Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
241MN015	Mine Water Pollution & Control	IC			2	2	50	50	100	-
241MN016	Mine Automation	IC			1	1	100	-	100	-
241MN017	Mine Planning	AC			2	2	50	50	100	-
241MN018	Mine Automation & Virtual Reality	AC			2	2	50	50	100	-
241MN019	Software Applications in Mining Engineering	AC			2	2	50	50	100	-
Total					**9**	**9**				

Mine Water Pollution & Control

	L	T	P	C
Course Code: 241MN015	**0**	**0**	**2**	**2**

Course Outcomes:

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

CO1: Describe the composition of various water samples
CO2: Measure pH and electrical conductivity of mine water samples
CO3: Determine acidity and alkalinity of a water sample
CO4: Analyse Total hardness of a water sample
CO5: Determine Na, K and Ca ions in a water sample

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. Determination of DO and BOD of a water sample.
2. Determination of pH and conductivity of a water sample.
3. Determination of acidity and alkalinity of a water sample.
4. Determination of Total Suspended Solids (TSS).
5. Assessment of Total Dissolved Solids (TDS).
6. Determination of Turbidity of a water sample.
7. Determination of COD of a water sample.
8. Determination of Total hardness of a water sample.
9. Determination of Carbonate hardness of a water sample.
10. Determination of Ultimate BOD.
11. Detection of Acid Mine Drainage (AMD) Parameters.

Additional Practice:

1. Determination of sulphate concentration in water.
2. Determination of Na, K and Ca ions in a water sample using flame photometer.

Text Books:

1. Standard Methods for the Examination of Water and Wastewater, Eugene W. Rice, Rodger B. Baird, American Public Health Association (APHA), 23rd Edition, 2022. ISBN Number: 978-0875532993.
2. Environmental Chemistry, Stanley E. Manahan, CRC Press, 10th Edition, ISBN: 978-1498776949.

Reference Books:

1. Water Quality & Treatment: A Handbook on Drinking Water, American Water Works Association (AWWA), McGraw-Hill Education, 6th Edition, ISBN: 978-0071630115.
2. Water Quality Assessments: A Guide to Use of Biota, Sediments and Water in Environmental Monitoring, Deborah V. Chapman, E & FN Spon (an imprint of Chapman & Hall), 2nd Edition, ISBN: 978-0419215905.

Web Links:

1. https://www.whitman.edu/chemistry/edusolns_software/BODBackground.pdf
2. https://www.ijnrd.org/papers/IJNRD2208157.pdf

Mine Automation

	L	T	P	C
Course Code: 241MN016	**0**	**0**	**1**	**1**

Course Outcomes:

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

- **CO1:** Apply the Principles and Strategies of Automation and enhancement of Productivity
- **CO2:** Classify Essential Elements of an Automated System
- **CO3:** Apply Automated Communication and Tracking Technologies: Image Processing
- **CO4:** Apply Mine Safety Applications, Mining operation simulations
- **CO5:** Analyze Virtual Reality Applications

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. Introduction to Automation, Principles and Strategies of Automation and enhancement of Productivity.
2. Essential Elements of an Automated System.
3. Autonomous Mining System I: Autonomous Haulage Systems.
4. Autonomous Mining System II: Automated Drilling System.
5. Autonomous Mining System III: Fleet Management System: TDS.
6. Mine Robotics: Mining Remote Operations & Control.
7. Radar Systems, RFID in Mining Engineering.
8. Geo-fencing, CCD camera in Mining for safety and management.
9. Global Navigational Satellite System in Mining production planning and efficient control of the machine.
10. Automated Communication and Tracking Technologies: Image Processing.
11. Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations – Part 1.

Additional Practice:

1. Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations – Part 2.
2. Virtual Reality Applications: Mining Equipment Concept development, Mine Safety

Applications, Mining operation simulations – Part 3.

Text Books:

1. The elements of statistical learning, Hastie, Trevor, et al. Springer, New York, Vol. 2. ISBN: 978-0387848570.
2. Applied statistics and probability for engineers. Montgomery, Douglas C., and George C. Runger, John Wiley & Sons. ISBN: 978-1119723456.

