With effect from the academic year 2021-22

DEPARTMENT OF CIVIL ENGINEERING

Scheme of Instruction

and

Syllabus of

M.E. (CIVIL ENGG)

Specialization: Mining Engineering.

Full Time & PTPG

AICTE Model Curriculum

2021-22

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500007, TS, INDIA.

INSTITUTE

Vision

The Vision of the institute is to generate and disseminate knowledge through harmonious blending of science, engineering and technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate , disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services to the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT

Vision

To be as a leading academic department on pace with global standards and contribute to the development of economic, technically viable and useful to societal problems and challenges of civil engineering profession and also contribute to the regional and country's developmental activities.

Mission

- To train the human resources with knowledge base in the field of Civil Engineering so that they can face the challenges of civil and infrastructural engineering problems to provide viable solutions.
- To integrate their understanding and attainable knowledge on the specializations for effective functioning in their profession and useful to the welfare and safety of mankind.
- To enhance the technical knowledge and research aptitude in the domains of various Civil Engineering specializations to serve the society in highly professional manner.
- Produce highly competent and capable professionals and motivated young academicians to provide solutions to real life problems of Engineering and Technology and has apt for continuous learning and dedication towards societal issues.

Programme Educational Objectives (PEO):

1. Impart and enrich knowledge in the fields of mining and earth resources engineering by the application of sound engineering principles
2. Exposure to the state-of-art techniques / knowledge of modeling techniques in to be adopted for different Mining Engineering Problems
3. Facilitate the policy makers and administrators to solve issues pertaining to regional Development using Mining Resources
4. Provide continuing education in the entire value chain of the profession starting from exploration to beneficiation of mineral deposits in a coordinated manner

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Programme Outcomes (PO):

1. Students will be able to solve the mining engineering problems by application of knowledge of basic sciences, engineering, geo-technology, economics, environment & management.
2. Graduates will have the technical skill to design mine excavations and conduct mining operations under a variety of geo-mining environments.
3. Achieve all round optimization of various unit operations of mining, ranging from exploration to beneficiation.
4. Analyze and evaluate the techno-economic feasibility of mining projects and deep understanding of economic and environmental implications of mine design and operations.
5. Students will be fully equipped with skills and knowledge related to mine management, optimization techniques with multi-disciplinary skills for achieving sustainable development of mineral industry.
6. Students shall have in depth knowledge in the entire value chain of the profession starting from exploration to beneficiation of mineral deposits in a coordinated manner

MAPPING OF PEO'S WITH PO'S

PROGRAMME EDUCATIONAL OBJECTIVES	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6

M. E. CIVIL (MINING ENGINEERING)

Type of course	Course Code	Course Name	Contact hours per week			Scheme of Examination		Credits
			L	T	P	CIE	SEE	
SEMESTER-I								
Core-I	MI 101	Surface Mine Planning and Design	3			30	70	3
Core-II	MI 102	Rock Mechanics and Ground Control	3			30	70	3
Program Elective-I	MI 103	Geo-Statistics	3			30	70	3
	MI 104	Advanced Exploration Techniques						
	MI 105	Advanced Metal Mining And Mechanization						
Program Elective-II	MI 106	Geo-Environmental Engineering	3			30	70	3
	MI 116	Instrumentation in Mining						
	MI 108	Hydraulics and Hydraulic Equipment in Mining						
Audit-I	AC 131	Disaster Mitigation and Management	2			30	70	2
	AC 031	English for Research Paper Writing						
	AC 033	Sanskrit for Technical Knowledge						
	AC 034	Value Education						
MC	CE 100	Research Methodology in Civil Engg.	3			30	70	3
Lab-I	MI 121	Computer Applications in Mining	2			50		1.5
Lab-II	MI 110	Advanced Mining Geology Laboratory	2			50		1.5
		Total	**21**			**280**	**420**	**20**
SEMESTER-II								
Core-III	MI 111	Numerical Modelling in Mining	3			30	70	3
Core-IV	MI 112	Rock Excavation Engineering	3			30	70	3
Program Elective-III	MI 113	Surface Mine Environmental Engineering	3			30	70	3
	MI 114	Modern Surveying Techniques						
	MI 115	Sustainable Mineral Industry						
Program Elective-IV	MI 107	Mine Economics and Investment	3			30	70	3
	MI 117	Underground Excavation Equipment						
	MI 118	Finite Element Analysis						
	CE 311	Ground Improvement Techniques						
Audit-II	AC 035	Stress Management by Yoga	2	1		30	70	0
	AC 036	Personality Development						
	AC 037	Constitution of India						
	AC038	Pedagogy Studies						
Core-V/ MC	MI 119	Mini Project			6	50		3
Lab-III	MI 120	Geo-Technical Engineering Laboratory			3	50		1.5
Seminar	MI 109	Seminar			3	50		1.5
		Total	**14**	**1**	**12**	**300**	**350**	**18**
SEMESTER-III								
Program Elective-V	MI 121	Blasting Technology in Rock Excavation	3			30	70	3
	MI 122	Mine Systems Engineering						
	MI 123	Advanced Metal Mining And Mechanization						

Type of course	**Course Code**	**Course Name**	**Contact hours per week**			**Scheme of Examination**		**Credits**
Open Elective	OE 941	Business Analytics	3			30	70	3
	OE 942	Industrial Safety						
	OE 943	Operational Research						
	OE 944	Cost Management of Engineering Projects						
	OE 945	Composite Materials						
	OE946	Waste to Energy						
	OE 947	Internet of Things						
	OE 948	Cyber Security						
Project	MI 125	Major Project Phase-I	6		20	100		10
		Total	**12**		**20**	**160**	**140**	**16**
SEMESTER-IV								
Project	MI 126	Major Project Phase-II			32		200	16
		Grand Total						68

CIE: Continuous Internal Evaluation SEE: Semester End Examination

MI 101

SURFACE MINE PLANNING & DESIGN

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

To learn the advancement of surface mining method.

Course Objectives:

- To introduce the various techniques for mine planning,
- geotechnical investigation and equipment management.
- To appreciate the modern trends in opencast mines, safety and environment

Course Outcomes:

1. The students will have insight about the advanced techniques for mine planning,
2. Geotechnical investigation and equipment management
3. Understand the modern trends in opencast mines safety and environment.

