Various types of explosives and its application in mines. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction: Important mineral resources, Importance of Mining and its consequences. | | **CO1** | One week |
| Basic terminology: Surface Mining, Underground coal and metal such as Mine, Mining, surface mining, underground mining, mineral, rock, ore, mineral deposit, beds, coal seam, veins, strike and dip, hanging wall, footwall, bench, haul road, bench slope, pit slope, overburden, dump, stripping ratio, shaft, adit, incline, tunnel, cross cut, drift, level, winze, raise, stope, dip and rise, level, face, panel, pillar, gallery, roadway . | | **CO1** | Two weeks |
| Phases of mining: Prospecting to reclamation, Brief description of elements of an opencast mine; ramp, haul roads, benches, production cycle, dumping of overburden and backfilling. Brief description of Board and Pillar development, and Longwall (advancing and retreating) methods of coal mining. | | **CO2** | Three weeks |
| Introduction to underground metal mining methods: Brief description of underhand, overhand, cut and fill, and sub level stoping methods of metal mining.<br>Introduction to Mining: Opening of deposits; mode of entry: adit, shaft, decline, and combined model; their applicability and comparison. | | **CO1, CO2** | |
| Drifting: Small and medium size tunnelling and drifting; drivage work in varying ground conditions using conventional methods – drilling, blasting, mucking, transportation, supports, services and cycle of operations<br>Mechanical methods of drivage of roadways and tunnels. | | **CO3** | Two weeks |
| Shaft sinking: Site selection, shaft sinking preparatory arrangements, drilling and blasting, mucking, hoisting, ventilation, pumping, lighting, supporting of sides, complete cycle of operations, special methods of sinking to be used in difficult ground conditions, deepening, and widening of shafts, modern techniques of shaft sinking.<br>Drilling for production of minerals from surface and underground mines, rotary, percussive and rotary-percussive drilling, short and long hole drilling equipment, mechanism of drilling, different types of bits, bit wear, drilling performance | | **CO3** | Two weeks |
| Explosives: types of explosives- their composition and properties.<br>Blasting: Brief introduction to blasting accessories, exploders; blasting practices in opencast and underground mines. | | **CO4** | Two weeks |

| 4. | Textbooks |
|---|---|

i) Introductory Mining Engineering: H L Hartman

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Coal Mining Methods: S K Das

ii) SME Mining Engineer's Handbook: Hustrulid

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | **L: 3 T: 1 P: 0** | L + T | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 3 | 3 | 0 | 2 | 0 | 2 | 3 | 0 | 0 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 0 | 3 | 2 | 0 | 3 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 0 | 2 | 3 | 0 | 2 | 0 | 2 | 3 | 0 | 0 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 0 | 3 | 2 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**NIL**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL202 Mine Surveying** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| | |
|---|---|
| **1.** | **Course Objective:** Students will be given the basic idea of principles of surveying and mine surveying. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Basic terminology of Surveying. |
| **CO2** | Various types of levelling. |
| **CO3** | Various types of terrestrial field surveying and curve setting. |
| **CO4** | Correlation survey, stope survey and development survey. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Surveying: Definition, objective, classification and principles of surveying. Linear measurement: Instruments for measuring distances, ranging survey lines. EDM: Principle of measurement; types; corrections; selection of equipment; total station. | | 1,3 | 1.5 |
| Miner's Instrument: Miners' Dial, Abney level, Clinometers, Suspension Compass, and Gyro-theodolite: Angular measurement: Prismatic compass - principle and construction; bearing of lines; local attraction; magnetic declination. | | 1,3 | 1.5 |
| Theodolite: Essentials of the transit and modern micro-optic theodolite; measurement of horizontal and vertical angles; theodolite traversing, traverse calculations, adjustment of the traverse; computation of co-ordinates; temporary and permanent adjustments. | | 1,3,4 | 1.5 |
| Levelling: Definition of levelling terms; levelling instruments; different types of levelling; booking and reduction methods; differential, profile, cross-sectional and reciprocal levelling; underground levelling; shaft depth measurement. | | 1,2,3 | 1.5 |
| Contours: Characteristics, methods of contouring and uses of contours; problem solving. Control Surveys: Tacheometry: Principle and classification of tachometry; stadia tachometry; distance and elevation formulae. | | 1,2,3 | 1.5 |
| Triangulation: classification, reconnaissance, measurement, procedures for angles and baseline; GPS and its application in mine surveying. | | 1,3,4 | 1.5 |
| Theory of errors, Calculation of most probable values, adjustment of observations. | | 1,3 | 1.5 |
| U/G Surveying: Correlation: Methods of correlation - direct traversing in inclined shaft, correlation in vertical, single and two shafts. Stope Surveying: Purpose, methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. | | 1,3,4 | 1.5 |
| Curve setting: Elements, laying of simple circular curves on surface and belowground. Transition curve and super elevation.<br>Development surveys: Setting a point of known coordinate, control of direction and gradient in drifts, tunnels, raises and winzes; application of lasers; Problems of underground traversing. Legal requirements as to mine plans in India, preparation and preservation of plans and sections, representation of geological and other features on mine plans and sections | | 1,3,4 | 1.5 |

| **4.** | **Textbooks** |
|---|---|

i) Surveying Vols. I, II, III Dr. B.C. Punmia

ii) Surveying Vol I and II Dr T.P. Kanetkar

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Metalliferous Mine Surveying Winniberg

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | **L: 3 T: 1 P: 0** | L + T | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 1 | 3 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 3 | 3 | 1 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP202 Mine Surveying** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| | |
|---|---|
| **1.** | **Course Objective:** Students will be given the basic idea of principles of surveying and mine surveying. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Basic terminology of Surveying. |
| **CO2** | Various types of levelling. |
| **CO3** | Various types of terrestrial field surveying and curve setting. |
| **CO4** | Correlation survey, stope survey and development survey. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Surveying: Definition, objective, classification and principles of surveying. Linear measurement: Instruments for measuring distances, ranging survey lines. EDM: Principle of measurement; types; corrections; selection of equipment; total station. | | 1,3 | 1.5 |
| Miner's Instrument: Miners' Dial, Abney level, Clinometers, Suspension Compass, and Gyro-theodolite: Angular measurement: Prismatic compass - principle and construction; bearing of lines; local attraction; magnetic declination. | | 1,3 | 1.5 |
| Theodolite: Essentials of the transit and modern micro-optic theodolite; measurement of horizontal and vertical angles; theodolite traversing, traverse calculations, adjustment of the traverse; computation of co-ordinates; temporary and permanent adjustments. | | 1,3,4 | 1.5 |
| Levelling: Definition of levelling terms; levelling instruments; different types of levelling; booking and reduction methods; differential, profile, cross-sectional and reciprocal levelling; underground levelling; shaft depth measurement. | | 1,2,3 | 1.5 |
| Contours: Characteristics, methods of contouring and uses of contours; problem solving. Control Surveys: Tacheometry: Principle and classification of tachometry; stadia tachometry; distance and elevation formulae. | | 1,2,3 | 1.5 |
| Triangulation: classification, reconnaissance, measurement, procedures for angles and baseline; GPS and its application in mine surveying. | | 1,3,4 | 1.5 |
| Theory of errors, Calculation of most probable values, adjustment of observations. | | 1,3 | 1.5 |
| U/G Surveying: Correlation: Methods of correlation - direct traversing in inclined shaft, correlation in vertical, single and two shafts. Stope Surveying: Purpose, methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. | | 1,3,4 | 1.5 |
| Curve setting: Elements, laying of simple circular curves on surface and belowground. Transition curve and super elevation.<br>Development surveys: Setting a point of known coordinate, control of direction and gradient in drifts, tunnels, raises and winzes; application of lasers; Problems of underground traversing. Legal requirements as to mine plans in India, preparation and preservation of plans and sections, representation of geological and other features on mine plans and sections | | 1,3,4 | 1.5 |

| **4.** | **Textbooks** |
|---|---|

i) Surveying Vols. I, II, III Dr. B.C. Punmia

ii) Surveying Vol I and II Dr T.P. Kanetkar

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Metalliferous Mine Surveying Winniberg

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | **L: 0 T: 0 P: 2** | L + T | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 1 | 3 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 3 | 3 | 1 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Study of Surveying Instruments for Linear Measurement
2. Traversing using Tape & Prismatic Compass
3. Horizontal Angles Measurement using Theodolite by Repetition Method
4. Horizontal Angles Measurement using Theodolite by Reiteration Method
5. Vertical Angles Measurement using Theodolite
6. Levelling using Dumpy Level
7. Determination of Tacheometric Constants
8. Distance & Elevation using Tacheometer for Staff Vertical: Horizontal Line of Sight
9. Distance & Elevation using Tacheometer for Staff Vertical: Inclined Line of Sight
10. Correlation Survey by Weisbach Triangle Method
11. Correlation Survey by Single Wire in Each of Two Shaft Method

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **HUL1XX English and Corporate Communication** | | |
| **Course Type:** | **IC** | | |
| **Name of the programme(s):** | **B.Tech** | | |
| **L – T – P** | **2-0-2** | **No. of Credits** | **3** |
| **Pre-requisites: Course Code(s) & Name(s)** | **Nil** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **HUL101** | | |

| | |
|---|---|
| **1.** | **Course Objective:** To impart the students with the skills they need in their academics and later in their professional pursuit |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Acquaint learners with basic of communication |
| **CO2** | Familiarize learners with nuances of corporate communication |
| **CO3** | Emphasize the importance of verbal and non-verbal communication |
| **CO4** | Discuss key features of corporate communication |
| **CO5** | Prepare learners for workplace challenges |

| **3. Detailed Description of the Course** | | |
|---|---|---|
| **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction to Communication**<br>• Principles of Communication<br>• Channels of Communication<br>• Inclusive Communication Practices<br>• Speaking and Listening Skills for Communication | CO1 | 2 |
| **Introduction to Corporate Communication**<br>• Different Forms of Corporate Communication<br>• Factors Influencing Corporate Communication<br>• Interpersonal Communication<br>• Communication for Effective Leadership | CO2 | 2 |
| **Verbal and Non-verbal Communication**<br>• Reading and Writing Skills for Corporate Communication<br>• Nonverbal Communication in Corporate Setting<br>• Interview and Group Discussion<br>• Presentation Skills | CO3 | 4 |
| **Features of Corporate Communication**<br>• Levels of Corporate Communication<br>• Barriers to Communication<br>• Organizational Communication<br>• Dos and don'ts of corporate communication | CO4 | 2 |
| **Strategies of Communication**<br>• Negotiating Conflict and Management<br>• Crisis Communication<br>• Emotional Intelligence and Stress Management<br>• Ethics in Corporate Communication | CO5 | 2 |

| 4. | Textbooks |
|---|---|

i) Joep Cornelissen, Corporate Communication: A Guide to Theory and Practice, 6th Edition, SAGE Publications, 2020, ISBN 1526491982.

ii) Meenakshi Raman and Prakash Singh, Business Communication, 2nd Edition, Oxford University Press, 2012, ISBN 9780198077053.

iii) Shirley Taylor and V. Chandra, Communication for Business: A Practical Approach, 1st Edition, Pearson, 2010, ISBN 9788131727652.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Ashraf Rizvi, Effective Technical Communication, 2nd Edition, McGraw Hill Education, 2017, ISBN 9352605780.

ii) Courtland L. Bovee, John V. Thill, et al., Business Communication Today, 14th Edition, Pearson, 2018, ISBN 9789353062682.

iii) Mary Ellen Guffey and Dana Loewy, Business Communication: Process and Product, 10th Edition, South-Western College Publishing, 2021, ISBN 0357129237.

iv) Paul A. Argenti, Corporate Communication, 7th Edition, McGraw-Hill Education, 2016, ISBN 9814636193.

v) Sharon Gerson and Steven Gerson, Technical Communication: Process and Product, 8th Edition, Pearson Education India, 2014, ISBN 9332518599.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

Mid Semester Examination – 20 Marks
Teacher Defined Assessment – 20 Marks
End Semester Examination – 60 Marks

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | | 3 | | | | |
| CO2 | | | | | | | | | 3 | | | | | |
| CO3 | | | | | | | 3 | | | 3 | 3 | | | |
| CO4 | | | | | | | | 3 | | | | | | |
| CO5 | | | | | | | | | | | | | | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

Week 1. Ice Breaker
Week 2. Oral Presentation
Week 3. Listening Activity
Week 4. Role Play
Week 5. Group Discussion
Week 6. Writing Activities
Week 7. Peer Interview
Week 8. PPT Presentation
Week 9. Debate
Week 10. Corporate Meeting
Week 11. Case Study
Week 12. Interviewing Strangers

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **ICL1XX: ENVIRONMENTAL STUDIES** | | |
| **Course Type:** | **IC** | | |
| **Name of the programme(s):** | | | |
| **L – T – P** | 2 – 0 - 0 | **No. of Credits** | **02** |
| **Pre-requisites: Course Code(s) & Name(s)** | **--** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | **--** | | |

| | |
|---|---|
| **1.** | **Course Objective:**<br>1. To introduce various natural resources, their importance and status.<br>2. To introduce the concepts of ecosystem, their structure and functions.<br>3. To introduce the concept of biodiversity conservation.<br>4. To introduce possible causes of various forms of environmental pollution and their consequences, methods of prevention.<br>**5.** To introduce various social and climatic changes due to pollution. |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand about various natural resources, their importance and status. |
| **CO2** | Understand the concepts of ecosystem and biodiversity, their structure, functions and conservation. |
| **CO3** | Understand the causes of various forms of environmental pollution and their consequences, and methods of prevention. |
| **CO4** | About the various changes in social and climate due to pollution and population and the environment. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Natural resources:** Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources. | CO1 | 04 |
| | **Ecosystem:** Concept of an ecosystem, Structure and functions of an ecosystem, Producers, consumers and decomposers, Food chain, food webs and pyramids.<br>**Biodiversity and its conservation:** Introduction, definitions: genetics, species and diversity, Value of biodiversity, Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threat to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Conservation of biodiversity: in-situ and ex-situ conservation. | CO2 | 03 |
| | **Environmental pollution:** Definition, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. | CO3 | 06 |
| | **Social issues and environment:** Sustainable development, Water conservation, Rain water harvesting, Watershed management, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accident, Environmental rules and regulations.<br>**Human population and environment:** Population growth, Environment and human health, Human rights, Value education, Role of information technology in environment and human health. | CO4 | 02 |

| **4.** | **Textbooks** |
|---|---|
| i) | Rajgopalan R., Environmental Studies, 3rd Edition, Oxford University Press, 2023. ISBN: 13. 9789354978944 |
| ii) | Benny Joseph, Environmental Studies, 3rd Edition, McGraw Hill, 2017. ISBN: 10. 9352605179 |
| iii) | Erach Barucha, Environmental Studies, 3rd Edition, Universities press (India), 2025, ISBN: 9789389211788 |

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Rao M.N. and Rao H.V.N., Air Pollution, 1st Edition, McGraw-Hill Publishing Company Limited, 2007. ISBN: 13, 978-0074518717.

ii) Rao C.S., Environmental Pollution Control Engineering, 3rd Edition, Wiley Eastern Limited, New Age International Limited, 1995. ISBN: 13. 978-9386649898.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

**Mid Term Examination:** 30 Marks
**Continuous Assessment (Seminars):** 10 Marks
**End Term Examination:** 60 Marks
**Total Marks:** 100