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Reference Books:

1. Mine Mechanization & Automation, G. Almgren, U. Kumar, N. Vagenas, 1st Edition. ISBN: 978-1402075355.
2. Automation in Mining, Mineral and Metal Processing, J. O'Shea M. Polis, Proceedings of The 3rd Ifac Symposium, Montreal, Canada. ISBN: 978-0080261645.
3. A General Introduction to Data Analytics, Joao Moreira, Andre Carvalho, Tomás Horvath, Wiley, 2019. ISBN: 978-1119467168.

Web Links:

1. https://www.identecsolutions.com/news/rfid-in-mining
2. https://www.unoosa.org/documents/pdf/icg/ISWI/IJSWS12-326.pdf

Mine Planning

	L	T	P	C
Course Code: 241MN017	**0**	**0**	**2**	**2**

Course Outcomes:

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

CO1: Apply Traditional Approaches to Reserve Estimation and Tonnage Factor
CO2: Determine Average Grade of Ore in Vertical and Horizontal Sections
CO3: Implement Advanced Weighting Techniques for Grade Estimation
CO4: Determine Lease Boundaries Using Bearings, Distance, and Coordinates
CO5: Create and Utilize a Geological Database for Drill Hole Data

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	-	-	-	-	-	1	1	1
CO2	3	-	2	-	-	-	-	-	1	1	1
CO3	-	3	2	-	-	-	-	-	1	1	1
CO4	-	3	2	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. Traditional Approaches to Reserve Estimation Tonnage factor.
2. Determination of average grade of ore in a vertical section.
3. Determination of average grade of ore in a horizontal section- Triangular method.
4. Determination of average grade of ore in a horizontal section- Polygonal method.
5. Constant distance weighting technique.
6. Determination of average grade of ore in a horizontal section- Inverse distance weighting technique.
7. Determination lease boundaries using bearings and distance.
8. Determination of lease boundaries using co-ordinates.
9. Creation of Geological Data Base.
10. Generation and displaying of drill holes.

Additional Practice:

1. Creation of 3-D Block Model.
2. Calculation of volume and tonnage using string file.

Text Books:

1. Introductory Mining Engineering, Howard L. Hartman and Jan M. Mutmansky, John Wiley & Sons, 2nd Edition, ISBN: 978-0471348511.

2. Ore Reserve Estimation and the Geostatistical Method, M. David, Elsevier Scientific Publishing Company, ISBN: 978-0444415143.

Reference Books:

1. Geological Modelling and Mine Planning with Surpac and Whittle, Sukumar Bandopadhyay, CRC Press (Taylor & Francis Group), 1st Edition, ISBN: 978-1138749927.
2. Surface Mining Technology: Progress and Prospects, Ajoy K. Ghose, CRC Press, Taylor & Francis Group, 1st Edition, 2022, ISBN: 9781032119333.

Web Links:

1. https://geologyhub.com/ore-reserve-estimation-methods/
2. https://www.911metallurgist.com/ore-reserve-estimation-methods/

Mine Automation & Virtual Reality

	L	T	P	C
Course Code: 241MN018	**0**	**0**	**2**	**2**

Course Outcomes:

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

- **CO1:** Apply Psychrometric Principles
- **CO2:** Evaluate Duct Flow Characteristics
- **CO3:** Validate Measurement Instruments
- **CO4:** Calculate Frictional and Drag Coefficients
- **CO5:** Interpret Relationships in Ventilation Systems

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-	-	-	-	-	-	-	1	1
CO2	3	3	-	3	-	-	-	-	-	1	1
CO3	3	3	-	-	-	-	-	-	-	1	1
CO4	3	3	-	-	-	-	-	-	-	1	1
CO5	3	3	-	3	-	-	-	-	-	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	3	-
CO3	2	-
CO4	2	-
CO5	1	-

Practice:

1. Use of Assmann Psychrometer and estimation of Psychrometer properties.
2. Determination of method factor of a duct.
3. Performance Evaluation of Mine Evasee Present in a Ventilation System
4. Calibration of orifice plates.
5. Calibration of Inclined Tube Manometer using Askania Minimeter.
6. Determination of Frictional Co-efficient of Mine Airways.
7. Precise Traversing in a Duct using Pitot Tube.
8. Establishment of the Relationship between Kata Cooling Power and Air Velocity.
9. Determination of Shock Pressure Loss in Presence of Tub and Estimation of Drag coefficient.
10. Fan Rating Test.