UNIT I

PLANNING **10**

Mine development phases, quality control and conservation. Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system, design of sumps and pumping systems and drainage. Feasibility Report - Contents and preparation. Introduction: Stages/Phases of mine life; Preliminary evaluation of surface mining prospects; Mine planning and its importance; Mining revenues and costs, and their estimation; Mine planning components, planning steps and planning inputs. Pit Planning: Development of economic block model; Pit Cut-off grade and its estimation; floating cone technique, Lerchs-Grossmann algorithm methods.

Production planning: Neccesity of Production Planning, new trends in Production planning, Determination of optimum mine size and Taylor's mine life rule; Introduction to production scheduling.

EQUIPMENT MANAGEMENT

Selection of mining system vis-à-vis equipment system. Machine availability, productivity, maintenance, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT II

GEOTECHNICAL PARAMETERS **7**

Application of geotechnical investigation for design of ultimate pit slope and other design parameter, slope failure, types of slope failure, factors effecting slope failures. Selection of initial mine cuts, location of surface structures, division of mining area into blocks, mine design, bench drainage, geometry, slope stability; open pit limits and optimization, Mine Closure plan and its importance, Mine Closure plan contents.

UNIT III

ANALYSIS AND DESIGN OF HIGHWALL SLOPES AND WASTE DUMPS **8**

Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology.

Design of haul roads: Design of road cross section; Design of road width, curves and gradient; Haul road safety features and their design. Design of drainage system.

UNIT IV

SAFETY AND ENVIRONMENT **10**

Safety aspects in opencast mines regarding height, width and slope of benches, drilling and blasting, fly rock, nearby dwellings, mine illumination, gradient and other aspects of haul roads, formation of spoil dumps, tailings management etc. pollution due to noise, vibrations due to machinery and blasting, water pollution, measurement monitoring and control measures for the same, land reclamation and afforestation, environmental audit.

UNIT V

MODERN TRENDS IN OPENCAST MINES **10**

Recent developments in mining methods and layouts. In pit crushing & conveying, continuous surface mining.

Extraction and dumping. Extraction of seams developed/extracted by underground methods.

Placer mining and solution mining – scope of applicability, sequence of development and machinery.

TOTAL: 45 PERIODS

REFERENCES

1. Surface Mine Planning by R.T Deshmukh
2. Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994
3. Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
4. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990 6. Hustrulid, W. and Kuchta, M., (eds).,
5. Cummings, A.B. and Given, I.V., SME Mining Engg. Hand book Vol.I and II, New York,1994
6. Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995
7. Fundamentals of Open Pit Mine Planning & Design, Elsevier, 1995.

MI 102

ROCK MECHANICS AND GROUND CONTROL

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To study about application of Rock Mechanics, Physico-Mechanical properties of rocks, non-destructive testing methods, time dependent properties of rocks.
- Design of different types of underground supports, etc.
- To study the theories of failure and approaches used for open pit and underground designs.

Course Outcomes:

1. The students will have detailed knowledge on the application of rock mechanics,
2. Design of different types of underground openings and supports.
3. Design, stabilization and monitoring of slopes, theories of subsidence and failure of rocks.

UNIT I
STRESS ANALYSIS **9**

Stress analysis in 2D and 3D, equations of equilibrium, Mohr's Circles, plane stress and plane strain condition, stress distribution in simple structures, Flexure of beams and rectangular plates,

UNIT - II
PROPERTIES OF ROCKS **9**

Physio-mechanical properties of rocks including tri-axial strengths and in-situ strengths and their application in the design of different types of excavations, rock indices viz. drillability index, caving index, etc. Time dependent properties of rocks and their application in structural design, static and dynamic elastic constants of rocks, rock mass classification methods. Selection excavator based on rock properties.

UNIT III
IN-SITU STRESSES AND THEORIES OF FAILURE **9**

In-situ stresses and instrumentation, drilling and blasting, measurement of stresses, strains, deformations, in-situ stress determination, strata monitoring in underground and opencast mines, mechanics a of drilling and blasting, blast vibration and its monitoring. Different theories of rock failure and their applications in design of mining structures.

UNIT IV **9**
DESIGN OF UNDERGROUND OPENINGS, SUBSIDENCE, ROCK BURST AND SLOPE STABILITY

Design of single and multiple underground openings, pillars including shaft pillar, scaling factors, mining subsidence, rock burst, design of slopes and spoil banks, slope stability in rock & soil and its analysis, slope monitoring and stabilisation techniques. Design of pillars including barrier and shaft pillars.

UNIT V

DESIGN OF MINE SUPPORTS **9**

Advances of mine supports, supports and bord and pillar and longwall workings, rock load assessment, design of different types of supports like conventional and non-conventional supports like shotcrete, fibre reinforced shotcrete, strata grouting, rock bolting, supports in tunnels and shafts.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley and Sons Inc., New York, 1967.
2. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78.
3. Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.

REFERENCES:

1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
2. Hoek, E., and Brown, S.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.
3. Jumkis, A.R. Rock Mechanics, Transtech Publications, Berlin, 1983.
4. Stacey, T.R. and Page, C.H., Practical Handbook for Underground Rock Mechanics, Transtech Publications, Berlin, 1986.
5. Whittaker, B.N. and Reddish, D.J., Subsidence – Occurrence, Prediction and Control – Elsevier Science Publishers, the Netherlands, 1989.

MI 103

GEO-STATISTICS
(Program Elective-I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To study various Geo-statistics techniques and their applications to mineral industry

Course Outcomes:

1. Students know about – Statistics- Theoretical models of Statistical distributions, viz. Normal (Gaussian), Lognormal, Binomial, Negative Binomial, Exponential and Poisson and their applications in resource evaluation; characteristics and properties of normal and geostatistics, various sampling methods, details about advanced geostatisticsand geo-statistical applications in the industry.