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | | | | | | | | | | | | | | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**NA**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL212 Underground Coal Mining Methods** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL209 Principles and Concepts of Mining Technology** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| Gives understanding of coal mining methods with respect to development and extraction. Provides methodology for selection of coal mining methods, methods of driving underground openings. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To know coal grading system, coal mining conditions and selection methods for coal mining in India |
| **CO2** | To learn various operations involved in development of Bord and Pillar mining |
| **CO3** | To learn various operations involved in depillaring of Bord and Pillar mining and Longwall mining |
| **CO4** | To understand special coal mining methods |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction**: status of coal reserves, grade and rank of coals available in India, status of coal mining in India, mining conditions in Indian coalfields; choice of mining methods | | **CO1** | 1.5 |
| **Development**: Bord and Pillar, and Room and Pillar Mining; design of bord & pillar workings, the panel system, panels and inter-panel barriers, size of pillars and galleries; methods of driving galleries; layouts for different combinations of loading and transport systems including continuous systems | | **CO2** | 2.5 |
| **Depillaring**: preparatory arrangements for depillaring; sequence and manner of extraction of pillars; mechanized pillar extraction, setting and withdrawal of supports; airblasts; partial extraction | | **CO3** | 2.5 |
| **Longwall Mining**: Evolutionary development of longwall mining, its application, layouts, development and extraction by conventional and mechanised methods; design of longwall workings - face length and panel length; salvaging of longwall faces | | **CO3** | 2.5 |
| **Thick seam mining**: multi-section mining, slicing methods, sublevel caving, integrated sublevel caving, blasting gallery method, thick seam extraction by cable bolting, hydraulic mining. | | **CO3, CO4** | 2 |
| **Contiguous seam working**: Working under surface structures and water bodies, harmonic mining; shaft pillar extraction; horizon mining, Gasification of coal | | **CO4** | 1.5 |

| **4.** | **Textbooks** |
|---|---|

i) Coal Mining Methods: S K Das

ii) Principles and Practices of Modern Coal Mining: R D Singh

iii) Underground Coal Mining Methods: J G. Singh

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Introductory Mining Engineering: H L Hartman

ii) SME Mining Engineer's Handbook: Hustrulid

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 1 | 3 | 3 | 2 | 2 | 0 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL213 Surface Mining Methods** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| Surface Mining is the most economical and safe means of mining mineral reserves. Students will understand the viability of surface mining. Students will be familiarized to opening of deposits under various conditions and haul road design. Mining of deposits under various conditions using various equipment combination with layouts including in-pit-crushing technology. Blast design under various geo-mining conditions. Conversion of underground coal mines to surface mines. Construction of external and internal dumps and reclamation will be covered. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Importance of surface mining, advantages, and disadvantages of Surface mining, |
| **CO2** | Elements of surface mining and aspects related to mine geometry. Opening of deposits under various conditions and haul road design. |
| **CO3** | Mining of deposits under various conditions using various equipment combination with layouts including in -pit-crushing technology. Problem solving of mine design covering – development, production, equipment capacity & strength calculation and layouts. |
| **CO4** | Conversion of underground developed to surface mines. Mine Dumps and Reclamation and with real life problems. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction:** Role of surface mining in mineral production in India, elements of surface mine planning- height, width, and slope of benches, overall and ultimate pit slopes, stripping ratio, cutoff grade, different mining costs and preliminary evaluation of surface mining prospects | | **CO1 & CO2** | 2 |
| **Types of Surface Mining Methods:** applicability, limitations, advantages and disadvantages. Opening up of Deposits – different systems of opening of deposits, site preparation, box cut, formation of benches, and haul roads. Layouts using different combinations of main excavation, loading and transportation systems. | | **CO1, CO2 & CO3** | 2 |
| **Blasting**: Blasting practices and blast design in surface mines | | **CO3** | 1 |
| **Extraction Methods:** Extraction of subsurface deposits - bedded deposits, massive deposits, pipe type, cap type and vein type deposits; mining of beach sands, placer mining, dimensional stone mining. Layouts with In-pit crushing and conveying, surface miners. Surface mining of coal seams developed by underground methods, surface mining over underground workings, mining in fiery strata, deep mining problems | | **CO2 & CO3** | 4 |
| **Dump Formation:** Types of waste dump - internal and external; dump formation methods and equipment. Reclamation methods by using different combination of equipment. | | **CO4** | 3 |

| 4. | Textbooks |
|---|---|

i) SME Handbooks

**ii)** Surface Mining: G.B. Misra

**iii)** Surface Mining Technology: Samir Kumar Das

| 5. | Reference Book(s) and Other Required Material |
|---|---|

iv) Bulk Handling in Open Pit Mines & Quarries: Reinhard H. Wohlbier

v) Coal Mines Regulations, 1957 and Metalliferous Mines Regulations, 1961

vi) Introductory Mining Engineering: Howard L. Hartman

vii) Modern Coal Mining Technology: Samir Kumar Das

viii) Opencast Mining – Technology and Integrated Mechanization: V.V. Rzhevsky

ix) Opencast Mining – Unit Operations: V.V. Rzhevsky

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 1 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL214 Underground Metalliferous Mining Methods** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Gives understanding of metal mining methods with respect to development and extraction. Provides methodology for selection of metal mining methods, methods of driving underground openings. To appraise the special mining techniques and problems | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understanding theories on the formation of metallic ore deposits, their shapes, and spatial and economic distribution. |
| **CO2** | Understanding the terminologies related to underground metal mining and the choice of developmental openings. |
| **CO3** | Understanding the parameters required for the selection of an optimum mining method. |
| **CO4** | Understanding various methods used for mining different kinds of underground metalliferous deposits. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction to Underground Metalliferous Mining Methods:** Classification of Metallic and Non-metallic minerals; Global and National Mineral Scenario; Spatial distribution of metallic mineral in India; Salient features of Indian Mining Industry | | **CO1** | 1 |
| **Projections and Nomenclature used in Underground Metal Mines:** Need to understand projections and views; Peculiarities with underground mines; Types of underground openings; Deposit and Spatial Terms; Directional terms and their relevance; Types of pillars; Excavation Terms. | | **CO1 & CO2** | 1 |
| **Type of Mineral Concentrations and Ore Bodies**: Theories of Ore Genesis; Mode of Formation and their characteristic types; Economic analysis for the assessment of viability of mineral resources. | | **CO1 & CO2** | 2 |
| **Design Elements of Underground Metal Mine and Mine Development**: Classification of Mineral Resources; Cut-off Grade; Production Rate and Mine Life; Mine Access Openings; Stages of Development Activities and Stope Development, Factors influencing choice of mining method. | | **CO2 & CO3** | 2 |
| **Unsupported Methods**: Classification of Methods; Room and Pillar Mining; Stope and Pillar Mining; Shrinkage Stoping; Sublevel Stoping. | | **CO3 & CO4** | 2 |
| **Supported Methods**: Classification of Methods; Cut and Fill Mining; Stull Stoping; Square-Set Stoping. | | **CO3 & CO4** | 2 |
| **Caving Methods**: Classification of Methods; Longwall Mining; Sublevel Caving; Block Caving. | | **CO3 & CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Hartman, H.L. and Mutmansky, J.M., 2002. *Introductory mining engineering*. John Wiley & Sons.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Gertsch, R.E. and Bullock, R.L., 1998. Techniques in underground mining: Selections from Underground mining methods handbook.

ii) Hustrulid, W.A. and Bullock, R.L. eds., 2001. *Underground mining methods: Engineering fundamentals and international case studies*. SME.

iii) Darling, P. ed., 2011. *SME mining engineering handbook* (Vol. 1). SME.

iv) Woodruff, S.D., 2013. *Methods of Working Coal and Metal Mines: Planning and Operations*. Elsevier.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 1 | 3 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNPXXX Survey Camp** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL202 & MNP202 Mine Surveying** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Students will undertake survey camp to become conversant with practical aspects and integration of several concepts of surveying through field and site work. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To learn the practical application of various surveying concepts. |
| **CO2** | To learn the use of various survey equipments in field conditions. |
| **CO3** | To analyse survey data and create informative reports |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s)** | **Duration in weeks** |
| Practical application of the concepts of field surveying | | **CO1** | 0.5 |
| Applicability of difference survey equipments for the given problem statement | | **CO2** | 0.5 |
| Analysis of survey data and creation of informative survey report | | **CO3** | 1 |

| **4.** | **Textbooks** |
|---|---|

i) Surveying Vols. I, II, III Dr. B.C. Punmia
ii) Surveying Vol I and II Dr T.P. Kanetkar

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Surveying – Bannister & Raymond

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| P | Practical | 0-0-2 | 1 | Mid Semester Exam. | 0 |
| | | | | Teacher Defined Assessment | 0 |
| | | | | End Semester Exam. | 100 |

| **7.** | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO2 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | | | | |
| CO3 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | | | | |

*High - 3; Medium – 2; Low – 1;*

| **8.** | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

| Course Code & Course Title: | MAL208 Probability Theory and Statistics | | |
|---|---|---|---|
| Course Type: | DE | | |
| Name of the programme(s): | B.Tech | | |
| L – T – P | 3-0-0 | No. of Credits | 3 |
| Pre-requisites: Course Code(s) & Name(s) | | | |
| Course Equivalence: Course Code(s) & Name(s) | | | |

| 1. | Course Objectives: |
|---|---|
| The objective of this subject is to expose student to understand the importance of probability theory and statistical analysis in science and engineering. | |

| 2. | Course Outcomes (Min. 3 & Max. 5): |
|---|---|
| CO1 | Understand the significance of probability and statistics in real life, engineering and industrial applications. |
| CO2 | Understand theoretical foundations of conditional probability, random variables, joint distributions, transformations |
| CO3 | Learn some significant special discrete and continuous distributions. |
| CO4 | Be able to use sampling theory, estimation, and regression. |

| 3. | Detailed Description of the Course | | |
|---|---|---|---|
| Topics | | CO(s) Addressed | Duration in weeks |
| Random Variable & Probability Distributions: Random Variables, Probability Mass/Density function, distribution function. Mathematical Expectation: Expectation, the variance, Moments, Moment Generating Function, Characteristic Function. Joint distributions, marginal/conditional distributions, covariance, correlation. | | CO1 & CO2 | 5 |
| Special Probability Distributions: Binomial, Poisson, Geometric, Normal, Uniform, Exponential. | | CO3 | 5 |
| Sampling Theory: Sample mean/variance, Sample moments, Sampling distributions of mean and variance. Chi-Square, Students 't', F-distribution. Estimation Theory: Point estimate and Interval Estimates, Confidence interval estimates of population parameters, confidence intervals for means, proportions and variance. Linear Regression: Least square method for curve fitting, Properties of linear regression. | | CO4 | 4 |

| 4. | Textbooks |
|---|---|


i) E. Parzen: Modern Probability Theory and Its Applications J. Wiley and Sons Inc., New York, 1960, ISBN-978-0471668251

ii) Miller and Freund: Probability and Statistics for Engineers, Pearson Education Limited, New York, 2018, ISBN- 978-8120342132

iii) M. R. Spiegel: Probability and Statistics, McGraw-Hill, 1995, ISBN- 978-0070151543

iv) Paul L. Meyer, Introductory Probability and Statistical Applications, Addison Wesley, 1970, SBN-13, 978-0201047103.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) V. K. Rohatgi and A.K.M.E. Saleh: An Introduction to Probability and Statistics, John Wiley & Sons, 2001 ISBN:9780471348467.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 10-20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | | | | |
| CO2 | 3 | 3 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | | | | |
| CO3 | 3 | 3 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | | | | |
| CO4 | 3 | 3 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | | | | |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL461 Drilling Technology** | | |
| **Course Type:** | DE (**HONOURS - 1**) | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| In this course, the student will be introduced to state-of-the-art technologies used in exploratory, production and rock breakage drilling operations. Further, performance parameters of drilling such as Drillability, drill-bit wear and bit consumption will also be introduced to enable students to choose an appropriate drilling system based on the existing geomining scenario. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Learn about various types of drilling systems in mining operation such as exploration, rock breakage, production and support. |
| **CO2** | Learn about state-of-the-art technologies of drilling used in mining industry. |
| **CO3** | Understand the intricacies of exploratory and production drilling systems |
| **CO4** | Learn about the methods of analysing a drilling operation from the perspective of mechanics, performance and economics |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Rock Drilling Methods:** Introduction; Types of drilling operations used in rock breakage; Applicability and limitations of different drilling methods vis-à-vis rock types and hole diameter. | | **CO1 & CO2** | 2 |
| **Percussive & Rotary Percussive Drilling:** Introduction; Fundamentals of percussive & rotary percussive drilling; Top hammer drilling; Down the hole hammer drilling; Advance systems; Drilling parameters and their estimation. | | **CO1, CO2, CO3 & CO4** | 2 |
| **Rotary Drilling:** Introduction; Fundamentals of rotary drilling; Drilling parameters and their estimation. Special drilling methods: Introduction; Jet piercing; Water-jet drilling, | | **CO1, CO2, CO3 & CO4** | 2 |
| **Exploration Drilling:** Boring for exploration; Various types of exploratory drills and their applicability – Auger, Cable-tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel | | **CO1, CO2, CO3 & CO4** | 2 |
| **Production Drilling:** Blasthole drills – types, classification, applicability and limitations; Underground Drills - types, classification, applicability and limitations; Mechanics of drilling; Performance parameters; Drilling cost; Selection of drilling systems, drilling errors, organization of drilling. | | **CO1, CO2, CO3 & CO4** | 2 |
| **Characteristics of Drilling:** Mechanics of drilling; Factors influencing drilling performance; Economics of drilling; Rate of drilling and Drillability; Wear in rock drilling tools: tool material; factors influencing wear; wear mechanism and methods of estimating/predicting tool wear. | | **CO1, CO2, CO3 & CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Turner, A. 2016. Drilling Technology Handbook

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Bourgoyne, A.T., Millheim, K.K., Chenevert, M.E. and Young, F.S., 1986. Applied drilling engineering (Vol. 2, p. 514). Richardson: Society of Petroleum Engineers.

ii) Mitchell, R. and Miska, S., 2011. Fundamentals of drilling engineering. Society of Petroleum Engineers.

iii) Tatiya, R.R., 2005. Surface and underground excavations: methods, techniques and equipment. CRC Press.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 1 |
| CO2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL453 Introductory Safety Engineering** | | |
| **Course Type:** | **MINOR 1** | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student familiarize with the basic concept of hazards, safety and management. To provide the knowledge of occurrence of accidents and its causes. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students understand the methodology of safety management. |
| **CO2** | Students can apply safety engineering principles to their industry. |
| **CO3** | Students understand the cost implications and legislative provisions of accidents |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | Safety management concept and systems in industry; Engineering aspects of safety management, Occupational safety and health, Industry wise hazards and its classification, hazards communication (HazCom) | **CO1** | 3 |
| | Safety Information system for industry, accidents statistics, Safety performance measurement Safety legislations for various industries, Safety Inspection Procedures | **CO2** | 4 |
| | Common industrial accidents, Accidents causation theories; Prevention and control techniques, Zero Accidents Potential (ZAP); Costs of accidents and its calculations. | **CO3** | 5 |

| **4.** | **Textbooks** |
|---|---|

i) The Handbook of Safety Engineering: Principles and Applications, F. R. Spellman and N. E. Whiting

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Industrial Safety Management, L M Deshmukh, McGraw-Hill Education LLC., 2005

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| **7.** | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 1 |
| CO2 | 3 | 2 | 0 | 3 | 3 | 0 | 0 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 2 | 0 | 3 | 3 | 0 | 0 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| **8.** | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

**N.A.**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL211 Rock Mechanics** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 (L) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Mining structures are made in the rock hence rock characterization and support design become immense need of mining graduates. Behaviour of rock is governed by rock properties and structural discontinuities in the rock. The students are acquainted with the determination of the strength properties of both absolute and index properties. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To make students conversant with different types of rock mass with regard to design of excavations and methods of designing. |
| **CO2** | To acquaint students with various types of supports and reinforcements as well as permanent supports of excavations. |
| **CO3** | To make them conversant with ground control and subsidence problems and preventive measures. |
| **CO4** | To understand the knowledge basic of stress analysis, rock modelling and soil mechanics to be applied for design of rock structures. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction:** Intact rock and Rock mass Properties: Introduction to Rock Mechanics; Concept of stress and strain in rock, Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Introduction to elementary rock mass classifications based on strength, hardness and RQD. Determination of physical properties, strengths, strength indices and static elastic constants; parameters influencing strength; abrasivity and its determination. | | **CO1** | 2 |
| **Time dependent and Dynamic properties of rock and rock mass, Failure criteria for rock and rock mass:** Propagation of elastic wave in rock media; determination of properties and elastic constants. Creep deformation and strength behaviour, creep test and rheological models. Theories of rock failure; Coulomb, Mohr and Griffith criteria; empirical criteria. | | **CO2** | 2.5 |
| **Stresses in Rock and Rock reinforcement techniques:** In situ stresses, methods of determination including over-coring and hydro-fracturing methods. Terminology used in rock reinforcement, pressure arch theory, support and reinforcement principles and design, classification of mine supports. | | **CO2** | 2.5 |
| **Distribution of stress patterns around mine openings:** Introduction to methods of stress analysis. Predictive methods for mine design, principles of classical stress analysis, closed form solutions for simple excavation. | | **CO4** | 1.5 |
| **Monitoring Rockmass Performance:** Purpose and nature, monitoring systems including seismic and micro-seismic methods. | | **ALL COs** | 1 |
| **Introduction to computational methods of stress analysis:** finite element, boundary element, distinct element methods and hybrid computational schemes. | | **CO4** | 1.5 |
| **Physico-mechanical properties of soil:** Physical properties including consistency and gradation; classification of engineering soils; engineering properties of soils — compressibility, consolidation, compaction and strength. | | **CO3** | 1.5 |

| 4. | Textbooks |
|---|---|

i) Manual on Rock Mechanics: Ramamurthy & Sharma, CBIP Publ.

ii) Rock Engineering: John Franklin and Maurice Dusseault, McGraw-Hill Publ. comp.

iii) Rock Mechanics by Debasis Deb and Abhiram Verma, PHI

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Rock Mechanics for hard rock mining: Jumikis

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 (L) | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 0 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 0 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 1 | 0 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP211 Rock Mechanics** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 (P) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Mining structures are made in the rock hence rock characterization and support design become immense need of mining graduates. Behaviour of rock is governed by rock properties and structural discontinuities in the rock. The students are acquainted with the determination of the strength properties of both absolute and index properties. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To make students conversant with different types of rock mass with regard to design of excavations and methods of designing. |
| **CO2** | To acquaint students with various types of supports and reinforcements as well as permanent supports of excavations. |
| **CO3** | To make them conversant with ground control and subsidence problems and preventive measures. |
| **CO4** | To understand the knowledge basic of stress analysis, rock modelling and soil mechanics to be applied for design of rock structures. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction:** Intact rock and Rock mass Properties: Introduction to Rock Mechanics; Concept of stress and strain in rock, Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Introduction to elementary rock mass classifications based on strength, hardness and RQD. Determination of physical properties, strengths, strength indices and static elastic constants; parameters influencing strength; abrasivity and its determination. | | **CO1** | 2 |
| **Time dependent and Dynamic properties of rock and rock mass, Failure criteria for rock and rock mass:** Propagation of elastic wave in rock media; determination of properties and elastic constants. Creep deformation and strength behaviour, creep test and rheological models. Theories of rock failure; Coulomb, Mohr and Griffith criteria; empirical criteria. | | **CO2** | 2.5 |
| **Stresses in Rock and Rock reinforcement techniques:** In situ stresses, methods of determination including over-coring and hydro-fracturing methods. Terminology used in rock reinforcement, pressure arch theory, support and reinforcement principles and design, classification of mine supports. | | **CO2** | 2.5 |
| **Distribution of stress patterns around mine openings:** Introduction to methods of stress analysis. Predictive methods for mine design, principles of classical stress analysis, closed form solutions for simple excavation. | | **CO4** | 1.5 |
| **Monitoring Rockmass Performance:** Purpose and nature, monitoring systems including seismic and micro-seismic methods. | | **ALL COs** | 1 |
| **Introduction to computational methods of stress analysis:** finite element, boundary element, distinct element methods and hybrid computational schemes. | | **CO4** | 1.5 |
| **Physico-mechanical properties of soil:** Physical properties including consistency and gradation; classification of engineering soils; engineering properties of soils — compressibility, consolidation, compaction and strength. | | **CO3** | 1.5 |

| 4. | Textbooks |
|---|---|

i) Manual on Rock Mechanics: Ramamurthy & Sharma, CBIP Publ.