Additional Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer.
2. Determination of Air pressure (Mine & Duct) by Pitot tube.

Text Books:

1. Elements of Mining Technology,D. J. Deshmukh, Central Techno Publication, 9th Edition, Vol II. ISBN: 978-8185213197.
2. Mine Environment and Ventilation, G. B. Mishra, Oxford University Press. ISBN: 978-0198088956.

Reference Books:

1. Mine ventilation and air conditioning, Howard L. Hartman. Wiley International. ISBN: 978-0471648557.
2. Environmental Engineering in Mines, Vutukuri& Lama, Cambridge University Press, Cambridge. ISBN: 978-0521476637.
3. Legislation in Indian mines a critical appraisal, Prasad and Rakesh, Vol. I & Vol. II. ISBN: 978-0521476735.

Web Links:

1. https://mv-iitkgp.vlabs.ac.in/exp/pitot-tube/procedure.html
2. https://mv-iitkgp.vlabs.ac.in/exp/ventilation-system/theory.html

Software Applications in Mining Engineering

	L	T	P	C
Semester: 241MN019				
Course Code:	**0**	**0**	**2**	**2**

Course Outcomes:

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

CO1: Describe different mine planning software.
CO2: Explain about DATAMINE software.
CO3: Explian about Surpac software
CO4: Explain about blasting software
CO5: Explain about Mine Design software

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	1	-	-	-	-	1	1	1
CO2	2	3	-	1	-	-	-	-	1	1	1
CO3	2	3	-	1	-	-	-	-	1	1	1
CO4	2	3	-	1	-	-	-	-	1	1	1
CO5	2	3	-	1	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. Introduction to Mine Planning Process and Application of Computer Technology in Mine Planning.
2. Computer Aided Mine Planning and Design Process with SURPAC.
3. To create Geological Database in SURPAC and Import of Geological Data.
4. To visualize the Drill Hole and charge distribution using O-pitblast software.
5. To Predict the surface subsidence over underground coal mining workings using ANSYS.
6. To perform Stress analysis in stability of pillar in coal mines using ANSYS and Flow Fluid.
7. To Study strata support behavior in underground mine using ANSYS.
8. To analyse Slope stability of benches using FLAC/ FLAC 3D software.
9. To optimize blast parameters using O-pitblast software.
10. To determine fragmantation size using FRAGLYST 4.0 software.
11. To prepare LULC maps for mine area.

Additional Practice:

12. To prepare NDVI maps for mining area.
13. To design mine plan using DATAMINE.

14. To analyse Slope stability of benches using GALENA.

Text Books:

1. Open Pit Mine Planning & Design, W. Hustrulid and M. Kuchta. ISBN: 978-0415403455.
2. Application of the Computers and Operation Research in the Mineral Industry, Bandopadhyay, S. SME Publication , Proceedings of the 30th international Symposium. ISBN: 978-0873352224.

Reference Books:

1. Computers in Mineral Industry, Mozumdar, B.K., Ramani, R.V. and Samaddar, A.B, CRC Press, 1st Edition. ISBN: 978-0849301650.
2. Tutorials on mine planning software SURPAC, Minex, Datamine.

Web Links:

1. https://www.researchgate.net/publication/341793185_Manual_National_Land_Use_Land_Cover_Mapping_using_Multi-temporal_Satellite_Data
2. https://support.esri.com/en-us/knowledge-base/how-to-create-an-ndvi-map-in-arcgis-pro-000030690
3. https://downloads.o-pitblast.com/files/manual/O-Pitblast%20Manual%20v.3.0.pdf