UNIT - I
STATISTICS **9**

Theoretical models of Statistical distributions, viz. Normal (Gaussian), Lognormal, Binomial, Negative Binomial, Exponential and Poisson and their applications in resource evaluation; Characteristics and properties of Normal (Gausian) and Lognormal Probability Distributions, Graphical and Numerical Techniques of Model Fitting, Estimation of Distribution Parameters and their applications in Ore Evaluation. Geostatistical Concepts and Theories: Regionalized Variable Theory, Geostatistical Schools of Thought, viz. American, South African and French; Stationarity assumptions – Strict Stationarity, Second Order Stationarity and Intrinsic Hypothesis.

Overview of Deterministic and Probabilistic models of Estimation; Exploratory data analysis. Classical what, when and why of geo-statistics. Extension, estimation and dispersion variance; calculation by discretisation and auxiliary functions.

UNIT - II
GEOSTATISTICS **9**

Practice of semi-variogram modelling; practice of kriging - steps and procedure. Ordinary Kriging: definition, point/block estimation procedures, techniques of semi-variogram model fitting; Geo-statistical evaluation scheme; Effect of Nugget variance on kriged weights.

Brief capsule on Non-linear and Non-parametric Geo-statistics: Lognormal, Disjunctive and Multi-Gaussian, Indicator and Probability Kriging.

Concepts of Geo-statistics; Semi-variogram: definition, derivation and characteristics and properties. Derivation and solving kriging system of equations for point and block. Geostatistical conditional simulation – Theory and approach, techniques and applications with special reference to Simulated Annealing Simulation. Relation with Co-variogram characteristics; Calculation of Experimental Semi-variograms in One, Two and Three-Dimensions calculation procedures. Computation of semi-variograms; mathematical models of semi-variogram associated difficulties (Models with Sill and without Sill, Nested Models and Trend Models.) viz. anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend.; Techniques of semi-variogram model fit.

UNIT - III

SAMPLING METHODS- 9

Theory and Concepts. Classical Statistical methods: Uni-variate and Bi-variate; Exploratory data analysis. Probability distributions: (i) Continuous distributions, viz. Normal (Gaussian), and Lognormal distributions and their fit to a sample distribution; (ii) discrete distributions, viz. Binomial, Negative binomial and Poisson distributions.

UNIT - IV

ADVANCED GEOSTATISTICS 9

Practical difficulties associated with semi-variography, viz. anisotropy, non-stationarity, regularisation, misclassified tonnage; grade control plan. Presence of nugget effect and presence of trend. Extension, Estimation and Dispersion variances: definitions, methods of calculations and applications; Screen Effect.

UNIT - V

GEO-STATISTICAL APPLICATIONS: 9

Optimisation of exploration drilling, calculation of mineral inventory, establishment of grade-tonnage relations, calculation and planning cut-off grade; misclassified tonnages; geo-statistical grade control plan.

Practical applications of Geo-statistics in geotechnical investigation, hydrocarbon exploration and reservoir modelling with case studies. Geo-statistical case studies of selected mineral deposits.

Text Books:

1. Sarma, D.D. Geostatictics with Applications in Earth Sciences, Springer Publications, 2009.
2. Journel, A.G. and Huijbregts, Ch. J., Mining Geostatictics, Academic Press, 1981.
3. Andereson, F. Geostatictics by Example Approach using R.

MI 104

ADVANCED EXPLORATION TECHNIQUES
(Program Elective-I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Credits: 3

Course Objectives:

- To know the mineral resources and prospecting techniques
- To study the physical properties of earth and application of physics in geology, to understand subsurface features and structures for better understanding of subsurface geology.
- To study the prefeasibility and feasibility reports and its evaluation methods

Course Outcomes:

1. The student will be having thorough knowledge on various geophysical and geochemical prospecting techniques.
2. The students will be able to choose the proper techniques of exploration and estimation of the reserves.
3. They will have knowledge of different mineral processing techniques.
4. They will know about the methods of preparation of feasibility reports and its evaluation techniques.

UNIT I
INTRODUCTION TO MINERAL AND MINING INDUSTRY

Introduction to mineral exploration, mineral resources in India and worldwide. National Mineral Policy, Economic Mineral Deposits, Sampling. Geological Prospecting: field survey and mapping techniques, field equipment, methods of mapping, pits and trenches. Mineral Prospecting: Exploration by Diamond Drilling. Exploration Geology, Regional Planning and Organization, Topographic Survey, Geological Mapping, Stratigraphy Correlation, Exploration Geochemistry, Field Procedure, Analytical Methods, Mineral Exploration - Triangulation, Establishment of Local Base from National Grid Base- - Exploration Strategy, Groups and their role, Strategy and structure of the exploration group, government policies Exploration investment decision, exploration targets.

UNIT II
GEO-PHYSICAL PROSPECTING

Electrical Methods: Scope of exploration geophysics – physical properties of the earth – Electrical methods – SP, IP, EM and Resistivity - methods of electrode arrangement – field methods resistivity, self-potential methods- interpretation -application in mineral prospecting – groundwater targeting, electrical logging methods in oil exploration,

Geophysical Well Logging — Fundamentals of radioactivity, principle of radioactivity, methods – types of counters – field methods and interpretation – Well logging - Self potential – resistivity – 32 radioactivity logging methods – caliper and other miscellaneous logging methods – field procedure and interpretation of data, Radioactivity Methods and Geophysical Well Logging.

Magnetic and Gravity Methods — types of magnetometer-field survey – anomaly - interpretation and prospecting. Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys,

Gravity Methods: Principle – field methods – gravimeters – corrections – interpretation of gravity data – determination of shape and depth of ore bodies — corrections & applications – GRACE

mission - gravity methods- gravimeter-identification of size and shape of bodies-correction of the data application in mineral exploration.

Seismic Methods: Seismic waves – travel velocity in various geological formations – principles – field operation – refraction and reflection survey – correction of seismic data – methods of interpretation – determination of altitude and depth of formations – various types of shooting. interpretation of seismic data- application identification of geological structures-oil fields location.

UNIT III

GEO-CHEMICAL PROSPECTING 10

Geochemistry of Minerals, Rocks and Waters: Mineral stability, compositional changes in minerals. River water, Seawater, Seafloor hydrothermal systems; Groundwater and Lakes. Characteristics of Magma, Melting of rocks, Water in Magmas, eutectic and melting. Distribution of trace components between rocks and melts.