ii) Rock Engineering: John Franklin and Maurice Dusseault, McGraw-Hill Publ. comp.

iii) Rock Mechanics by Debasis Deb and Abhiram Verma, PHI

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Rock Mechanics for hard rock mining: Jumikis

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 0-0-2 | 1 (P) | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 0 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 0 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 1 | 0 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Specimen Preparation of Various Tests
2. Determination of Volume, Mass & Density of Rock Specimen
3. Determination of Uniaxial Compressive Strength and Modulus of Elasticity
4. Determination of Tensile strength by Brazilian Test Apparatus
5. Determination of Shear Strength
6. Determination of Angle of Internal Friction &Cohesion by Triaxial Testing
7. Determination of Protodyakonov Index
8. Determination of Point Load Index Strength
9. Determination of Slake Durability Index Test
10. Study of Flat Jack Method to determine In-Situ Stress

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL210 Mine Transportation Machinery** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 (L) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| This course will introduce the student to the state-of-the-art tools available for transportation in mines. Additionally, concepts of material properties such as strength and its enhancement for metals will be briefly covered for better assimilation. Students will also be introduced to new concepts emerging in the field of bulk material and personnel transportation such as electric vehicles and unmanned automated vehicles. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the working and applicability of different mine transport system. |
| **CO2** | Design the capacity of different mine transport system. |
| **CO3** | Select an appropriate mine transportation system based on existing geo-mining scenario. |
| **CO4** | Understand the safety features and limitations of various mine transport systems. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Engineering Metals and their uses:** Steel and other ferrous alloys; Non-ferrous alloys; Application and Uses of alloys; Heat treatment and strength enhancement; Definitions and manufacturing techniques involved with wire ropes; Constructions and types of wire ropes; Measurements and testing of wire ropes; Rope deterioration; Wire Rope terminations and capping. | | **ALL COS** | 2.5 |
| **Track Haulage Systems:** Introduction to track haulage –rope and locomotive haulage; Construction, installation and selection of haulage units; Minimum gradient and Power Requirement; Safety devices and features; Track laying and maintenance protocols; Mine tubs/cars. | | **ALL COS** | 2 |
| **Conveyors:** Type of conveyors; Construction, installation and operation of conveyors; Capacity and power computations; Mobile conveyors and emerging trends in conveyors | | **ALL COS** | 2 |
| **Surface & Shaft Plant:** Pit-top and Pit-Bottom Circuits; Stacking, blending and reclaiming of materials; Design of storage system: Silos, bins and bunkers; Rapid loading system; Type and choice of headframe; Shaft fittings and guides; Safety devices; Keps, tilting platforms, receivers and roofing; Suspension gear; Cages & Skips | | **ALL COS** | 1.5 |
| **Winding:** Types, functioning and limitations of drum and friction winding; Duty cycle and torque-time computation; Winding capacity and production; multi-level and deep winding; Drives and brakes for winding; Speed controllers, depth indicators and safety devices for winding | | **ALL COS** | 2 |
| **Man-riding Systems:** Types of Man-riding systems; Construction and installation of such systems; Safety devices and case studies. | | **ALL COS** | 1 |
| **Other mine transportation solutions:** Railveyor system; Aerial Ropeway; Tube Transportation; Emerging vehicles for bulk, personnel and material transportation in mines. | | **ALL COS** | 1 |

| 4. | Textbooks |
|---|---|

i) S. C. Walker, Mine Winding and Transport. Elsevier, 2012.

ii) M. A. Ramlu, Mine hoisting, White Falcon, 1996

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) SME Mining Engineer's Handbook: Hustrulid

ii) Underground Mining Methods Handbook: Hustrulid

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 (L) | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 0 | 3 | 3 | 0 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 1 | 0 | 0 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP210 Mine Transportation Machinery** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 (P) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| This course will introduce the student to the state-of-the-art tools available for transportation in mines. Additionally, concepts of material properties such as strength and its enhancement for metals will be briefly covered for better assimilation. Students will also be introduced to new concepts emerging in the field of bulk material and personnel transportation such as electric vehicles and unmanned automated vehicles. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the working and applicability of different mine transport system. |
| **CO2** | Design the capacity of different mine transport system. |
| **CO3** | Select an appropriate mine transportation system based on existing geo-mining scenario. |
| **CO4** | Understand the safety features and limitations of various mine transport systems. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Engineering Metals and their uses:** Steel and other ferrous alloys; Non-ferrous alloys; Application and Uses of alloys; Heat treatment and strength enhancement; Definitions and manufacturing techniques involved with wire ropes; Constructions and types of wire ropes; Measurements and testing of wire ropes; Rope deterioration; Wire Rope terminations and capping. | | **ALL COS** | 2.5 |
| **Track Haulage Systems:** Introduction to track haulage –rope and locomotive haulage; Construction, installation and selection of haulage units; Minimum gradient and Power Requirement; Safety devices and features; Track laying and maintenance protocols; Mine tubs/cars. | | **ALL COS** | 2 |
| **Conveyors:** Type of conveyors; Construction, installation and operation of conveyors; Capacity and power computations; Mobile conveyors and emerging trends in conveyors | | **ALL COS** | 2 |
| **Surface & Shaft Plant:** Pit-top and Pit-Bottom Circuits; Stacking, blending and reclaiming of materials; Design of storage system: Silos, bins and bunkers; Rapid loading system; Type and choice of headframe; Shaft fittings and guides; Safety devices; Keps, tilting platforms, receivers and roofing; Suspension gear; Cages & Skips | | **ALL COS** | 1.5 |
| **Winding:** Types, functioning and limitations of drum and friction winding; Duty cycle and torque-time computation; Winding capacity and production; multi-level and deep winding; Drives and brakes for winding; Speed controllers, depth indicators and safety devices for winding | | **ALL COS** | 2 |
| **Man-riding Systems:** Types of Man-riding systems; Construction and installation of such systems; Safety devices and case studies. | | **ALL COS** | 1 |
| **Other mine transportation solutions:** Railveyor system; Aerial Ropeway; Tube Transportation; Emerging vehicles for bulk, personnel and material transportation in mines. | | **ALL COS** | 1 |

| 4. | Textbooks |
|---|---|

iii) S. C. Walker, Mine Winding and Transport. Elsevier, 2012.

iv) M. A. Ramlu, Mine hoisting, White Falcon, 1996

| 5. | Reference Book(s) and Other Required Material |
|---|---|

iii) SME Mining Engineer's Handbook: Hustrulid

iv) Underground Mining Methods Handbook: Hustrulid

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 0-0-2 | 1 (P) | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 0 | 3 | 3 | 0 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 1 | 0 | 0 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Study of Wire Ropes
2. Study of Rope Splicing
3. Study of Rope Capping
4. Study of Safety Devices on Rope Haulages
5. Study of Pit-Bottom and Pit-Top Layout
6. Study of Tipplers
7. Study of Track Laying
8. Study of Head Frame and Head Gear
9. Study of Guides and Keps

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL205 Mine Ventilation & Climate Engineering** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 (L) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To understand the basic concepts of ventilation. Apply various methods used in the subject. Awareness for practical problems. Recent developments in the subject. Solving ventilation problems. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Various gaseous pollutants including radon gas in metalliferous and coal mines. Their toxic effects, detection and means of their reduction in mine atmosphere. Statutory requirement of ventilation standards to be maintained. |
| **CO2** | Salient features of heat and humidity, their effect on working efficiency of miners, measurement and reducing both to tolerable limits. |
| **CO3** | Natural ventilation and its limitations. Types of Mechanical ventilators, various ventilation devices, selection, installation, working, and necessary calculation including expenditure and necessary statute. |
| **CO4** | Live case studies of mine ventilation, quantity & necessary pressure requirement, ventilation planning in underground coal and non-coal mines, auxiliary ventilation devices for improvement in ventilation. |
| **CO5** | Computer application in solving complicated ventilation circuits and special problems associated with deep underground and deep opencast mines. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Composition of Mine Atmosphere: Mine gases - production, properties, effects and detection; sampling and analysis of mine air; methane content; methane drainage; methane layering; flame safety lamp and its uses; methanometers; radon gas and its daughter products; continuous monitoring of gases | | **CO1** | 2.5 |
| Heat and humidity: Sources of heat in mines; effects of heat and humidity; psychrometry, kata thermometer; heat stress, air-conditioning | | **CO2** | 2 |
| Natural ventilation: Seasonal variations, calculation of NVP from air densities and thermodynamic principles | | **CO3** | 2 |
| Air Flow through Mine Openings: Laws of air-flow, resistance of air ways, equivalent orifice, distribution of air; flow control devices; automation and remote control of ventilation installations; ventilation surveys; permissible air velocities in different types of workings | | **CO3, CO4** | 1.5 |
| 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 | | **CO3** | 2 |
| Ventilation planning: Planning of ventilation systems and economic considerations; ventilation layouts for mining of coal and ore deposits; ventilation of workings/stopes using heavy blasting; calculation of air quantity required for ventilating a mine; calculation of total mine head; network analysis principles and computer applications | | **CO4** | 1 |
| Booster fans, auxiliary ventilation, recent developments in mine ventilation, venturi blowers; ventilation of deep mines - underground and open pit; standards of ventilation; ventilation cost calculations | | **CO5** | 1 |

| 4. | Textbooks |
|---|---|

i) Mine Ventilation: G. B. Mishra

ii) Sub-surface mine ventilation: Macperson

iii) Mine ventilation and air-conditioning in mines: Hartman

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Introductory Mining Engineering: Howard L. Hartman

ii) Elements of Mining Technology - Volume II: D. J. Deshmukh

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 (L) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP205 Mine Ventilation & Climate Engineering** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 (P) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To understand the basic concepts of ventilation. Apply various methods used in the subject. Awareness for practical problems. Recent developments in the subject. Solving ventilation problems. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Various gaseous pollutants including radon gas in metalliferous and coal mines. Their toxic effects, detection and means of their reduction in mine atmosphere. Statutory requirement of ventilation standards to be maintained. |
| **CO2** | Salient features of heat and humidity, their effect on working efficiency of miners, measurement and reducing both to tolerable limits. |
| **CO3** | Natural ventilation and its limitations. Types of Mechanical ventilators, various ventilation devices, selection, installation, working, and necessary calculation including expenditure and necessary statute. |
| **CO4** | Live case studies of mine ventilation, quantity & necessary pressure requirement, ventilation planning in underground coal and non-coal mines, auxiliary ventilation devices for improvement in ventilation. |
| **CO5** | Computer application in solving complicated ventilation circuits and special problems associated with deep underground and deep opencast mines. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Composition of Mine Atmosphere: Mine gases - production, properties, effects and detection; sampling and analysis of mine air; methane content; methane drainage; methane layering; flame safety lamp and its uses; methanometers; radon gas and its daughter products; continuous monitoring of gases | | **CO1** | 2.5 |
| Heat and humidity: Sources of heat in mines; effects of heat and humidity; psychrometry, kata thermometer; heat stress, air-conditioning | | **CO2** | 2 |
| Natural ventilation: Seasonal variations, calculation of NVP from air densities and thermodynamic principles | | **CO3** | 2 |
| Air Flow through Mine Openings: Laws of air-flow, resistance of air ways, equivalent orifice, distribution of air; flow control devices; automation and remote control of ventilation installations; ventilation surveys; permissible air velocities in different types of workings | | **CO3, CO4** | 1.5 |
| 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 | | **CO3** | 2 |
| Ventilation planning: Planning of ventilation systems and economic considerations; ventilation layouts for mining of coal and ore deposits; ventilation of workings/stopes using heavy blasting; calculation of air quantity required for ventilating a mine; calculation of total mine head; network analysis principles and computer applications | | **CO4,** | 1 |
| Booster fans, auxiliary ventilation, recent developments in mine ventilation, venturi blowers; ventilation of deep mines - underground and open pit; standards of ventilation; ventilation cost calculations | | **CO5** | 1 |

| 4. | Textbooks |
|---|---|

i) Mine Ventilation: G. B. Mishra

ii) Sub-surface mine ventilation: Macperson

iii) Mine ventilation and air-conditioning in mines: Hartman

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Introductory Mining Engineering: Howard L. Hartman

ii) Elements of Mining Technology - Volume II: D. J. Deshmukh

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 0-0-2 | 1 (P) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Study of flame safety lamp GL-50 & GL-60.
2. Detection of methane in mine atmosphere and its contents using GL-60 flame safety lamp.
3. Study of MSA D6D type Methanometer, Dragger Multi-gas Detector.
4. Detection of mine gases using gas chromatography.
5. Study of Dragger multi gas detector (Tube Type), Study of CO (MSA) detector (Tube Type)
6. To determine relative humidity in mines.
7. To determine the cooling power of mine air using Kata thermometer.
8. To determine heat stress at different locations.
9. Measurements of quality of air flow in ventilating duct.
10. To find static pressure and velocity pressure of mine-air.
11. To determine coefficient of friction for mine-airways.
12. Study of axial flow fan, centrifugal fan, and determination of fan Characteristic of axial flow fan.
13. Determination of Neutral Point in ventilating district for location booster fan.

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL428 Mine Management Information System** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To provide knowledge about information and database. To demonstrate the data base management and MIS. To give hands on training for database software. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will get initial knowledge about database and its preparation. |
| **CO2** | Students will develop skill handling database software |
| **CO3** | Students will get the idea about database and MIS application to mining. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Information as a Resource: Introduction to information management, concept of management information system, planning of information resources | | **CO1 & CO2** | 2 |
| Computer based information management systems, information methodologies and tools, system approach to various operations in mines, analysis of systems | | **CO1 & CO2** | 2 |
| Computer fundamentals for information system, database and database management systems, data mining, data warehouse, data banks, data storage and handling. Relational and other data bases | | **CO2 & CO3** | 1 |
| Capturing of information, on-line, offline, pre-processing, formatting etc, Forms and layout. Data processing systems; data communication, data loggers etc. | | **CO1 & CO2** | 2 |
| Mine management information system: Production information, human resource information, geological information, geo-technical information, environmental information, survey information, stores and inventory information, Marketing, financial etc | | **CO2 & CO3** | 2 |
| Decision support systems for mine mangers, reporting, models, expert systems, office automation, network layout of computer nodes and data communication | | **CO1 & CO2** | 1 |

| **4.** | **Textbooks** |
|---|---|

i) Management Information Systems -Kroenke and Hatch

ii) Management Information Systems -Terry Lucey

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Data base manuals of MS Access and Oracle

ii) Management Information System textbooks.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 0 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 |
| CO4 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **CEL384 Advanced Mining Geology** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **CEL284 Mining Geology** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To know prospecting and subsurface exploration methods. To know the engineering properties of rocks in context with geology. To understand the general arrangement of Indian stratigraphy. To understand the hydrological condition of the Earth. To know the Indian mineral deposits and their formation. To understand the concept of Remote Sensing & GIS techniques. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand the Internal structure of earth, fundamental geomorphic and dynamic processes on the Earth |
| **CO2** | To understand the rocks and minerals and their properties. |
| **CO3** | To understand the various geological structures and impacts on mining. |
| **CO4** | To understand the prospecting and subsurface exploration methods |
| **CO5** | To generate the sub surface profiles from geological maps and plotting structures |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Principles of Prospecting and Exploration: Geophysical methods; Electrical, Seismic, Magnetic and Radar methods of exploration. Geo-Chemical methods; dispersion, mobility, anomaly, pathfinder elements, sampling methods. exploratory drilling, different methods and applicability. Borehole logging, orebody modelling. | | **ALL COs** | 2.5 |
| Engineering Geology: Engineering properties of rocks in context to geology. Rock discontinuities and their bearing on rock performance and rock mass failures. Geology of natural slopes. Geological characteristics influencing subsidence and rock bursts. | | **ALL COs** | 2.5 |
| Stratigraphy: Physiographic and Tectonic Divisions of India. General review of Stratigraphy of India detailed study including economic potential of Archean, Cuddapah, Vindhyan, Gondwana, Deccan Traps and Tertiary systems of India. Geo-Hydrology: Hydrologic Cycle and equation, Vertical zones of sub-surface water, water table, aquifers, aquicludes, aquifuges and aquitards. Confined and unconfined aquifers. Influents and effluents, seepage, springs. Hydrologic properties of rocks; porosity, permeability. Occurrence and movement of Groundwater, Darcy's Law, water table maps and their usages, Hydrographs. | | **ALL COs** | 2.5 |
| Economic Mineral deposits. Processes of Ore genesis; magmatic concentration, Hydrothermal, contact metasomatism, residual concentration etc. Syngenetic and epigenetic deposits. Controls of ore localization. Metallogenic Epochs and provinces. | | **ALL COs** | 2.5 |
| Remote Sensing and Geographical Information System: Introduction to remote sensing technology, Analog and digital data products, remote sensing satellites, application of remote sensing for mining operations. Introduction to GIS and its applications. | | **ALL COs** | 2 |

