JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF MINING ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B. TECH MINING ENGINEERING

(Applicable for batches admitted from 2019-2020)

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IV Year – I Semester

S.No.	Category	Subjects	L	T	P	Credits
1	PCC	Computer Applications in Mining	3	--	--	3
2	PCC	Mine Planning and Design	3	--	--	3
3	PCC	Mine Legislation & General Safety	3	--	--	3
4	PEC-I	**Professional ELECTIVE Course** –I 1. Rocks slope Engineering 2. Mine Subsidence Engineering 3. Mine systems engineering	3	--	--	3
5	MC	IPR & Patents	--	2	--	--
6	PCC	Computer Applications in Mining Lab	--	--	2	1.5
7	PCC	Mine Planning and Design Lab	--	--	2	1.5
8	PCC	Survey Camp (One Week)	--	--	--	2
9	PCC	Mini Project	3	--	--	2
		Total Credits				**19**

IV Year – II Semester

S.No	Category	Subjects	L	T	P	Credits
1	PCC	Mine Economics & Investment	3	--	--	3
2	PCC	Numerical Modeling in Mining	3	--	--	3
3	PEC-II	**Professional ELECTIVE Course II** **1.**Planning of Underground Metal Mining Projects **2.**Long wall mining **3.**Planning of Surface Mining Projects	3	--	--	3
4	PCC	Seminar and Technical Writing	--	--	3	2
5	PCC	Major project	--	--	4	8
		Total Credits				**19**

- *BSC –Basic Science Course*
- *ESC – Engineering Science Course*
- *OEC- I – Open Elective (Offered by Civil branch)*
- *OEC- II – Open Elective (Offered by CSE branch)*
- *PEC - Professional ELECTIVE Course*
- *PCC - Professional Core Course*
- *HS – Humanities Science*
- *MC – Mandatory Course*

Total Course Credits =40+41+ 41+ 38= 160

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IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COMPUTER APPLICATIONS IN MINING					

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Course Objectives: To introduce the concepts on computer basics and its applications on mining industry. It covers the the application of geo-statistical methods in sampling, reserve estimation, computation of grade-tonnage curves, production scheduling simulation and modeling of mine structures using simulation language.

UNIT-I

Introduction to structure terminology and peripherals, algorithms, flow charts, programs, dedicated systems. application in mining.

UNIT-II

Exploration, rocket topographic models, bore hole compositing, ore reserve calculation, interpolation, geostatical models, open pit design, ultimate pit design, introductory process control, underground mine design.

UNIT-III

Production scheduling: Operational simulation: Introduction, simulation overview, objective, understand the role of modeling. Understanding the basic concept in simulation, example of simulation in mining aspects, simulation of machine repair problem.

UNIT-IV

concept of variability and prediction, example with dumping time problem, fitting distribution with chi-square test, random number generation, properties of random number, pseudorandom number, random variants generation.

methods of random variants generation, inverse transform method, acceptance rejection method, composition method, empirical method and rectangular approximation

UNIT-V

simulation languages, GPPS and SLAM, logical flow diagram of different milling activities, coding with GPSS and SLAM of different mining problems. Computer control, remote control, automatic, applications and limitations of control

Course Outcomes:

Basic knowledge of computer applications is essential in the mineral industry as most of the software were already commercially available to meet different application areas of mining (opencast, underground methods). These software proven to be very effective and hence basic knowledge of computer and exposure to developments of computational skills to handle mining software is

essential to be accepted by the industry. Application areas include rock engineering, mine design, slope stability, mining geo-statistics, financial analysis, valuation, risk analysis, feasibility etc.

TEXT BOOKS:

1. T.C.Bartee, digital computer fundamental, Mc Graw Hill, 4th edition 1984.

2. P.Malvino and D.P.leach digital principals and applications Mc Graw Hill 5th edition 1994.

REFERENCE BOOKS:

1.R.V. Ramani, application of computer methods in the mineral industry,published by society of mining engineers of AMIE,newyork city ,U.S.A, 1977.