Principles of Geochemistry: Introduction, Geochemistry of the Earth; Formation of the solar system and geochemical history of the earth, geochemical cycle- Distribution of elements in rocks and soils.

Geochemical Prospecting: anomaly- background values- mobility of ions-associated elements-path finder elements-surface indicators - geobotanical methods.

Exploration Geochemistry — Introduction – Primary dispersion pattern, Secondary dispersion pattern – background values. Geochemical anomaly – geochemical sampling. Principles and techniques used in the design and implementation of an exploration geochemical survey. aquatic environment – Marine, fluvial, lacustral, aerosols. Perturbations caused by human activity.

Isotope Geochemistry: Radioactive Decay, Determining Isotope Decay time, Potassium-Argon Systematic, Uranium, Thorium - Lead Systematics. Types of Isotope Fractionation, isotope Exchange between minerals and water, Carbon, Oxygen and Sulphur isotopes, First-order decay and growth equations.

UNIT IV

GEO-STATISTICAL METHODS

Practice of semi-variogram modelling; practice of kriging - steps and procedure. Ordinary Kriging: definition, point/block estimation procedures, techniques of semi-variogram model fitting; Geo-statistical evaluation scheme; Effect of Nugget variance on kriged weights. Brief capsule on Non-linear and Non-parametric Geo-statistics: Lognormal, Disjunctive and MultiGaussian, Indicator and Probability Kriging. Concepts of Geo-statistics; Semi-variogram: definition, derivation and characteristics and properties. Derivation and solving kriging system of equations for point and block. Geostatistical conditional simulation – Theory and approach, techniques and applications with special reference to Simulated Annealing Simulation. Relation with Co-variogram characteristics; Calculation of Experimental Semi-variograms in One, Two and Three- Dimensions calculation procedures. Computation of semi-variograms; mathematical models of semi-variogram associated difficulties (Models with Sill and without Sill, Nested Models and Trend Models.) viz. anisotropy, no stationarities, regularization, presence of nugget effect and presence of trend.; Techniques of semi-variogram model fit

UNIT V

ORE-BODY MODELLING, ORE RESERVE ESTIMATIONAND PREPARATION OF PROJECT REPORTS

Mineral Reserve Estimation: Reserves and Resource, classification of mineral deposits – Geological / Techno economic Considerations in Reserve Classification - Reserve Estimation Methods – Surface and Underground Deposits.

Orebody Modelling: Integrating Surface/ Underground mapping Drilling Sampling to evolve a 3D Model - Fold/Fault Interpretation from Maps and Bore hole Data - GIS Applications in mining and Mineral Projects.

Preparation and Evaluation of Project Reports: Evaluation of exploration and development projects, study of typical pre-feasibility and feasibility reports.

TEXT BOOKS:

Exploration and prospecting

1. Butterworth-Heinemann, Aspects of Ore Treatment and Mineral Recovery, , 8th Edition, 2015.
2. Chaussier, J.B., and Mores, J Mineral Prospecting manual, North Oxford Academic press,1987.
3. Haldar, S. K., Mineral Exploration Principles and Applications, Elsevier,First Edition, 2013.
4. Kuzvart, M. and Bohmer, M., Prospecting and Exploration of Mineral Deposits, Elsevier Science Publishers, 1993.
5. Lahee, Field geology, CBS pub, New Delhi, 1987.
6. Moon C J., Whateley M K.G. & Evans A M., Introduction to Mineral Exploration, Blackwell Publishing, Second Edition, 2012

Geo-physics

1. Arnaud Gerkens, J. C. d'. Foundation of exploration geophysics. New York, NY, U.S.A, 1989.
2. Bhattacharjee, S., Frontiers in Exploration Geophysics Oxford and IBH Publishing Company, 1992. Burger, H.R., Exploration Geophysics of the Shallow Subsurface, Prentice Hall, 1992.
3. Butler, B.C.M and Bell, J.D, interpretation of geological maps, Longman Scientific & technical Publ.,1st ED., New Delhi, 1988.
4. Dobrin, Geophysical prospecting, McGraw hill, New Delhi ,1981.
5. Dobrin, M.B An introduction to geophysical prospecting, McGraw Hill, New Delhi,1984
6. Rama Rao, B.S and Murthy I.B.R Gravity and magnetic methods of prospecting. Arnold Heinmann Pub. New Delhi, 1978.
7. Ramachandra Rao, M.B. Outline of geophysical prospecting. Wesley press, Mysore, 1975

Geo-Chemistry

1. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., Australia, 1996.
2. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC, Australia, 1998.
3. John V. Walther, Essentials of Geochemistry, Jones and Bartlett Publishers, 2005, Boston.
4. Mason, B., Introduction to geochemistry, John Wiley, USA, 1982.

MI 105

ADVANCED METAL MINING AND MECHANIZATION
(Program Elective-I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

To understand the advanced methods of working and mechanization for metal mining.

Course Objectives:

- To introduce the recent advancement of metal mine development
- To understand the various advanced methods of metal mining

Course Outcome:

1. The students will have good knowledge about the various advanced methods of metal
2. mining and special mining techniques to overcome the field issues.

UNIT I
ADVANCED MINE DEVELOPMENT **9**

Recent advances in raising, winzing, development of drives, tunnels, cross- cuts, drifts, stope preparations, opening up of mineral deposit, enlargement of drives and raises, recent trends in shaft sinking. Techno economic aspects.

UNIT II
ADVANCED METAL MINING AND STOPING PRACTICES **9**

Recent advances in stoping practices, VCR mining, deep mining, stoping practices in rock burst prone mines, back-filling, recent developments in metal mining in India.

UNIT III
MECHANISATION, SUPPORT SYSTEMS IN METAL MINES **9**

Mechanisation in metal mines – LHD declines, hydraulic transport, trackless mining, modern support system used in metal mines, recent developments in winding and transport

UNIT IV
SPECIAL MINING TECHNIQUES **9**

Marine mining methods – sea water, marine beaches, continental shelves, sea-bed sediments and polymetallic nodules, solution mining, ore leaching, in situ leaching techniques.