| 4. | Textbooks |
|---|---|

i) Principles of Engineering Geology, KVGK Gokhale, BS Publications

ii) Fundamentals of Engineering Geology, F.G.Bell, BS Publications

iii) Arogyaswamy RNP: Courses in Mining

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Ravindra Kumar: Principles of Stratigraphy

ii) Sabins F.A: Remote Sensing

iii) Todd D.K.: Groundwater Hydrology

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 0 | 3 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 0 | 2 | 2 | 2 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 0 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 0 | 2 | 2 | 3 | 2 | 1 |
| CO5 | 1 | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 3 | 0 | 3 | 3 | 2 | 1 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL459 Reliability Engineering** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student conversant with concepts of reliability engineering and its applications. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will understand concepts and terminology in reliability. |
| **CO2** | Students will understand the mathematics of reliability. |
| **CO3** | Students will understand the applications of constant failure model and estimation of system reliability. |
| **CO4** | Students will understand failure analysis and construct fault tree diagram |
| **CO5** | Students will understand applications of reliability engineering |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Introduction:** definition of reliability, the relationship between reliability, quality, and performance. Reliability as a Relative Measure, Reliability and the System Life Cycle, the consequences of having an unreliable product, that is, a product that fails supplier–customer reliability objectives and responsibilities, various stakeholders in product reliability. | **CO1** | 2 |
| | **Basic concepts of Reliability**: Introduction, reliability and quality, failure and failure modes, causes of failure and reliability, maintainability and availability, history of reliability, reliability literature. Hazard Rate, Percentiles Product Life, terms and definitions in reliability, application areas | **CO1 & CO2** | 2 |
| | **Reliability mathematics:** Introduction, random experiment, probability, random variables, distribution functions, Discrete distributions: Binomial Distribution, Poisson Distribution and Other Discrete distributions; Continuous distributions: Weibull, Exponential, The Normal (Gaussian) Distribution, The Lognormal Distribution, Gamma Distribution, Probability Plots | **CO2 & CO3** | 2 |
| | **System Reliability**: Reliability Block Diagram - Series, Parallel & combined series parallel configurations; redundant-active and passive types, Failure Mode, Effects and Criticality Analysis (FMECA), Failure Reporting, Analysis and Corrective Action System (FRACAS), Fault Tree Analysis (FTA), System state analysis-Markov Model, Availability, Downtime. | **CO3 & CO4** | 2 |
| | **Reliability Testing:** Failures and types of failures; Intrinsic & extrinsic failures; Failure cascade; Failure mode; Failure rate, MTTF, MTBF, Accelerated life testing (ALT) - Qualitative ALT, Quantitative ALT & its types, AF, Samples | **CO4 & CO5** | 2 |
| | **Reliability Applications**: Reliability cantered maintenance, Equipment reliability, system reliability, Reliability Management, Reliability culture, and human factors in reliability, reliability software applications | **CO5** | 2 |

| 4. | Textbooks |
|---|---|

i) Kailash C. Kapur, Michael Pecht, Reliability Engineering, John Wiley & Sons, 2014

ii) Reliability and Maintainability Engineering – Charles E. Ebeling, Tata McGraw Hill Edition.

iii) Maintenance Engineering – Er Sushilkumar Srivastava, S Chand Publications 1998

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Reliability Engineering- L. S. Srinath affiliated East- west Press Private Limited

ii) Reliability Engineering – E. Balagurusamy Tata McGraw Hill Publications

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 0 | 2 | 1 | 0 | 0 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 |
| CO2 | 2 | 3 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 0 | 1 | 2 | 0 | 0 | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 0 | 3 | 3 | 0 | 0 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 2 |
| CO5 | 2 | 1 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL454 Risk Assessment and Management** | | |
| **Course Type:** | **MINOR 2** | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student aware of risk management in Industry. To train the students for risk assessment methods | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Can determine the risk for operations and jobs with respect to hazards. |
| **CO2** | Can quantitively and qualitatively assess risks. |
| **CO3** | Can apply the risk management and mitigation techniques. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | Basic concept of risk, reliability and hazard potential; Elements of risk assessment; statistical methods; control charts; | **CO1** | 3 |
| | Qualitative and quantitative risk assessment and analysis, Probabilistic Risk Assessment, Hazards and Risk Management, Advanced risk assessment techniques - Fault Tree Analysis, HAZOP, failure mode and effect analysis, fuzzy model for risk assessment, job hazard and safety analysis | **CO2** | 5 |
| | Risk Management and control methods, Risk assessment and management software, Risk assessment and management industrial cases | **CO3** | 4 |

**4. Textbooks**

i) The Essentials of Risk Management by Michel Crouhy Dan Galai, Robert Mark

**5. Reference Book(s) and Other Required Material**

i) Risk Analysis: A Quantitative Guide, 3rd Edition David Vose

**6. Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]**

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

**7. Relationship of Course Outcomes to Program Outcomes:**

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 |
| CO2 | 2 | 2 | 0 | 3 | 2 | 0 | 0 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 |
| CO3 | 2 | 2 | 0 | 3 | 2 | 0 | 0 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

**8. List of Indicative Laboratory Experiment (if applicable):**

**N.A.**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL316 Mine Hazards and Pollution** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 (L) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with types of hazards viz. Fires, Explosion and Inundation which can take place in underground mines. To give knowledge in detail about the causes and mitigation measures for each of the hazard. To provide details of rescue operations to be conducted in mines after disasters. To make students understand problems of mine dust and illumination including the assessment and mitigating measures. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To familiarize with the concept of hazards in mines and rescue operations |
| **CO2** | To understand the basic mechanism of hazards |
| **CO3** | To develop the ability of analysing complex engineering problems associated with hazards. |
| **CO4** | To be competent in designing components and processes dealing with hazards. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Mine Fires: Causes of mine fires; spontaneous combustion - mechanism, susceptibility indices, factors affecting spontaneous combustion; detection and prevention of spontaneous heating; accidental fires – causes and prevention; dealing with mine fires - direct and indirect methods, fire stoppings; fires in quarries, coal stacks and waste dumps. | | **CO1, CO2, CO3** | 2 |
| Mine Explosions: Firedamp and coal dust explosions – mechanisms, causes and prevention; stone-dust and water barriers; investigations after an explosion. | | **CO1, CO2, CO3** | 1 |
| Inundation: Causes and prevention, precautions and techniques of approaching old workings; safety boring apparatus, pattern of holes; design and construction of water dams, shaft dams, emergency bulk heads, strengthening of dams | | **CO1, CO2, CO3** | 1 |
| Rescue and Recovery: Rescue equipment and their uses, rescue stations and rescue rooms; organization of rescue and recovery areas, re-opening of sealed-off workings. | | **CO4** | 2 |
| Illumination in mines- effect on safety, efficiency, and health; common types of safety lamps & their uses and limitations, maintenance and examination of lamps, their charging, cleaning, lighting, re-lighting; lamp room design and organization; lighting from mains – different types of illumination devices; illumination of pit bottoms. main roads, faces, pump houses and haulage rooms; standards of illumination in mines | | **CO1, CO2, CO3** | 2 |
| Airborne respirable dust in underground mines - generation, dispersion, measurement, and control.; classification, physiological effects, dust measurement, sampling of air-bone dust | | **CO1, CO2, CO3** | 1 |
| Introduction: Environmental issues in mineral industry; ambient environment mining complexes; environmental impacts of mineral exploitation - underground and opencast mining and associated activities. Environmental Administration in India: Administration and Management, EIA, preparation of Environmental Management Plan. Environmental audit, salient features of Environment Protection Act | | **CO1, CO2, CO3, CO4** | 1 |

| 4. | Textbooks |
|---|---|

i) Mine Fires, Inundation and Rescue: M.A.Ramlu, 1991

ii) Mine Illumination by Trotller.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Spontaneous Combustion: S C Banerjee

ii) Mine Fires: L C Kaku

iii) Mine Fires: Mitchell

iv) Mine Ventilation and Air conditioning: Hartman

v) Subsurface Ventilation and Environmental Engineering: McPherson

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 (L) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 0 | 3 | 2 | 2 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 0 | 2 | 1 | 2 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 0 | 2 | 3 | 3 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 0 | 3 | 1 | 2 | 2 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP316 Mine Hazards and Pollution** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 (P) |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with types of hazards viz. Fires, Explosion and Inundation which can take place in underground mines. To give knowledge in detail about the causes and mitigation measures for each of the hazard. To provide details of rescue operations to be conducted in mines after disasters. To make students understand problems of mine dust and illumination including the assessment and mitigating measures. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To familiarize with the concept of hazards in mines and rescue operations |
| **CO2** | To understand the basic mechanism of hazards |
| **CO3** | To develop the ability of analysing complex engineering problems associated with hazards. |
| **CO4** | To be competent in designing components and processes dealing with hazards. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Mine Fires: Causes of mine fires; spontaneous combustion - mechanism, susceptibility indices, factors affecting spontaneous combustion; detection and prevention of spontaneous heating; accidental fires – causes and prevention; dealing with mine fires - direct and indirect methods, fire stoppings; fires in quarries, coal stacks and waste dumps. | | **CO1, CO2, CO3** | 2 |
| Mine Explosions: Firedamp and coal dust explosions – mechanisms, causes and prevention; stone-dust and water barriers; investigations after an explosion. | | **CO1, CO2, CO3** | 1 |
| Inundation: Causes and prevention, precautions and techniques of approaching old workings; safety boring apparatus, pattern of holes; design and construction of water dams, shaft dams, emergency bulk heads, strengthening of dams | | **CO1, CO2, CO3** | 1 |
| Rescue and Recovery: Rescue equipment and their uses, rescue stations and rescue rooms; organization of rescue and recovery areas, re-opening of sealed-off workings. | | **CO4** | 2 |
| Illumination in mines- effect on safety, efficiency, and health; common types of safety lamps & their uses and limitations, maintenance and examination of lamps, their charging, cleaning, lighting, re-lighting; lamp room design and organization; lighting from mains – different types of illumination devices; illumination of pit bottoms. main roads, faces, pump houses and haulage rooms; standards of illumination in mines | | **CO1, CO2, CO3** | 2 |
| Airborne respirable dust in underground mines - generation, dispersion, measurement, and control.; classification, physiological effects, dust measurement, sampling of air-bone dust | | **CO1, CO2, CO3** | 1 |
| Introduction: Environmental issues in mineral industry; ambient environment mining complexes; environmental impacts of mineral exploitation - underground and opencast mining and associated activities. Environmental Administration in India: Administration and Management, EIA, preparation of Environmental Management Plan. Environmental audit, salient features of Environment Protection Act | | **CO1, CO2, CO3, CO4** | 1 |

| 4. | Textbooks |
|---|---|

iii) Mine Fires, Inundation and Rescue: M.A.Ramlu, 1991

iv) Mine Illumination by Trotller.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Spontaneous Combustion: S C Banerjee

ii) Mine Fires: L C Kaku

iii) Mine Fires: Mitchell

iv) Mine Ventilation and Air conditioning: Hartman

v) Subsurface Ventilation and Environmental Engineering: McPherson

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 0-0-2 | 1 (P) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 0 | 3 | 2 | 2 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 0 | 2 | 1 | 2 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 0 | 2 | 3 | 3 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 0 | 3 | 1 | 2 | 2 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**1.** Sketch and Describe Various Types of Portably Fire Extinguishers
**2.** Determination of Crossing Point Temperature
**3.** Determination of Explosibility of Coal Dust
**4.** Study of Procedure for Construction of an Isolation Stopping in the event of Spontaneous Combustion
**5.** Sketch and Describe Stone Dust Barrier
**6.** Sketch and Describe Water Barrier
**7.** Sketch and Describe Safety Boring Apparatus
**8.** Sketch and Describe Self-Contained Oxygen Breathing Apparatus (Partially Lung Governed Feed Type)
**9.** Study of Self Rescuer
**10.** Sketch and Describe Gas Mask
**11.** Study of Fresh Air Tube Apparatus
**12.** Dust Sampling by Konimeter and Dust Measurement
**13.** Dust Sampling by Gravimetric Dust Sampler
**14.** Dust Sampling by Personal Dust Sampler

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL315 Mine Excavation Machinery** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Minerals are high in demand therefore it involves high-capacity mining machines. Imparting knowledge of the following: constructional features, working, applications, capacity, calculations and safety features. To find out the right combination of various machines and their number required for desired output. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the necessity, construction, applications, and selection of various winning machines used in underground and open cast excavations. |
| **CO2** | Understand the necessity, construction, applications, and selection of various loading machines used in underground and open cast excavations. |
| **CO3** | Understand the necessity, construction, applications, and selection of various drilling machines in underground & surface excavation along with. |
| **CO4** | Understand the necessity, construction, applications, and selection of various ancillary equipment and pumps used in underground and open cast excavations. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Coal cutting machines:** shearers, coal ploughs, lump breakers, road headers, TBMs, raise and shaft borers, continuous miners, highwall continuous miners, stage loaders; their main features and applicability. | | **CO1** | 2 |
| **Loading machines:** rocker shovel, SDL, LHD, gathering arm loader, shuttle car, LPDTs, scraper; their main features, applicability, selection and production capacities | | **CO2** | 2 |
| **Opencast Machinery:** Shovels, draglines, dumpers, wheel loaders; their main features, applicability, selection, and production capacities. | | **CO2** | 2 |
| **Drills:** Underground coal and rock drills, jumbo drills, rock bolting machines. Small and large diameter surface blasthole drills, rippers and scrapers, road graders, dozers; their construction, application, selection, and operation | | **CO3** | 2 |
| **Continuous Surface Mining Equipment:** bucket wheel excavators, surface miners, spreaders, dredging equipment; their main features, applicability, selection and production capacities. | | **CO2** | 2 |
| **Pumps:** Types of mine pumps, application and related computations. **Miscellaneous Mining Equipment:** Power pack and Hydraulic System, Truck Despatch System, Stacker Reclaimer, Rock Breakers, Impact Hammers, Slurry Pumps, Equipment used in Shaft Sinking, In-pit Crushers. **Power Transmission in Machines:** Gear, V-Belt, Friction Belts, etc. | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) SME Vol on Underground Mining Methods Handbook Ed. Hustrulid

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) E. Lopez Jimeno, C. Lopez Jimeno, Ayala Carcedo: Drilling and Blasting of Rocks, 1995, CRC Press

ii) Ratan Raj Tatiya: Surface and Underground Excavations – Methods, Techniques and Equipment, Taylor & Francis (2005).

iii) Surface Mining Equipment by JW Martin, TJ Martin, TP Bennett, KM Martin; Martin Consultants, Inc, Golden Colorado 80402.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 0 | 0 | 3 | 3 | 0 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 |
| CO2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 0 | 0 | 3 | 1 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 1 | 0 | 0 | 2 | 3 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL322 Ground Control and Instrumentation** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 (L) |
| **Pre-requisites: Course Code(s) & Name(s)** | MNL211 & MNP211 Rock Mechanics | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with aspects of underground mine support application and design and also with slope stability problems | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the concepts of different rock-mass classifications and their application in support design. |
| **CO2** | Predict and control subsidence, rock bursts, and coal bumps. |
| **CO3** | Understand the concepts of slope stability. |
| **CO4** | Understand the concepts of instrumentation and monitoring of underground behaviour. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Design and Stability of Structures in Rock: Intact rock and rock mass classification systems; criteria for design and support of underground excavations; energy released by making an underground excavation; design of single and multiple openings in massive, stratified and jointed rock mass; Estimation of support requirement. Mine pillars and their classification, pillar stresses, pillar design, stability analysis of pillars. Timber and Steel support: Prop/post, various types of chocks, cross bars, lagging, forepoling; load bearing capacity of timber supports; setting up of timber supports, bulkheads, treatment and preservation of timber. Steel set - rigid and yielding types; shaft tubbing, wire mesh, steel lining, screw jacks and ratchet jacks; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports | | **CO1** | 3 |
| Active Supports: Rock bolts and dowels - different types and uses; mechanics of bolting. Anchored rock bolts Slot and wedge type, expansion shell type, grouted point anchor type. full column anchors, wooden and fiberglass dowels, mechanical full column anchors, split sets/friction rock stabilizers, installation and testing of rock bolts. Cable bolting — its installation and applications. Insitu constructed support | | **CO1** | 2 |
| Poured monolithic and reinforced concrete lining; guniting and shotcreting. Materials of backfill and their procurement; sand gathering plant; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling. Subsidence: Causes and impacts of subsidence; mechanics of surface subsidence, discontinuous and continuous subsidence; monitoring, prediction, control and management of subsidence. | | **CO2** | 2 |
| Caving of Rockmass: Caving characteristics of rocks; cavability index. Rockburst: Phenomenology of rockbursts; prediction and control of rockbrusts; bumps and gas outbursts. | | **CO2** | 1 |
| Surface Mine Slope Stability: Types of mine slope; influence of pit slope on mine economics; common modes of slope failure; factors influencing slope stability; slope stability assessment techniques; stability of analysis of slopes; measures to enhance slope stability; protection and monitoring of slopes. | | **CO3** | 2 |
| Study of strata behaviour, Instrumentation: Study of various instruments related to convergence, stress and load monitoring. | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Peng S S, Ground Control in Mines, John Wiely Publication