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MINE PLANNING AND DESIGN

Course Objectives: To study the planning aspects of production, scheduling and monitoring of openpit and underground mining for extraction of coal and other mineral deposits.

UNIT – I

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

UNIT – II

Open Pit Mining**:** Selection of initial mine cuts, location of surface structures, division of mining area into blocks, mine design, bench drainage, geometry, haul roads, slope stability; open pit limit sand optimisation, calendar plan, production planning, production scheduling, economic productivity indices.

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Course Outcomes: Students will be able to plan open cast and undergrtound mines for given conditions of production ,selection of machinery etc., with reference to geo mining parameters.

TEXT BOOKS:

1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.

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2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995.

REFERENCE BOOKS:

3. Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.
4. Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier,1993.
5. Passamehtoglu, A.G., Karpuz, C., Eskikaya, S. and Hizal, T., (Eds), Mine Planning and Equipment Selection, Elsevier, 1994.
6. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.
7. Swilski, and Richards, Underground Hard Coal Mines, Elsevier, 1986. Singh, B. and Pal Roy, P., Blasting in Underground excavations and mines, CMR Dhanbad, 1993.

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		3	**0**	**0**	**3**
MINE LEGISLATION & GENERAL SAFETY					

Course Objectives: It is very important to all mining engineering students because, it provides an insight to various laws, rules and Acts related to Mines Safety and mining legislation. A separate paper on the above subject is one of the requirements for the DGMS certification for qualifying in the exam of Mines Manager.

UNIT – I
General principles of mining laws, mines & Minerals (Regulation & Development), Act.

UNIT – II
Mineral concession rules, principle provision of mine act. Rules & regulation framed there under (CMR - 1957, MMR - 1961)

UNIT – III
Indian Electricity rule, Mine rescue rule, industrial dispute Act.

UNIT – IV
V-T rules, Pit Head Bath Rules, DGMS circular.

UNIT – V
Coal mines regulations and metalliferous mines regulations

Introduction to rescue rules, vocational training rules, maternity benefit act and rules. Causes & Classification of Accidents, accidents statistics, Accidents investigation & Reports.

Course Outcomes:
The student will be benefitted with this course paper as it covers all the mining legislation and statutory Ruls, Acts and amendments made from time to time. This paper is one of the qualifying papers for DGMS exams.

TEXT BOOKS:
1. Mine Act - 52 by B. K. Kejriwal
2. DGMS Circulars

REFERENCE BOOKS:
3. Mines Act, Mine regulations, Mine rules Govt. of India Publication
4. Legislation In Indian Mines - Critical Appraisal by Prasad & Rakesh

IV Year - I Semester		**L**	**T**	**P**	**C**

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		3	**0**	**0**	**3**

(PROFESSIONAL ELECTIVE COURSE- I)
ROCK SLOPE ENGINEERING

Course Objectives: To introduce the basic mechanics of rock slope failures To learn the types of rock failure and its influencing parameters

UNIT I Basic mechanics of rock slope failure**:**
Rock slope economics; continuum mechanics approach to slope stability; slope parameters; effect of water pressure;factor of safety of slopes;slope heightvs slopeangle;designof slopes.

UNIT II Geologicaland rock strength properties:
Geological parametersaffecting slope stability; graphical representation of geological data; plotting and analysis of field measurements; physico-mechanicalproperties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.

UNIT III
Planefailure:
Plane failure analysis; graphical analysis of stability; influence of ground water on stability; influence of tension crack; analysis of failure on a rough plane; rock reinforcement of slopes;

Wedge failure:
Analysis of wedge failure; wedge analysis including cohesion and water pressure; Wedge stability charts for friction only; case studies. Numerical problems.