UNIT V
SPECIAL PROBLEMS OF ORE MINING **9**

Special problems of deep mines – rock pressure, heat, humidity, rock burst, noise and dust pollution, deep winding and transport, etc.

TOTAL: 45 PERIODS

REFERENCES:

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Vol.I and II,Society of Mining Engineers of American Institute of Mining, Metallurgical Petroleum Engineers, Inc., New York, 1994.
2. Hartman, H.L., Mine Ventilation and Air Conditioning, Wiley Inter Science Publication, New York, 1986
3. Peng, S.S, Ground Control, Wiley Interscience, New York, 1985
4. Underground Mining Methods Handbook, AMIE Publication, 1992
5. Karmakar, H., Mine Working, Vol. I and II, Lovely Prakashan, Dhanbad, 1995
6. Underground Mining Methods and Technology, Elsevier Science Publishers, 1990

MI 106

GEO-ENVIRONMENTAL ENGINEERING
(Program Elective-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives

- To understand the necessity and scope of safe waste disposal systems
- To gain comprehensive understanding about the planning and design of waste disposal systems
- To learn the analysis and design of applications of Geosynthetics in Geo-environmental applications.

Course Outcomes

1. Competence in identifying the requirements of a safe waste disposal system
2. Ability to analyse and design the Geo-environmental application of geosynthetics
3. Competence in construction practices and evaluation of post construction improvement

UNIT – I **9**

Wastes: source, production and classification of wastes, soil pollution processes, waste characterization.

UNIT – II **9**

Waste disposal facilities such as landfills and impoundments, slurry walls, landfill planning and design.

Barrier systems – basic concepts, design and construction, stability, compatibility and performance contaminant transformation and transport in subsurface.

UNIT – III **9**

Monitoring surface contamination, stabilization, and modification of wastes.

Reuse of waste materials, contaminated site remediation. Case studies in waste handling.

UNIT – IV **9**

Soil erosion and conservations – causes of soil erosions, factors contributing to erosion – climatic factors, topographical factors, vegetation factors. Erosion control – cropping systems, gullies, check dams, contouring, wind striping, ridging, bank protection.

UNIT – V **9**

Application of Geosynthetics: Introduction – Classification & Functions of Geosythetics – Over view of Geotextiles, Geogrids, Geonets, Geomembranes and Geocomposites.

Geosynthetics in Geo-environmental Engineering: Capping & Lining – Design requirements – Case studies.

Total: 45 Periods

Suggested Reading:

1. Daniel, D. E. Geotechnical practice for waste disposal, Chapman and Hall, London 1993
2. Rowe, R. K., Quigley, R. M. and Booker, Clay barrier systems for waste disposal facilities, J.R., E & FN Spon, London, 1995
3. Reddi, L. N., and Inyang, H. F. Geoenvironmental Engineering – principles and applications, Marcel Dekker, 2000
4. Bagchi, A. Design, construction and monitoring of landfills, John Wiley & Sons, New York 1994
5. Sharma, H. D. and Lewis, S. P., Waste containment systems, Waste stabilization and landfills: Design and evaluation John Wiley & Sons, New York 1994
6. Koener, R.M. (2012), "*Designing with Geosynthetics, Vol.1 & 2,* Xlibriss Corporation LLC.

MI 116

INSTRUMENTATION IN MINING
(Program Elective -II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives: To learn about

- Electrical instruments
- Pressure and flow measurements
- Temperature and Environmental parameters measuring instruments
- Rock mechanics and ground control instruments.

Course Outcomes:

1. Upon Completion of this subject, the students can able to explain different types of used in various mining activities

UINT I
ELECTRICAL INSTRUMENTS **9**

Basic Concepts: Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation. Accuracy, precision, resolution, sensitivity, linearity, span and range-Dynamic characteristics. Ammeters (MI & MC), Volt meters, Watt meters (Dynami), Energy Meters, Megger, Earth resistance measurement and thermocouples, Inclinometers

UINT II
PRESSURE AND FLOW MEASUREMENTS **9**

Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges and sensors– Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge, deformation gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge. Piezometer, Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rotameter.

UNIT III
VIBRATION, HUMIDITY, VELOCITY AND LEVEL MEASUREMENTS **9**

Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer – Vibrometers – Geo-phones. Humidity – Hot wire electro type hygrometer – Dew cell – Electrolysis type hygrometer. Anemometer, Velometer, Pitot static tube, Sound level meter, microphone, Lux meter; Level measurements: – Float gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors . Differential pressure method and Hydrastep method -Solid level measurement.

UNIT IV
INSTRUMENTATION IN EXCAVATION **9**

Introduction to various instruments in excavation, electronic and manual data generation
Bore hole logging system, acoustic/ultrasonic instruments, ground penetrating radars Stress and strain, deformation, Instrumentation for performance monitoring. Field investigations for selection and design of mechanical excavators and drilling systems. Data loggers, Automated data acquisition, analysis and interpretation.

UNIT V

INSTRUMENTATION IN ROCK MECHANICS 9

Different types of Load cells, stress capsules, Flatjack, tape extensor meters, convergence indicators and recorders, borehole deformation gauges of different types, depth indicators. Seismic measurements, Application of instrumentation in rock mechanicsin Mining**,** rock slope instrumentation.

TOTAL: 45 PERIODS

Text Books:

1. De, N.K. and Sen, P.K. 'Electric Drives' Prentice Hall of India Private Ltd, 2002.
2. Subramaniam, V. 'Electric Drives' Tata McGraw Hill , New Delhi,2007
3. Dubey, G.K. 'Fundamentals of Electrical Drives' Narosa, Second Edition.
4. Morrris, A.S. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999.
5. Doeblin, E.O. Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999.
6. Whittaker, B. N. and Frith, R. C. (1990): Tunneling: Design, Stability and Construction, London: Institution of Mining and Metallurgy
7. Hoek, E and Brown, E.T. (1980):Underground Excavation in Rock, The Institution of Mining and Metallurgy, London
8. Bieniawski, Z. T. (1984):Rock Mechanics Design in Mining and Tunneling, Balkema.
9. John Dunnicliff Geotechnical Instrumentation for Monitoring Field Performance Lexington, Massachusetts

References:

1. Bhattacharya, S.K., Singh, B. 'Control of Electrical Machines', New Age International Publishers,2002.
2. Bird, J. 'Electrical Circuit theory and technology' Elsevier, First Indian Edition, 2006.
3. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
4. Patranabir, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
5. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 1999.
6. Liptak, B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994.