ii) Hoek & Brown, Rock Slope Engineering:

iii) Hudson & Harrison: Engineering Rock Mechanics

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Brady and Brown: Rock Mechanics for Underground Mines

ii) Hoek, E, Kaiser, P.K. and Bawden W.F. entitled Support of Underground Excavations in Hard Rock

iii) Hoek, Practical Rock Engineering

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 (L)) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP322 Ground Control and Instrumentation** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-2 | **No. of Credits** | 1 (P) |
| **Pre-requisites: Course Code(s) & Name(s)** | MNL211 & MNP211 Rock Mechanics | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with aspects of underground mine support application and design and also with slope stability problems | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understand the concepts of different rock-mass classifications and their application in support design. |
| **CO2** | Predict and control subsidence, rock bursts, and coal bumps. |
| **CO3** | Understand the concepts of slope stability. |
| **CO4** | Understand the concepts of instrumentation and monitoring of underground behaviour. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Design and Stability of Structures in Rock: Intact rock and rock mass classification systems; criteria for design and support of underground excavations; energy released by making an underground excavation; design of single and multiple openings in massive, stratified and jointed rock mass; Estimation of support requirement. Mine pillars and their classification, pillar stresses, pillar design, stability analysis of pillars. Timber and Steel support: Prop/post, various types of chocks, cross bars, lagging, forepoling; load bearing capacity of timber supports; setting up of timber supports, bulkheads, treatment and preservation of timber. Steel set - rigid and yielding types; shaft tubbing, wire mesh, steel lining, screw jacks and ratchet jacks; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports | | **CO1** | 3 |
| Active Supports: Rock bolts and dowels - different types and uses; mechanics of bolting. Anchored rock bolts Slot and wedge type, expansion shell type, grouted point anchor type. full column anchors, wooden and fiberglass dowels, mechanical full column anchors, split sets/friction rock stabilizers, installation and testing of rock bolts. Cable bolting — its installation and applications. Insitu constructed support | | **CO1** | 2 |
| Poured monolithic and reinforced concrete lining; guniting and shotcreting. Materials of backfill and their procurement; sand gathering plant; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling. Subsidence: Causes and impacts of subsidence; mechanics of surface subsidence, discontinuous and continuous subsidence; monitoring, prediction, control and management of subsidence. | | **CO2** | 2 |
| Caving of Rockmass: Caving characteristics of rocks; cavability index. Rockburst: Phenomenology of rockbursts; prediction and control of rockbrusts; bumps and gas outbursts. | | **CO2** | 1 |
| Surface Mine Slope Stability: Types of mine slope; influence of pit slope on mine economics; common modes of slope failure; factors influencing slope stability; slope stability assessment techniques; stability of analysis of slopes; measures to enhance slope stability; protection and monitoring of slopes. | | **CO3** | 2 |
| Study of strata behaviour, Instrumentation: Study of various instruments related to convergence, stress and load monitoring. | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Peng S S, Ground Control in Mines, John Wiely Publication

ii) Hoek & Brown, Rock Slope Engineering:

iii) Hudson & Harrison: Engineering Rock Mechanics

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Brady and Brown: Rock Mechanics for Underground Mines

ii) Hoek, E, Kaiser, P.K. and Bawden W.F. entitled Support of Underground Excavations in Hard Rock

iii) Hoek, Practical Rock Engineering

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 0-0-2 | 1 (P) | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

1. Study the Mine Plan
2. Study the different types of support systems for underground mines
3. Study the theories of bolting
4. Study the support design for the cement capsule bolts
5. Study the support design for the cement resin bolts
6. Study the Subsidence monitoring
7. Study the Instrumentation plan
8. Study the stress monitoring instruments
9. Study the convergence monitoring instruments
10. Study the load monitoring instruments

| | | | |
|---|---|---|---|
| **ourse Code & Course Title:** | **MNL434 Advanced UG Metal Mining & Design** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL214 Underground Metalliferous Mining Methods** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To give knowledge of advanced techniques of underground metal mining and its design. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will get ideas about the advancement of metal mining methods with regards to mechanization and automation |
| **CO2** | Students will be trained to select the method of mining based on geo-mining data. |
| **CO3** | Student will develop initial skill to stope design. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Development- size of stope level interval | | **CO1** | 1 |
| Classification and Selection of stoping methods | | **CO1 & CO2** | 1 |
| Design and locating the orepass and levels. Design of stopes: Stope design and production planning, scheduling. Ring drilling, fan drilling design | | **CO1, CO2 & CO3** | 2 |
| Mechanisation and Selection of equipment | | **CO2** | 1 |
| Methods of extraction of pillars | | **CO2** | 2 |
| Mine fills, pastefill, cemented fills | | **CO2** | 1 |
| Deep mining problems Case studies: Indian and mines from other countries | | **CO3** | 1 |
| Mine costing | | **CO1 & CO2** | 1 |

| **4.** | **Textbooks** |
|---|---|

i) Introductory Mining Engineering: Hartman

ii) Underground Mining Methods Handbook: Hustrulid (SME York, 1994)

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Techniques in Underground Mining: Selection by– Richard E. Gertsch et al, SME 1998

ii) Underground Mining Methods: Engineering Fundamentals and International Case Studies by A. Hustrulid,

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL425 Mass Production Technology for Underground Coal** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL212 Underground Coal Mining Methods** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To provide knowledge of advanced techniques of underground coal mining. To develop concept of system engineering and design approaches of advance techniques of underground coal mining | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand basics and designing of continuous mining technology. |
| **CO2** | To get detailed knowledge of operations involved in development and depillaring by continuous miner. |
| **CO3** | To learn basics and designing of longwall mining technology. |
| **CO4** | To get in-depth knowledge of operations involved in development and coal extraction in longwall mining. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Status of coal mining in India and abroad, Need for mass production technology for Indian coal. | | **CO1** | 1 |
| Continuous Mining Technique: applicability, design, equipment required and their selection, cutting mechanism, rock tool interaction, cutting capacity, cutting performance, operational and technical parameters, cycle of operation, various layout, panel development, pillar extraction methods, design of pillars, strata control and monitoring, support system, cut-out distance, case studies, shortwall mining. | | **CO2** | 4 |
| Longwall Mining Technique: applicability, design of panel, face layouts, gateroadway development, Shearer: sumping and cutting methods, rock tool interaction, design of cutting drums, performance, power requirement, haulage speed, cutting capacity, drum loading capacity and efficiency, carrying capacity of AFC, design of chain pillar and barrier pillar, strata mechanics, ground control, design and performance of shield power supports, cycle of operation, ventilation pattern, case studies, thick seam mining. | | **CO3 & CO4** | 5 |
| Filling of goaf: filling material and their properties, methods of filling, filling arrangement, preparation, transportation and placement of fill material. | | **CO2 & CO3** | 2 |

| **4.** | **Textbooks** |
|---|---|

i) Coal Mine Ground Control, S.S. Peng, John Wiley

ii) Advances in Coal Mine Ground Control, S.S. Peng, Woodhead Publishing

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) SME Mining Engineers' Handbook, W A Hustrulid, SME, USA

ii) Underground Mining Method Handbook, W A Hustrulid, SME, USA

iii) Longwall Mining, S.S. Peng, John Wiley

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 0 | 3 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 2 | 2 | 2 | 3 | 2 | 3 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL426 Underground Space Technology** | | |
| **Course Type:** | DE (**HONOURS - 2**) | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with aspects underground space development. To develop skill of excavation for underground space development | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understanding need for and importance of underground space. |
| **CO2** | Understanding importance of site-investigation and its various features for the creation of underground space |
| **CO3** | Understanding the conventional methods of developing underground spaces. |
| **CO4** | Understanding the modern methods of developing underground spaces. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction to Underground Space:** Types of Underground Spaces; Functions of tunnels and caverns; Need for and importance of underground space; Applications of underground excavation; Benefits of Underground Spaces; Financing Underground Space Development Projects. | | **CO1, CO2** | 2 |
| **Design of Underground Space and Selection of Excavation Methods:** Parts of a typical underground space; Different types of cross sections and their design features; Need and types of tunnel linings; Inherent problems and concerns with tunnel construction; Design of tunnel: alignment, financial viability, geotechnical issues; Overview of methods of excavation; Preliminary selection and design process. | | **CO2, CO3, CO4** | 2 |
| **Site Investigation for Tunnelling:** Need, Introduction and Phasing; Stages and Phases Site Investigation; Importance of Geological Mapping and techniques; Subsurface Investigation Techniques; Role of Geophysical and geotechnical investigation. | | **CO2, CO3, CO4** | 2 |
| **Cut and Cover Method:** Introduction to cut and cover method; Types of cut and cover method; Planning for cut and cover method; Excavation Support Systems; Problems with cut and cover method. | | **ALL COS** | 2 |
| **Hard Rock Tunnelling Method:** Introduction to Hard Rock tunnelling; Methods for tunnelling through hard rocks; Unit operations in tunnel excavation; Partial Face and Full-Face Tunnelling machines; Excavation ventilation system; Excavation support for hard rocks; Problems with hard rock tunnelling. | | **ALL COS** | 2 |
| **Soft Ground Tunnelling Method:** Introduction to Soft Ground tunnelling; Methods for tunnelling through soft ground; Design and planning of NATM tunnels; Hard rock tunnelling machinery; Partial Face and Full-Face Tunnelling machines; Problems with soft ground tunnelling. | | **ALL COS** | 2 |

| 4. | Textbooks |
|---|---|

i) Kuesel, T.R., King, E.H. and Bickel, J.O., 2012. Tunnel engineering handbook. Springer Science & Business Media.

ii) Tatiya, R.R., 2005. Surface and underground excavations: methods, techniques and equipment. CRC press.

iii) Brox, D., 2017. *Practical guide to rock tunneling*. CRC Press.

iv) Clayton, C.R., Matthews, M.C. and Simons, N.E., 1982. *Site investigation* (No. Monograph). London, UK: Granada.

v) Feng, X.T., 2017. *Rockburst: mechanisms, monitoring, warning, and mitigation*. Butterworth-Heinemann.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Chapman, D.N., Metje, N. and Stark, A., 2017. *Introduction to tunnel construction*. CRC Press.

ii) Clayton, C.R.I., 2009. Urban site investigation.

iii) Tatiya, R., 2005. Civil excavations and tunnelling: A practical guide. Thomas Telford.

iv) Wahlstrom, E., 2012.*Tunneling in rock* (Vol. 3). Elsevier.

v) Yan, J., Celestino, T., Thewes, M. and Eberhardt, E. eds., 2024. *Tunnelling for a Better Life*. CRC Press.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 0 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MML291 Mineral Processing** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understanding the working principle and mechanism of crushing and grinding operations |
| **CO2** | Understanding the basic principles of separation of minerals by jigging, tabling and heavy media separation |
| **CO3** | Understand forth floatation operation for upgradation of ores/minerals, Electrostatic/Magnetic separation operation |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Mineral beneficiation and its role in mineral exploration and conservation with special reference to Indian economic minerals | | **CO1** | 1.5 |
| Theory and practice of crushing and grinding, conventional units and their performance and choice. Laboratory techniques, interpretation and plotting of data, industrial screens and classifiers, dry and wet processes | | **CO1** | 3 |
| Importance of sampling and methods used in mills, Picking, washing and classification. Theory and applications of sinks and float, jigging and flowing film concentration-methods and equipment used. | | **CO2** | 3 |
| Physico-chemical principles, flotation reagents, floatation machines and circuits, application to common sulfide, oxide and oxidized minerals | | **CO2, CO3** | 3 |
| Principles, operation and field of application; Dewatering and drying: thickening, filtration and drying; Methods of coal washing, washability curves | | **CO3** | 1.5 |
| Simplified flowsheets for the beneficiation of coal and typical ores of copper, lead, zinc, iron and manganese with special reference to Indian deposits; Brief description of leaching methods | | **CO3** | 1.5 |

| **4.** | **Textbooks** |
|---|---|

i) Principles of Mineral Dressing: A.M. Gaudin

ii) Mineral Processing Technology: Barry A. Wills, Tim Napier-Munn

iii) Handbook of Mineral Dressing: Taggart

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Elements of Ore Dressing: A.F. Taggart

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 0 | 3 | 0 | 2 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 3 | 3 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL455 Ergonomics and Training in Safety** | | |
| **Course Type:** | **MINOR 3** | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| To provide the basic knowledge about ergonomics with respect to safety. To make students conversant with ergonomics in industrial operations and machines | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Can use ergonomics principles to the machine operations. |
| **CO2** | Can apply safe ergonomical practices. |
| **CO3** | Can understand the need and method of industrial training |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | Principles of ergonomics, Designing workstations and tools to reduce work- related musculoskeletal disorders (MSDs), Physical Ergonomics, man-machine- environment interaction, ergonomically design machines | **CO1** | 3 |
| | Cognitive Ergonomics, Organizational Ergonomics, Ergonomics in workplace, workshops etc. and its design, Ergonomics in Construction, Importance of Ergonomics for the Safety Professional, Safety practices in various operations | **CO2** | 5 |
| | Industrial training: Element of training cycle, Assessment of needs. Techniques of training, Design of training programs. Types of training, modern methods of training, training simulators, virtual training. Evaluation and review of training programs | **CO3** | 4 |

**4. Textbooks**

i) Introduction to Human Factors and Ergonomics by BRIDGER

ii) Health, Safety and Ergonomics, Editors: Andrew S. Nicholson, John E. Ridd eBook ISBN: 9781483192314, Elsevier

**5. Reference Book(s) and Other Required Material**

i) Environmental Health and Safety Audits by Lawrence B. Cahill

ii) Guidelines for Auditing Process Safety Management Systems by John Wiley

**6. Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]**

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

**7. Relationship of Course Outcomes to Program Outcomes:**

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 0 | 3 | 2 | 0 | 0 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 2 | 1 | 2 | 3 | 1 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 2 | 1 | 2 | 3 | 1 | 3 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

**8. List of Indicative Laboratory Experiment (if applicable):**

**N.A.**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL401 Mine Legislation and Safety** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students are made conversant with legal requirements and safety aspects of mining. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | General principles of Mining Laws and their history |
| **CO2** | Salient features of Mines Act and mines rules |
| **CO3** | General provisions of CMR 1961 and MMR 1961 |
| **CO4** | Legal aspects of safety and health of Mine workers. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction:** General principles of mining laws, development of mining laws in India. Sources of legislations, mining laws of India. | | **CO1, CO2** | 1 |
| **Legal Framework:** General provisions of MMDR Act, 1957 MCDR Rules, 2017 and MCR Rules, 2016 | | **CO1, CO2, CO4** | 2 |
| **Occupational Health and Safety:** General provisions of Mines Act, 1952 Mines Rules, 1955 and Additional provisions of Indian Electricity Rules, 1956 | | **CO1, CO2, CO4** | 2 |
| **Additional rules for occupational health and safety:** Salient features of Workman Compensation Act, 1923, Mine Creche Rules, 1966, Coal Mine Pit Head Bath Rules, 1959, Mine Vocational Training Rules, 1966 and Mines Rescue Rules, 1985 | | **CO1, CO2, CO4** | 2 |
| **CMR and MMR:** General Provisions of Coal Mine Regulations, 2017 and Metal Mine Regulations, 2012 | | **CO1, CO3, CO4** | 2 |
| **Safety and Health in Mines**: Occupational hazards of mining and diseases; accidents and their classification; statistics of fatal and serious accidents; frequency rates and severity rates of accidents; cause-wise analysis; basic causes of accident occurrence; investigations into accidents and accident reports; in-depth study of accidents due to various causes; Cost of Accidents. | | **CO1, CO2, CO3, CO4** | 2 |
| **Emergency measures and emergency organization**: Disaster Management Plans for major disasters of explosions, inundation etc. Measures for improving safety in mines, risk assessment | | **CO1, CO4** | 1 |

| **4.** | **Textbooks** |
|---|---|

i) DGMS Circulars by L.C.Kaku

ii) Safety in Mines: A survey of accidents, their causes and prevention by Prof. Kejriwal

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad

ii) NIOSH Publications

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 0 | 2 | 0 | 0 | 3 | 2 | 3 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| CO2 | 1 | 0 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 3 | 3 | 3 | 2 |
| CO3 | 2 | 0 | 2 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 0 | 3 | 0 | 0 | 3 | 3 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL429 Blasting Technology for Mining & Construction** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students are made conversant with rock fragmentation by using explosives. They will learn blast design in surface and underground mines. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To know various types, characteristics, testing and legal aspects of explosives. |
| **CO2** | To understand blasting accessories, initiation system, drilling pattern and blast design. |
| **CO3** | To learn rock breakage mechanism, blast evaluation techniques and blasting software. |
| **CO4** | To understand the environmental effects of blasting, controlled blasting and special blasting techniques |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| History and use of explosives: blasting and its applicability to mining and construction industry, Characteristics and constituents of explosives, Basics of explosives and their classifications as low explosives, high explosives and blasting agents, Bulk explosive, Explosive for special application, Indian classification of explosives. | | **CO1** | 2 |
| Properties of explosives for their selection, Laboratory and field testing of explosives, Provisions in Explosives Act and legal aspects of explosives including storage and handling of explosives. | | **CO1** | 2 |
| Blasting accessories: Safety fuse, Detonating cord, Cord relays, Nonel, Detonator: plain, electric, electronic, Sequential blasting machine, Underground blasting accessories, Preparation of priming cartridges, testing of blasting accessories | | **CO2** | 2 |
| Blast design: Various Pattern of holes for drives and drift, roadways, underground storage and tunnels, pattern of holes for surface & underground excavation, Initiation system and firing sequences. Blasting operation in surface and underground coal mines, metal mines, drifts, shaft, tunnels and caverns. Safety precautions before and during blasting operation, Empirical approaches to blast design. | | **CO2** | 2 |
| Mechanics of rock breakage by blasting, Rock explosive interaction, various rock fragmentation theories. Role of rock parameters, Controllable and non-controllable parameters, Evaluation of blasting results, Use of various software for blasting, | | **CO3** | 2 |
| Environmental ill effects of blasting, Controlled blasting techniques for surface blasting and underground blasting, Use of innovative techniques in blasting like, air deck, cushion blasting, underwater blasting, blasting near sensitive structures, cast blasting etc. use of blasting techniques for demolition of structures. Blast Economics, blasting costs and role of fragmentation with blasting costs, cost optimization, | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Engineering rock blasting operations: S. Bhandari, A. A. Balkema Pulb.