UNIT IV Circula and toppling failure:
Conditions for circular failure; derivation of circular failure analysis; effect of ground water; circularfailurecharts;Bishop'sandJanbu'smethodsoffailureanalysis;casestudies. Types oftopplingfailure;secondarytoppling modes;analysisoftopplingfailure;limitequilibriumanalysisof topplingfailures;Influenceof slopecurvatureon stability; slopedepressurisation;protection of slopes; control of rock falls; measurement and monitoring and interpretation of slope displacements. Numerical problems.

UNIT V Rock slope failure monitoring and slope stabilization:
Types of slope movement, Surface and Sub-surface monitoring methods inclusing instrumentation and techniques & Guidelines for monitoring programs. Causes of rock falls; Rock slope stabilization programs – stabilization by rock reinforcement & rock removal; protection measures against rock falls.

Course Outcome:

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The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters

TEXT BOOKS:

1. Hoek,EandBray,J.W.,RockSlopeEngineering,InstitutionofMiningandMetallurgy, 1991.
2. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989.
3. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction,A.A. Balkema, Netherlands, 2006.

REFERENCE BOOKS:

1. Duncan C. Wylie and Chris Mah, Rock Slope Engineering, 4th Edition, 4th Edition, CRC Press, 456p, 2004.
2. John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1st Edition, CRC Press, 510p, 2009.
3. William A. Hustrulid(Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Slope stability in Surface Mining, Society for Mining, Metallurgy, and Exploration, 442p, 2001.
4. John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4th Edition, Wiley-Blackwell; 4 edition, 488p, 2007.

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		3	0	0	3
(PROFESSIONAL ELECTIVE COURSE- I) **MINE SUBSIDENCE ENGINEERING**					

Course Objectives: The mine subsidence is a common phenomena in any underground coal mining operations. The subsidence prediction, causes and analysis and preventive measures to be taken form an important role in coal mining operations. The subsidence impact on surface structures, governing laws to subsidence control, instrumentation and monitoring techniques and to minimize such effects need to be emphasized.

UNIT-I

Introduction: strata movement at the mining horizon, convergence in mine working, factors influencing convergence in mine working. subsidence mechanism; Zones of movement in the ovelying beds, veritical and horizontal movements, subsidence trough, angle of draw, angle of break sub-surface subsidence.

UNIT-II

subsidence prediction: different methods of surface subsidence prediction - graphical, analytical, profile function, empirical and theoretical models.

UNIT-III

Time influence and impact on structures: Influence of item on subsidence, example from long wall and bord and pillar working.

Mining damage to building, industrial installations, railway lines, pipes cannels, etc.,

UNIT-IV

calculation of ground movement over time. types of stress on structures stress-strain behavior of soils. Different standards suggested for mining and ground in respect of subsidence.

UNIT-V

Time influence and impact on structures: influence of item on subsidence, examplr from long wall and board and pillar working.

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Course Outcomes:

The subsidence of mined out areas. The mechanism of failure of strata after creating the voids and filling the mine voids with different materials need to be addressed to monitor the ground movement.

TEXT BOOKS:

1. Kratzsch, H.Miningsusnsidence Engineering, Sringervertag publications, Berlin,1983

2. Whittakerm B.N. and Raddish, D.J.Subsudebce, occurrence, prediction and contolElsvier publication amsterdam, 1989.

REFERENCE BOOKS:

1. Mining subsidence engineering, by Kratzsch, published by Nedra of Moscow,1978
2. Brauner, G.Subsidence due to underground Mining, Part I & II and III U.S. Department of Interior, Bureau of Mines, 1973

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IV Year - I Semester		L	T	P	C
		3	0	0	3
(PROFESSIONAL ELECTIVE COURSE- I) **MINE SYSTEMS ENGINEERING**					

Course Objectives:
The objective of this subject is to provide knowledge of solving the models for their optimal solutions.