MI 108

HYDRAULICS AND HYDRAULIC EQUIPMENT IN MINING
(Program Elective-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To provide student with knowledge on the application of hydraulic power in process, in mining and construction Industries.
- To provide students with an understanding of the hydraulics and components utilized in modern industrial hydraulic power system.
- To develop a measurable degree of competence in the design, construction and operation of hydraulic power circuits.
- To impart students on the science, use and application of hydraulics in Industry. Also to impart knowledge on the methodology of basic and advanced design of hydraulics systems.

Course Outcomes:

1. Upon completion of this course, the students will be able to: Identify hydraulic components and its symbol and usage. Ability to design hydraulic circuits.
2. It helps students to get knowledge on the need, use and application of hydraulic power and make them familiar to mining equipment design that lead to automation.

UNIT I
FLUID POWER PRINICIPLES **9**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection Different types of fluids used hydraulic systems, Water base Viz. Oil in water, Water in Oil, Water Glycol; Synthetic fluids like Phosphate easter, their properties, merits demerits and suitability.– Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power. Fluid Power ANSI Symbols, Bernoulli's theorem and its applications, Laminar and turbulent flows and their applications.

UNIT II
POWER GENERATING ELEMENTS **9**

Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Properties, Characteristics and Performance, specifications, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems. Rotary Actuators – selection, specification and characteristics, Hydrostatic drives, types, selection. Hydraulic power packs.

UNIT III
CYLINDERS, COMPONENTS AND ACCESSORIES **9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications — Accumulators, Intensifiers, Problems.

UNIT IV

HYDRAULIC CIRCUITS AND SYSTEMS 9

Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits. Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - planning, copying, - Power pack circuits, Drilling machines, powered supports, shearer, continuous miner, road headers, drilling machine, forklift, earth mover (shovels, rippers, graders, etc.) circuits design methodology- design and selection of components - safety and emergency mandrels – Cascade method. Use of relays, counters, timers, ladder diagrams, use of microprocessor in circuit design.

UNIT V

TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic Design of hydraulic circuits for Drilling machines, powered supports, shearer, continuous miner, road headers, drilling machine, forklift, earth mover (shovels, rippers, graders, etc.) applications. Fault finding– application -fault finding - hydro circuits.

TOTAL: 60 PERIODS

Text Books:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997.

References:

1. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, Tata McGRaw Hill, 2001.
2. Dudley, A. Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
3. Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

AC131

DISASTER MITIGATION AND MANAGEMENT
(Audit Course -I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Description of the concepts of water and air pollution
- To know the various types of disasters and its effect on structures.
- Study the quality assurance and damage assessment of structures, repair, rehabilitation and retrofitting techniques.
- Awareness about flood characteristics and flood forecasting systems, flood mitigation

Course Outcomes:

1. Gaining understand of the fundamentals of disaster maintenance and repair strategies and know the materials and techniques used for repair of structures.
2. Ability to critically review and interpret scientific information based on flood forecasting and flood routing techniques.

UNIT – I

Disaster: Classifications - Causes - Impacts including social, economical, political, environmental, health, psychosocial, etc.

Seismic performance of buildings: case studies of major earthquakes in the country, dam age to buildings, damage patterns, performance of non-engineered buildings.

Introduction to Repair and rehabilitation of structures.

UNIT – II

Quality assurance for concrete – Strength, Durability and Thermal properties of concrete.

Damage Assessment: - Condition assessment and distress, Purpose of assessment, Rapid assessment - diagnostic techniques, Investigation of damage, , Evaluation of surface and structural cracks, Dam age assessment procedure, destructive, non-destructive and semi destructive testing systems, Procedure for evaluating damaged of structure.

UNIT III

Repair, Rehabilitation And Retrofitting Techniques : Repair materials, Common types of repairs – Repair in concrete structures – Repairs in under water structures – Guniting – Shot create –Underpinning, Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake, Retrofitting techniques.

UNIT – IV

Introduction to Disasters: Hazard, Vulnerability, Resilience, Risks.-Disaster- Different types of cold wave-heat wave- droughts- floods-Effect of climate change on Processes.

Flood characteristics and forecasting: Measureable features of a flood (Elevation, discharge, volume, and duration), flood forecasting (unit hydrograph method, meteorological and snow data, and snow field air temperatures), operation of flood forecasting systems.

Space-time characteristics of rainfall: Policy criteria for design flood of a major and minor reservoir, spillways, diversion dams and barrages, design flood criteria for dams and other hydraulic structures (CWC recommendations).

UNIT - V

Flood Routing: Mathematics of flood routing, various methods of flood routing, Hydrologic and Hydraulic routing.

Flood mitigation: flood ways, channel improvement, evacuation and flood proofing, land management, flood plain management, estimating benefits of flood mitigation.

Flood plain adjustments and regulations: Results of controlling floods, alternatives to controlling floods, range of possible adjustments, practical range of choice, critical characteristics of flood hazards..

Suggested Reading:

1. A.R. Santakumar, "Concrete Technology", Oxford University Press, New Delhi, 2006.
2. Pankaj Agarwal and Manish Shrihkande (2006). "Earthquake Resistance Design of Structures." Prentice Hall of India
3. Ravishankar. K., Krishnamoorthy. T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
5. Ven Te Chow (1964), 'Hand Book of Applied Hydrology', McGraw-Hill Publishers, New York.
6. Linsley, R. K. and Franzini A. W. (1992), 'Water Resource Engineering', McGraw-Hill Publishers, New York.
7. Daniel H. Hoggan (1989), 'Computer Assisted Flood Plain Hydrology and Hydraulics', McGraw-Hill Publishers, New York.

AC031

ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course -I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 0

Course Objectives:
Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

Course Outcomes:

1. Academic writing features; Academic writing kinds; Important academic writing skills
2. The process of research; general research document structure

UNIT – I
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT – II
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, useful phrases.