ii) Konya, C.J. and Walter, E.J., 1991. Rock blasting and overbreak control (No. FHWA-HI-92-001; NHI-13211). United States. Federal Highway Administration.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Drilling and Blasting of Rocks, By C. Lopez Jimeno, E. Lopez Jimeno, Francisco Javier Ayala Carcedo Hustrulid.

ii) Langefors, U. and Kihlström, B., 1963. The modern technique of rock blasting (Vol. 405). New York: Wiley

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO2 | 1 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 |
| CO3 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL404 Mine Planning** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with aspects of mine planning. To develop skill of planning of mining operations. To develop expertise in mine design. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand various components of mine planning |
| **CO2** | To learn general planning principles |
| **CO3** | Design of various components of mine system |
| **CO4** | Plan and design an overall mine. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Principles of planning, Features of mine planning, planning for new projects and reconstruction planning, short range and long range planning, phases of mine planning, project implementation and monitoring, types of reserves & their inter-relationship, geological reports, weather, topography, drainage and climate report | | **ALL COS** | 2.5 |
| Fixing the mine boundary- surface and underground, size of mine, limited and unlimited reserves, optimum designed capacity, reserve allocation. Dividing mine into various panels, stope, panel dimensions Mine entries: types, their application, location, selection shape and size opening. Planning for pit top and pit bottom layouts, choice of layout | | **ALL COS** | 2.5 |
| Infrastructure planning: CHP/mineral handling plant, workshop, power, water requirement, communication Method of mining: factors to be considered, surface v/s underground, selection of various methods of extraction, production estimation, production potential of different panels, fixing the target mine | | **ALL COS** | 2.5 |
| Transportation planning: alternatives, choice of men, material and mineral transport systems, essential requirement, and selection Ventilation planning: objectives, steps, essential features of ventilation system, different types of ventilation systems, network solutions, economics of ventilation | | **ALL COS** | 2.5 |
| Drainage planning: assessment of make of water, drainage layout, design of sumps, selection of pumps and pumping capacity; Manpower planning, Planning for mine closure and post mining land use planning | | **ALL COS** | 2 |

| **4.** | **Textbooks** |
|---|---|

**i)** Introductory Mining Technology by Hartman

**ii)** Mine Planning: Jayant Bhattacharya

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Coal Mine Planning by S.P.Mathur

ii) Underground Mining Methods Handbook by Hustrulid

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNP314 Mine Training and Study Tours** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-4 | **No. of Credits** | 2 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| Students must undergo one (1) month training in mines during summer break after 4th semester. Students must visit the various mines through study tours undertaken during 3rd, 5th and 6th semesters. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To learn the detailed practical applications of various mining concepts. |
| **CO2** | To learn various basic practical mining concepts. |
| **CO3** | Experiential learning of theoretical mining concepts at field |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Understanding the mine plans and surface layouts | | **ALL COs** | 1 |
| Understanding the geology and strata monitoring plan | | **ALL COs** | 1.5 |
| Understanding the mine operations and scheduling of machinery | | **ALL COs** | 1.5 |

**4. Textbooks**

i) Introductory Mining Technology by Hartman

**5. Reference Book(s) and Other Required Material**

ii) D. J. Deshmukh - Elements of Mining Technology, Vol. I & II Denett & Co.

**6. Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]**

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| P | Practical | 0-0-4 | 2 | Mid Semester Exam. | 0 |
| | | | | Teacher Defined Assessment | 0 |
| | | | | End Semester Exam. | 100 |

**7. Relationship of Course Outcomes to Program Outcomes:**

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 3 | 0 | 0 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 0 | 3 | 0 | 0 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 0 | 3 | 0 | 0 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

**8. List of Indicative Laboratory Experiment (if applicable):**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MND319 Mini Project** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-6 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students will be assigned mini projects based on the curriculum studied so far. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To exhibit the knowledge about the methodology to carry out research. |
| **CO2** | To analyse and execute the objectives of research. |
| **CO3** | To prepare and present research report |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |

| **4.** | **Textbooks** |
|---|---|

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| D | Project | 0-0-6 | 3 | Mid-Session Evaluation - I | 30 |
| | | | | Mid-Session Evaluation - II | 20 |
| | | | | Session-End Evaluation - I | 50 |

| **7.** | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| Co3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| **8.** | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL320 Advanced Surveying & Remote Sensing** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL202 & MNP202 Mine Surveying** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To disseminate knowledge to student about modern surveying and methods for precision survey in mining. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To learn various map projection system, earth datum and coordinate systems. |
| **CO2** | To comprehend working principle and application of advanced survey instruments in mines. |
| **CO3** | To learn working principle and application of photogrammetry and drone in mines. |
| **CO4** | To understand working principle and application of remote sensing system and GIS in mines |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| National Grid: Map Projections; Transformation of coordinates, Geodesy: Geoid, spheroid and ellipsoid, Geocentric, Geodetic and Astronomical Coordinates | | **CO1** | 2 |
| GNSS: Various navigation satellite system, regional systems principle, operation, application to mine survey, EDM, Total survey station, principle and application to mine survey | | **CO2** | 2 |
| Gyro-theodolite, principle, application to mine survey, LiDAR, Laser profilers, principle, application to mine survey, and application of laser | | **CO2** | 1 |
| Photogrammetry: Types, Principle of photogrammetry, Photograph types, Scale of photograph, Relief displacement, Ground coordinates, Overlaps, Stereoscope, Flight design, Drone: principle, application to mine survey | | **CO3** | 2 |
| GIS: Components, Raster data, Vector data, Data acquisition, Data prepressing & Georeferencing, Query based analysis, GIS software, GIS application in mining | | **CO4** | 2 |
| Remote sensing: Components, Sources of EM radiation, EM Radiation interaction with atmosphere with earth's surface, atmospheric windows, spectral signature, Remote Sensors and platforms, Image resolution, Satellites orbits, Image processing, IRS & INSAT system, Remote sensing software. Application of remote sensing in mining | | **CO4** | 3 |

| **4.** | **Textbooks** |
|---|---|

i) Thomas L., Ralph W. Kiefer, and Jonathan C. (2015), Remote Sensing and Image Interpretation

ii) Kang-tsung Chang. (2002), Introduction to Geographic Information System

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) John A. Richards (2012), Remote Sensing and Digital Image Analysis

ii) Burrough, P.A. and Mc Donnel, R.A.(1998), Principles of Geographic Information System

iii) Lu, Zhiping, Qu, Yunying, Qiao, Shubo (2014), Geodesy: Introduction to Geodetic Datum and Geodetic Systems

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL431 Novel Mining Methods** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Students are made conversant with non-conventional mining methods. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Understanding single and multi-hole borehole mining techniques |
| **CO2** | Understanding hydraulic mining and leaching technologies |
| **CO3** | Understanding recent advances in deep-sea mining and extra-terrestrial mining |
| **CO4** | Understanding recent advances in coal-bed methane drainage and underground coal gasification |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction to Novel Mining Methods:** Classification of novel mining methods; Advantages over conventional mining methods; Global and Indian Scenario; Benefits of novel mining methods. | | **ALL COS** | 0.5 |
| **Solution Mining Method**s: Physico-chemical processes of solution mining; Borehole mining/extraction methods; Single well systems; Multi-well systems; Environmental aspects of solution mining; Borehole mining equipment and tools; Leaching methods; Ore-Lixiviant Systems for different minerals; Evaporite Mining methods. | | **CO1, CO2** | 1.5 |
| **Hydraulic Mining Methods:** Subclassification of hydraulic mining; Placer mining; Hydraulicking; Tools, operational conditions, Process characteristics; Dredging; Mechanical & Hydraulic Dredges; In-land dredges; Operational conditions; Process characteristics. | | **CO1, CO2** | 2 |
| **Deep-sea Mining Methods:** Need for deep-sea mining; Status of deep-sea mining; Regulations of deep-sea mining; Types of oceanic minerals; Case studies of hydraulic mining systems; Environmental impacts of deep-sea mining. | | **CO3** | 2 |
| **Extra-terrestrial Mining:** Extra-terrestrial resources; Viability of nearby celestial objects; Lunar Resources; Classification of asteroids; In-situ Resource Utilisation; Systems of mining in space; Economics and Regulations of Extra-terrestrial mining. | | **CO3** | 2 |
| **Coal Bed Methane:** Coal Fundamentals and Geology; Key Coal Properties; Coal Permeability; Measurement of Coal bed Gas Content; Isotherms and Recovery Factor; Development Considerations; Well Design and Drilling; Gas Recovery & Well Performance. | | **CO4** | 2 |
| **Coal Gasification**: Introduction to gasification, Chemical reactions; Underground gasification – principles and potential; Conversion of coal to syngas; Impact of coal properties on gasification; Production of coal for gasification: mining and beneficiation perspective; Conversion of syngas to a variety of chemical products; Environmental aspects around a gasification plant; Relevance of coal gasification and its future potential; Sustainable $CO_2$ capture and sequestration possibilities. | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Hartman, H.L. and Mutmansky, J.M., 2002. *Introductory mining engineering*. John Wiley & Sons.

ii) Hustrulid, W.A. and Bullock, R.L. eds., 2001. *Underground mining methods: Engineering fundamentals and international case studies*. SME.

iii) Britton, S.G., Mutmansky, J.M., Gentry, D.W., Schlitt, W.J., Karmis, M. and Singh, M.M. eds., 1992. *SME mining engineering handbook* (Vol. 2). Littleton, Colorado: Society for Mining, Metallurgy, and Exploration.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Thakur, P., Schatzel, S.J. and Aminian, K. eds., 2014. *Coal bed methane: From prospect to pipeline*. Elsevier.

ii) Thakur, P., Schatzel, S.J., Aminian, K., Rodvelt, G., Mosser, M.H. and D'Amico, J.S. eds., 2020. *Coal bed methane: theory and applications*. Elsevier.

iii) Sharma, R., 2017. *Deep-sea mining* (pp. 41-56). Cham: Springer International Publishing.

iv) Jakhu, R.S., Pelton, J.N. and Nyampong, Y.O.M., 2017. *Space mining and its regulation* (Vol. 106). Cham, Switzerland: Springer International Publishing.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL423 Geostatistics** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| Students are made conversant with basic statistical and geostatistical methods. Application of these tools are made with reference to mineral grade calculations | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Statistical distributions – random, normal and lognormal and its importance in mining environment. |
| **CO2** | Characteristics and Various models of variogram |
| **CO3** | Semi variogram calculations |
| **CO4** | Krigging method for grade and reserve estimation |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Classical statistics, random distributions, normal and lognormal theory. Concept of geostatistics and its application to mining; Spatial statistics, Co-variogram, definitions, estimation, fitting | | **CO1** | 4 |
| Variogram, semi-variogram, definition, estimation, experimental variogram, fitting; application, uses of variogram. Various model of variograms: random model, spherical model, exponential model, gaussian model, Linear model, logarithmic or de Wijsian model, parabolic model Nugget effect, its implication on model, anisotropies Numerical calculation of variogram, and graphs for one, two and three dimensions | | **CO2, CO3** | 4 |
| Krigging method for grade and reserve estimation. Krigging estimator, krigging error, point krigging, block krigging, optimal valuation Use for geostatistical software for various application Case studies of grade estimation | | **CO4** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Geostatistics – Methods and Applications: Rendu J.M.

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Open Pit Planning – SME

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 2 | 2 | 1 |
| CO2 | 1 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 1 | 2 |
| CO3 | 2 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 1 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL457 Emergency Management and Safety Audit** | | |
| **Course Type:** | MINOR 4 | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-1-0 | **No. of Credits** | 4 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make aware the students about various disasters. To train the students for disaster management methodologies | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Can use disaster management and emergency management techniques to reduce the severity |
| **CO2** | Can prepare the disaster management plans. |
| **CO3** | Can prepare safety management and audit plans |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Accidents, Disaster and Catastrophes: Introduction on Disasters, Types of Disaster: Natural Disaster, Man-made Disaster, Accidents (Air, Sea, Rail & Road), Structural failures, War & Terrorism etc. Causes, effects and practical examples for all disasters. Disaster and Emergency Management, Preparedness and Response Early Warnings and Safety Measures of Disaster, Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies, Role of IT in Disaster Preparedness | | **CO1** | 4 |
| Disaster Management. Disaster Response: Introduction, Disaster Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan, Rescue, Search, Evacuation and Logistic Management, Role of Government, International and NGO Bodies, Psychological Response and Management (Trauma, Stress, Rumor and Panic), Relief and Recovery. Medical Health Response to Different Disasters Disaster Planning: Theoretical approaches; the emergency and responses; emergency/disaster control agencies; worksite considerations - evaluations, treatment, access, public awareness, shutdown procedures. | | **CO2** | 4 |
| Monitoring for Safety, Occupational Health and Safety Management System, ILO and EPA Standards. Safety measurement and control: Frequency rate, incidence rate, severity rate, mean duration rate, duration rate; monitoring accident rates, Safety Audit: Objectives, Internal and external audit; third party audit. Audit procedures, duration, report preparation, Safety inspection, safety organisation for supervision, Accident Investigation and Reporting: safety record management, Accident report preparation | | **CO3** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Disaster Management Handbook, Jack Pinkowski

ii) Industrial Disaster Management and Emergency Response U. K. Chakrabarty

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Environmental Health and Safety Audits by Lawrence B. Cahill

ii) Guidelines for Auditing Process Safety Management Systems by John Wiley

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-1-0 | 4 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 3 | 2 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 2 |
| CO2 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**N.A.**

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MND456 Major Project Phase -1** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-6 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students will be assigned a dissertation topic based on his/her area of interest within mining domain. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To identify the area of work and scope of work. |
| **CO2** | To prepare the objectives of the research work |
| **CO3** | To exhibit the knowledge about the methodology to carry out research. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |

| **4.** | **Textbooks** |
|---|---|

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| D | Project | 0-0-6 | 3 | Mid-Session Evaluation - I | 30 |
| | | | | Mid-Session Evaluation - II | 20 |
| | | | | Session-End Evaluation - I | 50 |

| **7.** | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| **8.** | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL421 Mine System Engineering** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students aware about the concept of system engineering and its relevance to mining. To expose the students to various mathematical models for optimization, maximization, & minimization. To extend the knowledge about project management tools, decision making and simulations applicable to mining. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will acquire knowledge about different modelling techniques for mining and allied applications. |
| **CO2** | Students will acquire some simulation knowledge useful for decisions making and management. |
| **CO3** | Students will acquire knowledge about Project Management with PERT & CPM. |
| **CO4** | Students will acquire knowledge about simulation technique. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction to Systems Engineering*:* Concept of system, components and system environment; classification of systems; systems analysis; creative aspects of planning and design; factors influencing creativity; techniques for generating alternative ideas/solutions. | | **CO1** | 2 |
| Mathematical Programming Methods*:* Linear programming - definition/elements, assumptions and limitations of LPP; graphical solution; geometry and algebra of simplex method; interpretation of simplex table; application of linear programming for solution of mining problems related to production, blending, scheduling. | | **CO1** | 2 |
| Transportation and Assignment Problems*:* Mathematical modelling and solution algorithm; application to mining problems. | | **CO1** | 2 |
| Project Management with PERT & CPM: Network Models Assumptions of PERT and CPM; art of drawing network; redundancy and identification of redundant jobs; algorithm for calculation of critical path and identification of critical jobs; criticality index; statistics related to PERT; probability of completing a project by a due date; lowest cost schedule; case examples application to mining problems. | | **CO3** | 2 |
| Decision Analysis*:* Decision problems; model formulation; decision analysis based on expected monetary value and utility value. Optimisation techniques and queueing theory. | | **CO2** | 2 |
| Simulation: Introduction and concept; scope and limitation; system type versus simulation technique; generating input data; Monte-Carlo simulation; deterministic and stochastic simulation of various systems in mines. | | **CO4** | 2 |

| **4.** | **Textbooks** |
|---|---|


i) Haberfellner, R., Nagel, P., Becker, M., 2019. Systems engineering Springer International Publishing.

ii) Hillier F.S. and Lieberman G.J., 2001. *Introduction to operations research*. McGraw-Hill.

iii) Parnell G.S., Driscoll P.J. and Henderson D.L., 2010. *Decision Making in Systems Engineering and Management*. John Wiley & Sons.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) ORT Applications by Kulkarni

ii) Graham C. and Denis T., 2013. *Stochastic Simulation and Monte Carlo Methods: Mathematical Foundations of Stochastic Simulation*. Springer