UNIT -I: Introduction
Introduction to optimization techniques, Introduction to linear programming, problem formulations, graphical solutions, unboundedness, infusibility, unique solution, multiple solutions. Mining examples

UNIT -II:
Simplex method with different combinations of constraints, Big M method, Duality of linear programming, importance of dual problems, interpretations of solutions of primal from dual

UNIT -III: Transportation Problem
A: Formulation–Optimal solution, unbalanced transportation problem–Degeneracy, variants in assignment problems, mining examples.
B: Assignment problem – Formulation – Optimal solution - Mining examples

UNIT -IV: Inventory and Waiting line
Importance of Inventory, Introduction to inventory, basic assumptions in EOQ model, EOQ (Economic Order Quantity). Introduction to waiting line theory, basic assumptions in waiting line, determination of waiting time in quee, waiting time in system, Single channel quee systems – arrivals Poisson distributed, service time exponential distribution

UNIT-V:
Introduction to CPM, Importance of CPM, Determination of Early start times, Early finish times, Latest finish times, Critical path, Project duration, Crashing of a network, Importance of PERT, Probability of project completion time, Assumptions in PERT

Course Outcomes: students can optimize the production through implementation of various models such as CPM, PERT etc., for extraction of minerals.

TEXT BOOKS:
1. Introduction to O.R /Taha/PHI Publishers
2. Operations Research / S.D.Sharma/Kedarnath Publisher
REFERENCE BOOKS:
1. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
2. Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan& Lawrence Friedman/ Literary Licensing
3. Operations Research / R.Pannerselvam,PHI Publications.

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IV Year - I Semester		L	T	P	C
		0	2	0	0
IPR & PATENTS					

Course Objectives:

- To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines
- Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments

Course Outcomes:

- IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents
- Student get an insight on Copyrights, Patents and Software patents which are instrumental for further advancements

UNIT I

Introduction to Intellectual Property Rights (IPR): Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

UNIT II

Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations

UNIT IV

Trademarks: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities
Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

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UNIT V

Trade Secrets & Cyber Law and Cyber Crime: Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets –
Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.
Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions – E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

TEXTBOOKS:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.

REFERENCE BOOKS:

1. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
2. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
3. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
4. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
5. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
6. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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IV Year - I Semester		L	T	P	C
		0	0	2	1.5
COMPUTER APPLICATION IN MINING LABORATORY					

Course Objectives: Providing basic introduction on CAD applications, with reference to generation of basic CAD drawings for mine planning. Different types of drawing commands, editing, query based commands, for the preparation of CAD graphics.

Part-A

1. Learning of the following commands using a CAD package.
2. Drawing Commands: Line, arc, circle; polygon, Donut, Solid, Spline Pline, Text, M Line, ellipse, dimensioning, object snaps point, Hatch, layers, Units.
3. Editing Commands: Limits, Erase, Array, Copy, Move, Offset, Stretch, Pedit, change properties, Trim, Extend, Fillet, Chamfer, Break, Mirror, Scale, Rotate, Zoom, Pan. Enquiry Commands: Id, list, Dist, Area, DB list, Status Selection sets i.e. window, crossing, fence, W polygon. Plotting.

Part-B

8 exercises (mining drawing) using any of the above commands.

Course Outcomes: The students will be provided with exposure on CAD graphics, to demonstrate these abilities in the form of CAD mine drawings.

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IV Year - I Semester		L	T	P	C
		0	0	2	1.5
MINE PLANNING AND DESIGN LAB					

Course objectives: Creation and utilization of data base for various studies and applications of the same for planning and design of mining projects.

1. Determination of stripping ratio.
2. Determination of Pit limits.
3. Calculations of powder factor of blasting in open cast & underground mining blasting.
4. Calculation of fleet size for shovel, dumper combination in open cast mine.
5. Estimation/calculation of production in underground mine using, LHD, SDL ,RH, CM, long wall equipments.
6. Ventilation study & Calculation for bord &pillar and long wall panels in underground coal mines.
7. Design of Pillars.
8. Subsidence Predictions.
9. Problems on network analysis for ventilation
10. Slope stability problems.

Course Outcomes: Students can simulate the geomining parameters for planning and design of open cost and underground mines including selection of required machinery and equipment