UNIT III
Sections of a Paper, Abstracts. Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT – IV
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods.

UNIT - V
skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. How to ensure paper is as good as it could possibly be the first- time submission

Suggested Readings:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I] [41]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AC 033

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course -I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 0

Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Outcomes:

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

UNIT-I:

- Alphabets in Sanskrit.
- Past/Present/Future Tense.
- Simple Sentences.

UNIT-II:

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT-III:

- Technical concepts of Engineering-Electrical,
- Mechanical,
- Architecture,
- Mathematics

References:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

AC034

VALUE EDUCATION
(Audit Course -I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 0

Course Objectives :

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes :

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT I:

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements.

UNIT II:

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature, Discipline.

UNIT III:

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

UNIT IV:

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence,Humility, Role of Women.
- All religions and same message.

- Mind your Mind, Self-control.
- Honesty, Studying effectively

References :

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

CE 100

RESEARCH METHODOLOGY IN CIVIL ENGG.

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Learn the research types, methodology and formulation.
- Know the sources of literature, survey, review and quality journals.
- Understand the research design for collection of research data.
- Understand the research data analysis, writing of research report and grant proposal.

Course Outcomes:

1. Differentiate the research types and methodology.
2. Able to do literature survey using quality journals.
3. Able to collect research data.
4. Process research data to write research report for grant proposal.

UNIT – I **9**

Scientific Research: Definition, Characteristics, Types, Need of research. Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

Defining and formulating the research problem-Meaning of a research problem, Sources of research problems, Criteria of a good research problem, Importance of literature review in defining a problem, Errors in selecting a research problem, Scope and objectives of the research problem. Approaches of investigation of solutions for the research problem.

UNIT – II **9**

Literature review-Source of literature, Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Research design – Basic Principles, Need of research design, Features of good design, Important concepts relating to research design.

Developing a research plan - Exploration, Description, Diagnosis, Experimentation. Determining experimental and sample designs.

UNIT – III **9**

Execution of the research - Necessary instrumentations, Various data collection methods in Civil Engineering. Data processing and data interpretation. Data presentation and illustration.

Types of the reports–Technical reports and thesis; Different steps in the preparation – Layout, structure and language of technical writing; Writing research papers; Developing a Research Proposal, Common formats of the research proposals;

Oral presentation–Planning, Preparation, Practice, Making a presentation, Importance of effective communication

UNIT – IV **9**

Ethical issues - Research ethics, Plagiarism, Citation and acknowledgement

Patenting and development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT Patent Rights. Problems encountered by researchers in India.

UNIT – V **9**

Basics of statistics. Sampling and its types. Determination of sampling size. Sampling and non-sampling errors in statistics. Data: handling of data-significant figures & rounding. quality of data- precision & accuracy. Types of data.

Descriptive statistics: Summarization of Data- Measure of central tendency, Measure of central dispersion, Measure of symmetry.

Inferential statistics: Hypothesis of testing, Parametric (t-test & Analysis of variance) and Non-Parametric Tests. Univariate and Bivariate analysis; Correlational analysis.

Introduction to linear regression model and multi-linear regression models.

mathematical basis and introduction to SPSS

Suggested Reading:

1. C.R Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, New Delhi, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
3. Ratan Khananabis and SuvasisSaha, "Research Methodology", Universities Press, Hyderabad, 2015.
4. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & Engineering students"
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
8. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publishing Pvt. Ltd., New Delhi, 2004.
9. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
10. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.

MI 121

COMPUTER APPLICATIONS IN MINING LABORATORY

Instruction: 2 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 1.5

AIM: To develop algorithms and programs on various mining related problems in basic programming languages.

Course Objectives:

- To study the computer programming for mining problems, mine ventilation network analysis, modelling of surface and underground workings using various software.

Course Outcomes:

1. The students will have knowledge on design and planning of surface and underground mining methods using mining software

List of Experiments/ Programming:

1. Computer programming for mining problems like design of pillars / blast design / subsidence prediction.
2. Mine ventilation network analysis.
3. Database systems and analysis
4. Digitisation and scanning of mine plans
5. Ore body modelling.
6. Pit optimization.
7. Truck dispatch system optimization.
8. Production Scheduling for grade control
9. Digital Terrain modelling and Wire-frame modelling
10. Mine modelling
11. Slope stability analysis
12. Modelling of airflow through underground workings using finite element method.
13. Solving problems on excavation in rock and support
14. Patch test and stress around simple openings and comparing the numerical solution with closed form solution.
15. Modelling of typical open stope in metal mine and stability analysis of walls and pillars
16. Modelling of mechanical behaviour of pillars under different geo-mining conditions
17. Modelling of caving behaviour in strata
18. Modelling of slope
19. Modelling of supports in mines
20. Modelling of a hydroelectric cavern and gas oil storage cavern

TOTAL: 60 PERIODS

MI 110

ADVANCED MINING GEOLOGY LAB

Instruction: 2 periods per week *Duration of SEE: -- hours*
CIE: 50 marks *SEE: -- marks*
Credits: 1.5

Course Objectives:

- The geological concepts, processes, materials and phenomena are well understandable in the field rather than in the class room.
- An attempt in this direction is to show some important minerals and rocks, models of geological structures, and maps of different kinds in the laboratory.

Course Outcomes: At the end of the course, students will be able to

1. Identify the various rock forming and ore forming minerals.
2. apply various tools and techniques to measure water, air and noise pollution and adopt mitigative measures.
3. Identify various structural deformities in open and under ground mines and will be able to take corrective measures to safe and optimal recovery of minerals.
4. Understand the importance and uses of topographic and geological maps in the mining
5. design survey and estimate the mineral reserves.