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 0 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 2 | 2 | 0 | 3 | 3 | 0 | 0 | 2 | 1 | 2 | 2 | 3 | 2 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL402 Surface Mine Environment** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student conversant with prevailing environmental legislation in India. To provide knowledge in detail about various sources of pollution in surface mines and mitigating measures against each source. To make student conversant with social impacts and aspects of getting approvals and permissions for running mining industry | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand environmental issues in mineral industry |
| **CO2** | To understand issues related to air and water pollution |
| **CO3** | To understand environmental issues related to blasting |
| **CO4** | To understand management of environment |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction: Environmental issues in mineral industry national and global; ambient environment mining complexes; environmental impacts of mineral exploitation - underground and opencast mining and associated activities. | | **CO1** | 1 |
| Air Pollution: Sources, monitoring, and control, Water Regime: Availability water quality; water pollution treatment and water management. Noise and Vibrations: Causes, precautions, measurement, prevention, and reduction. Blasting: Environmental aspects of blasting.: | | **CO2 & CO3** | 3 |
| Ecological Environment and its management including biological reclamation. Land Environment: Visual impacts; landscape analysis; land use; landscape planning; physical reclamation and subsidence management. | | **CO1 & CO4** | 3 |
| Societal Environment: Societal environment and its management including resettlement and rehabilitation; socio-economic impacts; sustainable development; concept of carrying capacity-based planning | | **CO1 & CO4** | 3 |
| Waste Management: solid wastes - generation, treatment, and disposal. Environmental Administration in India: Administration and Management, preparation of Environmental Management Plan. Environmental audit, salient features of Environment Protection Act | | **CO4** | 3 |

| **4.** | **Textbooks** |
|---|---|

i) Environmental Impact of Mining by Stocks

ii) Sengupta M., 2021. *Environmental Impacts of Mining: Monitoring, Restoration, and Control.* CRC Press

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Mining and Environment by B.B.Dhar

ii) Mine Environment by Dhar and Thakur

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL430 Rock Slope Engineering** | | |
| **Course Type:** | DE (**HONOURS - 3**) | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student conversant with slope stability problems. To develop skill in slope stability analysis by various methods. To deal with slope stability problems in mines and in general. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Learning basic slope stability in mining operations as well as civil excavation |
| **CO2** | Developing expertise in slope stability analysis |
| **CO3** | Expertise in management of slopes |
| **CO4** | Expertise in Dump Management |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Basic Concepts: Engineering issues of Slope stability, Basic terminology, Slope failure causes and process, basic mechanism of slope failure | | **CO1** | 1 |
| Rock mass properties: various properties, data collection, stereographic projections | | **CO1** | 2 |
| Ground water: Role of ground water flow, influence of ground water on slope stability, evaluation of ground water conditions in slopes | | **CO1, CO2** | 2 |
| Plane failure: general conditions and failure analysis, Wedge failure: general conditions and failure analysis | | **CO2** | 2 |
| Toppling failure: general conditions and failure analysis, Circular failure: general conditions and failure analysis | | **CO2** | 2 |
| Rock slope stabilization techniques, Geotechnical Instrumentation and Monitoring | | **CO3** | 2.5 |
| Aspect of Waste dump stability analysis | | **CO4** | 1 |

| **4.** | **Textbooks** |
|---|---|

i) Engineering Rock Slope Stability: Charles A Kliche (SME publication)

ii) Rock Slope Engineering: Hoek & Bray

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Pit slope manual: Mineral Research Laboratories, Canada

ii) Slope Stability in Surface mining: W A Hustrulid, SME Publication

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 1 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL432 Mine Automation** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with aspects of automation and control applied to mines. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will understand scope and role of automation in mining operation |
| **CO2** | Students will understand data communication and modern computerised control systems |
| **CO3** | Students will understand use of latest techniques used for mine automation. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Scope and role of automation in mining operation and human related factors. System engineering approach and use of operational data from mining equipment and its use the mining process. | | **ALL COs** | 4 |
| Data communication and modern computerised control systems. Data formats and IREDES, mine process data, AGV technology. Basic foundations for automation of mining equipment. Navigation, surface navigation and GNSS (satellite navigation), mine planning tools, etc | | **ALL COs** | 4 |
| Automation of drilling and drill rig, drilling process. Automation of underground loading and transportation systems. Automation in tunnelling projects. Automation in monitoring of environments in longwall and continuous mining system Automation of transportation system in surface mining. Use of robotics in mining for production and disaster management purpose | | **ALL COs** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Chaulya S.K. and Prasad G.M., 2016. Sensing and Monitoring Technologies for Mines and Hazardous Areas: Monitoring and Prediction Technologies. Elsevier.

ii) Panagiotou G.N. and Sturgul J.R., 1997. Mine Simulation. CRC Press.

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Society of Mining Engineering Handbooks –Vol –I and II

ii) Introductory Mining Engineering: Hartman

iii) Underground Mining Methods Handbook: Hustrulid (SME NY, 1994)

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 0 | 3 | 0 | 2 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 0 | 2 | 0 | 3 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL458 Instrumentation & Non-Destructive Testing** | | |
| **Course Type:** | DE (**HONOURS - 4**) | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| In this course, students will be introduced to an array of monitoring systems that are used in the field for measuring various phenomenon ranging from deformation, loads, temperature, pressure and velocity. Further, students will also be familiarized to various laboratory testing systems including non-destructive testing that help characterize rocks and other engineering materials. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand state-of-the-art instrumentation systems for monitoring rockmass with respect to underground and surface mines |
| **CO2** | To understand state-of-the-art instrumentation systems for laboratory rock characterisation |
| **CO3** | To understand instrumentation techniques available to monitor the mine environment with regards to safety and environment control |
| **CO4** | To understand non-destructive techniques to measure various features with rocks and other materials used in mining operation. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Rockmass Monitoring**: Need of rockmass monitoring; Introduction to Geotechnical instrumentation systems; Design of Geotechnical measurement systems | | **CO1 & CO3** | 2 |
| **In-situ stress, deformation and temperature monitoring systems:** Convergence indicators and recorders; Extensometers; Deformation gauges; Bore hole camera and image analysis; Pressure, Load and Stress Cells; Flat Jacks. | | **CO1 & CO2** | 2 |
| **Laboratory stress, deformation and temperature monitoring:** Strain gauges and Displacement transducers; Load cells; Data Loggers and data analysis; thermocouples and infra-red temperature sensors; Application of Transducers for measurement of Displacement, Force, Strain, Pressure, Flow, Temperature and other non-electrical quantities | | **CO2 & CO3** | 2 |
| **Seismic and micro-seismic monitoring systems:** Blasting and blast performance instrumentation, Image and Data analysis | | **CO2 & CO3** | 2 |
| **Mine Environment Monitoring:** Monitoring of mine gases, temperature, humidity and air velocity; Continuous & live monitoring methods; Data transmission and Tracking; Leaky feeder and Fibre optic based systems. | | **CO3** | 2 |
| **Non-destructive testing & methods:** Principle and methodology of different NDT methods; Ultrasonic Testing, Radiographic, magnetic and Optical Testing methods; Measurement of hardness – fracture toughness; Acoustic Emission; Analytical Techniques: XRD, SEM, DTA | | **CO4** | 2 |

| 4. | Textbooks |
|---|---|

i) Hencher, S., 2015. Practical rock mechanics. CRC Press.

ii) Jeremic, M.L., 2020. Strata mechanics in coal mining. CRC Press.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Anderson, G.L. and Hadden, D.M., 1999. The gas monitoring handbook. Avocet Press Inc.

ii) Morris, A.S., 1993. Principles of measurement and instrumentation. Prentice Hall.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 0 | 2 | 3 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 2 | 3 | 2 |
| CO2 | 3 | 2 | 0 | 3 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 0 | 3 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 2 | 0 | 3 | 3 | 0 | 0 | 0 | 2 | 2 | 3 | 1 | 3 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL462 Mine Waste Management** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| In this course, the student will be introduced to state-of-the-art technologies used in handling, safe disposal and use of different types of waste arising out of mining operations. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Student will have knowledge of Solid Mine Waste Management |
| **CO2** | Student will have knowledge of Liquid Mine Waste Management |
| **CO3** | Student will have understanding of Mine Waste recycle and utilisation |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Rock or solid mine waste: Types of solid waste: Overburden rock, Gangue Material and Mill Tailings, Construction of internal and external dumps, design of dumps, mitigation of environmental problems, Disposal of Gangue, construction and design of stockpiles, Environmental issues of gangue materials and their management, Tailing Management: design and construction of tailing dams, Environmental issues of tailing and their management | | **CO1** | 4 |
| Liquid mine waste: Mine Water, Mine water management: Sump design, treatment of water, disposal of mine water, Environmental issues of mine water and their management, Sludge, Mine sludge management: Handling and Disposal of mine sludge, Environmental issues of mine sludge and their management | | **CO2** | 4 |
| Mine waste recycle and utilisation: Recycling and utilisation of Mine waste, Environmental issues recycling and utilisation and their management, Environmental aspects of waste management | | **CO3** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Lottermoser B.G., 2010. Mine Wastes: Characterisation, Treatment and environmental Impacts. Springer.

ii) Das S., Sahu H. and Mishra S., 2024. Sustainable Management of Mining Waste and Tailings: A Circular Economy Approach. CRC Press.

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Environmental Impact of Mining; C G Down & J Stocks, Applied Science Publishers Ltd, London

ii) Environmental Aspects of Mining Areas, Bulletin No.27, Indian Bureau of Mines, Nagpur

iii) https://eddypump.com/education/mine-waste-disposal-methods/

iv) http://canadianminingmagazine.com/understanding-mining-waste-management-and-disposal-methods/

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 1 | 3 | 3 | 0 | 0 | 0 | 3 | 2 | 2 | 1 | 3 |
| CO2 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL321 Artificial Intelligence and IoT in Mining** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| This course will introduce novel concepts of artificial intelligence techniques and Internet of Things and their application in mining domain. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand AI, perform problem solving |
| **CO2** | To carry out data analysis and use informed search techniques |
| **CO3** | To carry out data analysis and understand ML concepts |
| **CO4** | Effective use of Neural networks |
| **CO5** | To understand and practice IoT, Machine learning approaches and Artificial Intelligence and its application in mining industry |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Introduction: Brief review of AI history, artificial intelligence and its applications in data sciences Basics of problem solving, problem representation; Search Techniques: Problem size, complexity; Uninformed search techniques- Depth, Breadth, Uniform Cost, Depth Limited | | **CO1** | 2.5 |
| Informed search techniques: Heuristic Based Search, Greedy Based First Search, A* Search; Local Search algorithms: Hill-climbing, Simulated Annealing, Genetic Algorithms. | | **CO2** | 2.5 |
| Conceptual introduction to Machine Learning: Linear Regression, Logistic Regression, Inductive Classification, Supervised, Unsupervised, and Semi-Supervised Learning, Deep Learning, Reinforcement Learning, k-means partitional clustering. Expectation maximization (EM) for soft clustering. | | **CO3** | 2.5 |
| Introduction to Neural Networks: Artificial Neural Networks, Neurons and biological motivation. Linear threshold units. Perceptron: representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks. | | **CO4** | 2.5 |
| Internet of Things and application of AI, ML and IOT in Mining Industry: Overview of IoT, Design Principles for Connected Devices; Internet Principles, Industry 4.0, embedded devices, overview of Communication in the IoT, data handling, data conversions and cloud computing in IoT, security in IoT, Mining application case studies of AI, ML and IoT | | **CO5** | 2 |

| **4.** | **Textbooks** |
|---|---|


i) Rich and Knight “Artificial Intelligence” MGH Publication, 2018

ii) A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013

**iii)** Richard I. Levin and David S. Rubin, Statistics for Management, 7th Edition, Pearson, 1998

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Tom Mitchell "Machine Learning" McGraw Hill, 1997.

ii) Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach;Pearson Education, 2009

iii) Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.

iv) Ethem Alpaydin; Introduction to machine Learning, Third Edition

v) Arshdeep Bahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 2 | 1 | 0 | 0 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 1 |
| CO2 | 2 | 3 | 0 | 2 | 2 | 0 | 0 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 0 | 1 | 2 | 0 | 0 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 0 | 3 | 3 | 0 | 0 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MND460 Major Project Phase -2** | | |
| **Course Type:** | DC | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 0-0-6 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MND456 Major Project Phase -1** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students will be assessed on the progress made on assigned dissertation topic. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To execute the methodology by various tools |
| **CO2** | To analyse the data using relevant data analysis tools. |
| **CO2** | To prepare and present research report. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |

| **4.** | **Textbooks** |
|---|---|

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| D | Project | 0-0-6 | 3 | Mid-Session Evaluation - I | 30 |
| | | | | Mid-Session Evaluation - II | 20 |
| | | | | Session-End Evaluation - I | 50 |

| **7.** | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| **8.** | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

| Course Code & Course Title: | MNL317 Smart & Clean Mining Technologies | | |
|---|---|---|---|
| Course Type: | DE | | |
| Name of the programme(s): | B.Tech | | |
| L – T – P | 3-0-0 | No. of Credits | 3 |
| Pre-requisites: Course Code(s) & Name(s) | NIL | | |
| Course Equivalence: Course Code(s) & Name(s) | NIL | | |

| 1. | Course Objectives: |
|---|---|
| Students will get the knowledge about productive smart, efficient and intelligent mining. Students will understand the significance of green and eco-friendly mining. | |

| 2. | Course Outcomes (Min. 3 & Max. 5): |
|---|---|
| CO1 | Students will get the knowledge about productive smart and efficient mining |
| CO2 | Students can identify and asses the recent developments in intelligent and prognostic maintenance that could be useful for their work sites and how to introduce them |
| CO3 | Can realize the importance of clean and sustainable mining |

| 3. | Detailed Description of the Course | | |
|---|---|---|---|
| Topics | | CO(s) Addressed | Duration in weeks |
| Remote Mining Techniques, Automated mining: Autonomous vehicles, automated equipment includes excavators, load haul dump, drillers & breakers, robotic trucks, and other automated equipment remote-controlled drilling rigs, unmanned drone inspection and smart ventilation control | | CO1 | 2 |
| Modern Instrumentation in HEMM for Safety and Productivity Enhancement Advances in Instrumentation and monitoring of Mining Machinery Instrumentation for intelligent mines, Smart actuators and Smart controllers for monitoring of large movements in underground and open pit mines | | CO1 | 1 |
| Real-time condition monitoring, measuring bearing vibration and temperature, wireless machine monitoring, detecting, condition monitoring systems beyond preventive maintenance and predictive maintenance. Borehole remote mining, underground remotely operated continuous mining machines other continuous mining processes | | CO2 | 1 |
| The Industrial Internet of Things (IIOT) applications to mining and digital mines Automated sensors, RFID tags, intelligent systems, and data transfer mechanism Cellular technology of networking, wireless data transfer and control of machines. | | CO2, CO3 | 1 |
| Eco-friendly clean mining: Environmentally friendly mining processes, Reevaluating Cut-off Grades, conservation of minerals, Coal washing and covered transportation, Mill tailing management | | CO3 | 2 |
| Water regime management in mines, water recycling, water treatment, Toxic waste treatment, contamination control, Wet mining, water sprinkling, wet drilling, wet cutting, modern dust control and treatment techniques | | CO2, CO3 | 1 |
| Innovative synchronization of mine site restoration and reclamation techniques, Zero-emission mining | | CO3 | 2 |

| 4. | Textbooks |
|---|---|

i) Preue A., Frenz W., 2021. Yearbook of Sustainable Smart Mining and Energy 2021: Technical, Economic and Legal Framework. Springer.

ii) McEwen A. and Cassimally H., 2013.Designing the Internet of Things. 1st edition, Wiley.

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Arshdeep Bahga, Vijay Madisetti, 2014. Internet of Things: A Hands-On Approach. Universities Press.

ii) Xie S., Chen D., 2023. Method and Technology of Green Coal Mining. MDPI Energies.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 3 | 2 |
| CO2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 0 | 0 | 0 | 3 | 3 | 1 | 3 | 1 |
| CO4 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL427 Mine Safety Engineering** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant about significance of safety in industry and safety management. To provide the training about risk assessment and carrying out safety audit. To impart knowledge about site specific safety and training | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will gain the idea about preparation of safety management plan and risk calculation |
| **CO2** | Students will learn the various steps of safety audit |
| **CO3** | Students will develop a initial skill to monitor the safety related to mining |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Safety management systems in Indian mining industry; engineering aspects of safety management. Basic concept of risk, reliability and hazard potential; elements of risk assessment; statistical methods; control charts; appraisal of advanced techniques - fault tree analysis, failure mode and effect analysis, quantitative structure - activity relationship analysis; fuzzy model for risk assessment. | | **ALL COs** | 4 |
| Measurement of safety efficiency; safety audit methods; safety records management. Safety legislations, Safety meetings, constitution of safety committees, functions, pit safety committee | | **ALL COs** | 4 |
| Ergonomics, Safety practices in various operations, blasting, drilling, equipment and machine handling, site specific safety, ground control, ventilation and gases; safety codes, implementation and monitoring of safety programmes Recent Trends of development of safety engineering approaches. Safety training | | **ALL COs** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Mine Safety by Prof. Kejriwal

ii) Occupational Safety and Health in Industries and Mines by C.P.Singh

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad

| **6.** | **Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations]** |
|---|---|

| **Code** | **Type** | **Structure L+T+P** | **Credits** | **Evaluation Weightage (%)** | |
|---|---|---|---|---|---|
| | | | | **Method** | **Range** |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | **Relationship of Course Outcomes to Program Outcomes:** |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 0 | 2 | 1 | 0 | 0 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 1 |
| CO2 | 2 | 2 | 0 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | **List of Indicative Laboratory Experiment (if applicable):** |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL433 Advanced Surface Mining & Design** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | **MNL213 Surface Mining Methods** | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant advanced aspects of surface mining. To develop skill in planning and design of surface mines | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To understand cut-off grade, ultimate pit slope angle and break-even-stripping ratio. In the light of this information ultimate pit design. |
| **CO2** | To plan and design opencast coal mines, opencast metal mines and hill mining – involves layout, equipment calculation. |
| **CO3** | To understand different loading and transport equipment – their technical combination based on output capacity. |
| **CO4** | To design waste dumps, haul roads, drainage system. |
| **CO5** | To design various blasting practices. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Open pit Optimisation considering Ultimate pit slope, cutoff grades and stripping ratio. Optimum Production Scheduling Planning and Design of Surface coal mines, Planning and design of Open pit Mines, Planning of Hill Mining | | **CO1** | 2.5 |
| Design of Surface mines Using Inpit Crushing, Surface Miners, Rock Breakers, Design of Highwall Mining | | **CO2** | 2.5 |
| Advances in Loading, Hauling and transportation equipment (Shovel, Draglines, Dumpers, Cross-pit Conveyors, Skip Transportation etc), Application and design of Truck Dispatch System, Application of GPS in surface mining | | **CO3** | 2.5 |
| Design of Waste Dumps and Tailing Ponds, Design of Haul roads, Design of Drainage System. Monsoon preparation in surface mines | | **CO4** | 2.5 |
| Design of large-scale bench blasting: coal and non-coal: cast blasting, coyote blasting, chamber blasting, Estimation of Mining Cost for surface mines | | **CO5** | 2 |

| **4.** | **Textbooks** |
|---|---|

i) Hustrulid W., Kuchta M. and Martin R., 1998. Open Pit Mine Planning & Design, Volume 1-Fundamentals. CRC Press, Taylor and Fransis Group.

ii) Rzhevsky V.V., 1978. Opencast Mining Unit Operations. Mir Publication.

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Fundamentals of Open Pit Mine Planning & Design: Hustrulid, W. and Kuchta, M.

ii) Surface Mining – Kennedy, B.A., 2nd Edition, SME, New York, 1990

iii) SME Mining Engg. Cummings, A.B. and Given, I.V., Hand book Vol.I and II, New York

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 1 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO5 | 2 | 3 | 3 | 3 | 2 | 2 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 3 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL406 Mining Economics** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with importance of mineral economics. To make aware about the various financial aspects of mineral industry. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will have knowledge about various aspects of mining economics. |
| **CO2** | Students will have knowledge about various inventory of minerals, ore sampling and ore reserve estimation. |
| **CO3** | Students will develop skill in financial management in mining industry. |
| **CO4** | Students will develop skill in mine valuation and feasibility. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| **Introduction:** Economic importance of the mineral industry; mining economy, risky nature of the mining industry; State and the mining industry; national mineral policy | | **CO1, CO2** | 1 |
| **Mineral resource:** Concept, classification and estimation. Mineral inventory -concept, characteristic features, composition and economic significance; estimation of life index. Economics of mineral exploration and production Mineral price and pricing, price index. Mineral consumption and substitution; market survey and demand analysis. Conservation of mineral resource - scope and limitations. | | **CO1, CO2, CO4** | 2 |
| **Forms of business organization**: Private and public enterprises. acquisition and merger. Mine finance: Capital and its importance, sources of finance, shares, debentures and the cost of capital, various forms and formation; Royalty, taxes and duties*;* imports and exports. | | **CO1, CO3, CO4** | 1 |
| **Mine Sampling:** Definition, purpose and scope; sampling methods and computations; reliability of mine sampling. Loss of mineral in mining: Classification and incorporation of losses; coefficient of completeness of mineral extraction; dilution and recovery. | | **CO1, CO2, CO4** | 2 |
| **Geostatistics:** Geostatistical application for grade and reserve estimation | | **ALL COS** | 1 |
| **Cost of mining*:*** Capital and operating costs; factors affecting operating cost; methods of estimating future costs; standard cost and forecast; budget and budgetary control. | | **ALL COS** | 2 |
| **Mine examination and valuation:** Examination and valuation of mines/mineral properties; Hoskold and modern concepts, present value computation | | **ALL COS** | 2 |
| **Economic feasibility studies:** Need for economic analysis; techno-economic analysis data estimates; methods of investment appraisal; risk analysis; societal versus private interest economic evaluation. | | **CO1, CO3, CO4** | 2 |

| **4.** | **Textbooks** |
|---|---|

i) Mineral Economics by Chatterjee

ii) Mineral Economics by R.T. Deshmukh

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Valuation and Examination Of Mineral Property by Parks

ii) Indian Mineral Yearbook – Indian Bureau of Mines

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 0 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 0 | 0 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 0 | 0 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 1 |
| CO4 | 0 | 0 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL464 Project Management and Evaluation** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| This course will enable students to evaluate and manage projects of various scales using engineering decision. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will be able to understand project and its properties. |
| **CO2** | Students will be able to plan & schedule the project activities |
| **CO3** | Students will demonstrate the ability to understand the use of human resources |
| **CO4** | Students will be able understand project estimation and control processes |
| **CO5** | Students will be able to evaluate project |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Introduction:** Concepts of Project Management, Project Management Life Cycle, unique attributes of a project, importance of project management, difference between project, program and portfolio | **CO1** | 2 |
| | **Establishing the Project:** Project Planning, Constraints of a project, Project Priority Matrix, Scope, Time, Cost and Performance Goals of project, Project Scope Management, COS, POS, RBS and WBS. Project implementation phase and its substages, different project implementations approaches. | **CO2** | 2 |
| | **Project Human Resource Management:** Organizing Human Resources and Contracting, Organizing systems and Procedures for Project implementation, unique requirements of project organisation, | **CO3** | 2 |
| | **Project Control:** Project Estimation techniques, characteristics of a project estimate, Project Direction, Coordination and Control, and a Brief about Project Quality and Risk Management. | **CO4** | 3 |
| | **Project Evaluation:** Benefits and Limitations of Project evaluation, Methods of Project evaluation. Project Management Performance. Management Information System, Project Evaluation Tools. Project audit report, Components of project monitoring systems | **CO5** | 3 |

| **4.** | **Textbooks** |
|---|---|

i) Project Management: David Cleland, Lewis Ireland, Tata McGraw Hill

ii) Guide to Project Management: Harold Kerzner, Tata McGraw Hill.

iii) Project Management: The Managerial Process, Erik W. Larson, Clifford F. Gray,

iv) Project Management: Jack Gido, James Clements, Cengage Learning

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Project Management Body of Knowledge, Book by Project Management Institute

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 |
| CO2 | 1 | 3 | 0 | 2 | 2 | 0 | 0 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 2 | 0 | 1 | 2 | 0 | 0 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 1 |
| CO4 | 1 | 2 | 0 | 3 | 1 | 0 | 0 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 2 |
| CO5 | 2 | 2 | 0 | 2 | 3 | 0 | 0 | 1 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL422 Rock Excavation Engineering** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students aware about the concept of excavation engineering and its relevance to mining. To expose the students to various excavation techniques and their design aspects. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Concepts of Excavation Engineering, Understanding of Rock and its importance in Characterization in Excavations |
| **CO2** | Excavatibility of Rock and its components like Cuttability, Drillability, Rippability etc. |
| **CO3** | Theories of rock tool interaction in all the excavation methods (Drilling, Blasting, Cutting etc) |
| **CO4** | Design principles of Drilling, Cutting Ripping Machines, Wear Mechanisms. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Introduction:** Scope and importance of rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks vis-a-vis excavation method; selection of excavation method. | **CO1** | 1 |
| | **Drilling:** Mechanics of rock drilling; design and operating parameters of surface and underground drilling; evaluation of drill performance; drill ability of rocks; mechanism of bit wear; bit selection; problems of drilling; economics of drilling. | **CO2, CO3 & CO4** | 2 |
| | **Blasting:** Mechanics of rock fragmentation by explosives; advancement in explosives and blasting technique; their selection criteria for rock excavation; blast design for surface excavations and optimization; Advanced blasting techniques; blast performance evaluation; cast blasting; techno-economic and safety aspects of surface and underground blasting; advances in blast design for underground excavations; control blasting; computer-aided blast designs; review of tunnel blasting techniques, recent advances and novel techniques of blasting | **ALL COs** | 4 |
| | **Rock cutting:** Theories of rock tool interaction for surface excavation machinery; design of cutter head - rippers, dozers, scrapers, BWE. Continuous surface miners, auger drills; theories of rock tool interaction for underground excavation machinery; design of cutter head - ploughs, shearers, roadheaders, continuous miners and tunnel boring machines: selection criteria for cutting tools; advanced rock cutting techniques - high pressure water jet assisted cutting. Recent Developments in rock excavation machinery. | **CO2, CO3 & CO4** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) Blasting Practices by G.K.Pradhan

ii) Explosives and Blasting Practices in Mines by Dr. Sameer Kumar Das

iii) Drilling by G. Chugh

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) SME – Mining Engineers Handbook

ii) Surface Mining – SME

iii) Introduction to Mining by Hartman

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO4 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL405 Computer Applications in Mining** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make students conversant with importance of computers in mining engineering. To make aware about the various software and its application to mine planning and design. To demonstrate and impart initial training to use the software. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will have knowledge about various software application worldwide in the field of mining engineering |
| **CO2** | Students will develop some skill and practice to use the software |
| **CO3** | To models mine cases for design and planning |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| **Topics** | | **CO(s) Addressed** | **Duration in weeks** |
| Overview of software for Mine Planning and Design. | | **CO1, CO3** | 2 |
| CAD and computer graphics applications for preparation of mine plans and sections | | **CO1, CO3** | 1.5 |
| Statistical and geostatistical techniques used in mining calculations, ore reserve and ore grade estimation using computer software packages | | **CO1, CO3, CO4** | 1.5 |
| Analogue and digital simulations, deterministic and stochastic computer simulation models of mining operations. Computer simulation of mine ventilation systems. coal and mineral handling systems, haulage and winding calculations | | **CO1, CO2, CO3** | 1.5 |
| Introduction to the application of robotics in mines, remote controlled and man-less mining. | | **CO1, CO2, CO3** | 1.5 |
| Database systems: Overview of file organization - sequential, direct, indexed, hashed, inverted; introduction to RDBMS; use of DBASE and Microsoft Access. Mine management Information Systems, Inventory management application | | **CO1, CO3, CO4** | 2 |
| Expert systems: concept and applications in mining. Artificial Intelligence Programming. | | **CO1, CO3** | 1.5 |
| Computer applications to mine environment, computer aided blast applications. | | **CO1, CO3, CO4** | 2 |

| **4.** | **Textbooks** |
|---|---|

i) Nguyen H., Bui X. and Zhang W., 2024. Applications of Artificial Intelligence in Mining and Geotechnical Engineering. Elsevier.

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

ii) SURPAC Software Manual

iii) Operation Research Application by Kulkarni

i) DBASE Handbook

ii) CAD Manuals

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |
| CO2 | 2 | 1 | 3 | 3 | 2 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL403 Mine Management** | | |
| **Course Type:** | DE | | |
| **Name of the programme(s):** | B.Tech | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| The students are made conversant with management, organization, structures, personnel management and managerial behaviours. This would be very much essential for their duties as of manager which they have to perform in future. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | To know managerial aspects of mines and its organization and structures. |
| **CO2** | To understand the fundamentals of principles of management. |
| **CO3** | Application of management principles in mining industries. |
| **CO4** | To study the behaviour science, industrial psychology and motivations etc human aspects. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | **Introduction**: Evolution of management, theory and practice, principles of scientific management; elements of management functions - planning, organization, staffing and controlling organization; structuring organization for mining enterprises. | **CO1** | 2.5 |
| | **Personnel Management**: Selection, training and development of human resource; job evaluation and performance appraisal, and incentives, standard of performance. Manpower planning for mines. Communication: types and its importance, two-way personal communications; transmission of facts and feelings; directing and disciplining Leadership: study of traditional leader behaviors - autocratic, democratic and Laissez-Faire behaviour; Behavioural | **CO2** | 2 |
| | **Sciences for Management**: Human needs, theory of motivation and organization design; conflicts in organization, sources of conflicts, dealing with conflicts, organizing for conflict resolution, conflict and growth; individual motivation; behavioral view of controlling; Group and individual behavior. | **CO2** | 2 |
| | **Industrial Psychology Industrial Relations**: Definitions, objectives and applications; Industrial disputes - definitions and causes; industrial discipline, grievance causes, and grievance procedure; trade union movement, trade unions collective bargaining; adjudication - adjudicating authorities and their subject matters: workers' participation in management. | **CO4** | 1.5 |
| | **Materials Management**: Introduction; purchase and stores management; Inventory Management: Introduction; components, scope and limitations; nature of inventory; classical E. O. Q. model; E. O. Q. model with quantity discount; an E. O. Q. problem with safety stock; inventory optimization, Office management. | **CO3** | 2 |

| **4.** | **Textbooks** |
|---|---|


i) Business Administration and Management, S.C. Saxsena, Sahitya Bhavan Agra, 1995
ii) Management Theory and Practices, B.S. Moshal, GPC publication New Delhi
iii) Personnel Management and Industrial Psychology, Verma and Agarwal, Educational Publishers
iv) Principles of Management by Kulkarni and Chopde

| 5. | Reference Book(s) and Other Required Material |
|---|---|

i) Industrial Engineering and Production Management, M. Mahajan, Dhanpat Rai company.
ii) Finance for Mine Management by Sloan
iii) Production Management by William Stevenson, Richard publication, 1982

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 0 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 0 | 2 | 3 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

| | | | |
|---|---|---|---|
| **Course Code & Course Title:** | **MNL534 GROUTING TECHNOLOGY** | | |
| **Course Type:** | DE **(HONOURS - 5)** | | |
| **Name of the programme(s):** | M.Tech (Excavation & Tunnel Engineering) | | |
| **L – T – P** | 3-0-0 | **No. of Credits** | 3 |
| **Pre-requisites: Course Code(s) & Name(s)** | NIL | | |
| **Course Equivalence: Course Code(s) & Name(s)** | NIL | | |

| **1.** | **Course Objectives:** |
|---|---|
| To make student conversant about application of different types of grouts and its properties used excavation. | |

| **2.** | **Course Outcomes (Min. 3 & Max. 5):** |
|---|---|
| **CO1** | Students will understand the principles, viscosity, thixotropy, and types of grouts used in rock and soil strengthening. |
| **CO2** | Students will apply various grouting injection techniques and assess grout quality and setting durability. |
| **CO3** | Students will be able to select grouting equipment and design grouting based on geological site investigations. |
| **CO4** | Students will evaluate compaction and remediation grouting practices and testing methods. |

| **3.** | **Detailed Description of the Course** | | |
|---|---|---|---|
| | **Topics** | **CO(s) Addressed** | **Duration in weeks** |
| | Grouting Principles & Types: Principles, purpose and application of grouting, viscosity and thixotropy of grout, flow of grout in cracks, pressures for grouting, utility for control of water movement, strengthening of both soil and rock, and structural applications. Grouts: Types of grout cement, chemical, cellular grout, silica fume modified grouts and microfine cement. | **CO1** | 3 |
| | Grouting Techniques & Assessment: Grouting techniques: injection techniques, jet, displacement, and permeation. Mix preparation, grout quality. Procedure of grouting assessment during and after grouting, Water testing in grout holes, Monitoring and control methods. Grouting in surface and sub- surface excavations. | **CO2** | 4 |
| | Equipment & Design: Grouting equipment: drilling and grouting equipment, grouting mixers, agitators, pumps, valves, pressure gauges, fittings on grout holes, grouting arrangement. Site investigation, geology, permeability and grouting design Grouting in stressed rock, computer aided grouting. | **CO2** | 3 |
| | Compaction & Remediation: Compaction, Remediation, and Testing of grout: field and laboratory studies related to grouting materials, Grouting verification methods and related technologies. Compaction grouting: mechanisms; theories, practice; effect of fines in compaction grouts. Remediation grouting: mine subsidence, cement grouting of dam joints. | **CO4** | 4 |

| **4.** | **Textbooks** |
|---|---|

i) C. Houlsby; Construction and Design of Cement Grouting: A Guide to Grouting in Rock Foundations (April 1990) John Wiley & Sons (Sd); ISBN: 0471516295

ii) Robert Bowen, Grouting in Engineering Practice

| **5.** | **Reference Book(s) and Other Required Material** |
|---|---|

i) Ground Treatment: Design and Installation, by John H. Long & Colin Jenkins, ICE Publishing.

| 6. | Evaluation Details: [Refer Table No. 5 of Academic Ordinances, Rules and Regulations] |
|---|---|

| Code | Type | Structure L+T+P | Credits | Evaluation Weightage (%) | |
|---|---|---|---|---|---|
| | | | | Method | Range |
| L | Lecture | 3-0-0 | 3 | Mid Semester Exam. | 20-30 |
| | | | | Teacher Defined Assessment | 20 |
| | | | | End Semester Exam. | 50-60 |

| 7. | Relationship of Course Outcomes to Program Outcomes: |
|---|---|

***Mapping with POs***

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 |

*High - 3; Medium – 2; Low – 1;*

| 8. | List of Indicative Laboratory Experiment (if applicable): |
|---|---|

**NIL**