List of Experiments (Any 10)

1. Mineralogy: Identification and description of important rock-forming and ore minerals.
2. Petrology: Identification and description of rock specimens.
3. Distribution of important mineral resources of India and their origin.
4. Interpretation of a geological map/metallogenic map of India.
5. Ore reserve estimation.
6. Calculating carbon footprints of a mining operation.
7. Thickness of strata by graphical method.
8. Applications of Remote Sensing and Drones in mine surveys/operation
9. Primary and secondary strutures applicable to mineral resources.
10. Understanding the implication of various primary and secondary structure on mineral production.
11. Applications of geophysical prospecting methods in exploration and exploitation of mineral resources.
12. Water pollution monitoring in mines: pH, DO, TDS measurement
13. Introduction to acid mine drainage treatment technology.
14. Air pollution monitoring in mines: Introduction to various particles and gasses emission monitoring techniques.
15. Noise pollution monitoring in mines: measuring techniques and mitigation measures
16. Dust monitoring in the mines.
17. Use and reclamation of mine overburden.
18. Strain and Stress: Measurement and Analysis.
19. Hydrogeological properties of rocks: Measurement and Analysis.
20. Measuring Dip and Strike of rock formations.

Suggested Reading :

1. *K.M. Gurappa, Structural geology Manual*
2. *B.S. Sathya Narayanaswamy Engineering Geology Laboratory Manual, Eurasia pub.*

SEMESTER-II

MI 111

NUMERICAL MODELLING IN MINING

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To study the finite element methods, finite difference methods and boundary element methods
- To understand the practical applications of numerical methods in mining field.

Course Outcomes:

1. The students will get the concept about finite element models, methods and boundary elements method and its practical applications in mining and rock mechanics.

UNIT I
INTRODUCTION TO ELASTIC AND PLASTIC MODELS **9**

Fundamentals, elastic, plastic, homogeneous and isotropic, non-linear elastic and elastoplastic models. Need for numerical modelling in design of excavations in mines; Domain and boundary conditions; Discretisation of domain and boundary; Methods of numerical simulation for excavations in mining.

UNIT II
FINITE DIFFERENCE METHODS **9**

Concept, formation of mesh element, finite difference patterns, solutions, application to mining. Commercial Softwares for application in mining.
Explicit finite difference method; Finite difference equation; Mechanical damping, mechanical time-step determination, solution stability, advantages and their limitations. Non-linear solution methods Introduction to Numerical Modelling Packages: Strand – 7 and FLAC.

UNIT III
FINITE ELEMENT METHODS **9**

Concept, discretisation, element configuration, element stiffness, Assembling elements to form a structural stiffness matrix; Imposing boundary conditions and solving structural equations Elements on assumed displacements, constant strain triangle, isoparametric formulation, advantages and their limitations., two and three dimensional solutions, linear and non-linear analysis, applications in geomechanics; simulation of joints in strata. Commercial Software for application in mining.

UNIT IV
BOUNDARY ELEMENT METHOD **9**

Concept, discretisation, formulation, merits, demerits and limitations, different methods of solution for isotropic and infinite media. Commercial Softwares for application in mining. Boundary Element Method: Introduction, formulation, advantages and their limitations.

UNIT V

PRACTICAL APPLICATIONS IN MINING AND ROCK MECHANICS 9

Practical Applications in stress analysis, slope and dump stability, subsidence prediction, pillar design, rock burst, different types of mine supports, etc.

Constitutive modeling and their uses: Mohr's Coulomb Plasticity model for simulation of rock failure, Interfaces to simulate the bedding planes, Simulation of support in rock: bolts, props and lining.

TOTAL: 45 PERIODS

References

1. Desai, C.S. and Abel, J.F., Introduction to the finite Element Method, Van Nostrand Riehokl Co., New York, 1983.
2. Zienkiewicz, O.C., The Finite Element Method in Engineering Science, Tata McGraw Hill 1972.
3. Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 1987.
4. Mukhopadyay, M., Matrix Finite Element – Computer and Structural Analysis, Oxford and IBH Publishing co., 1984
5. Brown, E.T., (Ed) Analytical and Computational Methods in Engineering and Rock Mechanics, Allen and Unwin, London, 1987.

MI 112

ROCK EXCAVATION ENGINEERING

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the rock mechanics, rock cutting technology, rock cutting tools and rock excavating machine.

Course Outcomes:

1. The students will get familiarity about rock mechanics properties, rock cutting technology and excavating machines.

UNIT I
INTRODUCTION **9**

Concepts, historical developments in rock excavation, systems, factors affecting the rock fragmentation, mechanism ofrock breakage and fracture; their application to rock fragmentation. Different analysis methods of Rock fragmentation and brief view of prediction models for fragmentation. Rock breaking processes: Primary, Secondary and Tertiary, Energy consumption computations.

UNIT II
ROCK MECHANICS **9**

Rock properties related to machining process; application of compressive, tensile and multiaxial strengths, index tests and abrasivity, anisotropy, elasticity, porosity, laminations, bedding and jointing in rock fragmentation process.

UNIT III
ROCK CUTTING TECHNOLOGY **9**

Mechanism of drilling – rotary, percussive, rotary percussive, mechanics of rock machining, theory of single tool rock cutting, crack initiation and propagation, breakage pattern, rock excavation by cutting action – picks, discs, roller cutters water jet cutting, methods of evaluation of drillability and cuttability of rocks. Advances in drilling equipment, pneumatic versus hydraulic, design and operating parameters of surface and underground drilling; evaluation of drill performance; mechanism of bit wear; bit selection; economics of drilling.

UNIT IV
ROCK CUTTING TOOLS **9**

Rock cutting tool materials, different types, relative applications and their choice, tool shape and size, specific energy consumption, tool wear, effect of operational parameters on tool performance, maintenance and replacement of cutting tools of excavating machines.
Theories of rock tool interaction for surface excavation machinery rippers, dozers, scrapers, BWE, continuous surface miners, auger drills; theories of ploughs, shearers,–rock tool interaction for underground excavation machinery roadheaders, continuous miners and tunnel boring machines; selection criteria for high pressure water jet assisted–cutting tools; advanced rock cutting techniques cutting.

UNIT V

ROCK EXCAVATING MACHINES **9**

Excavating machines, principles, operation, applicability and technical indices of road headers, TBM'S coalface machines and bucket wheel excavators. Recent Developments in rock excavation machinery.

TOTAL: 45 PERIODS

REFERENCES

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Vol. I and II, Society of Mining Engineers, America, 1992.
2. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
3. Chugh, C.P., Diamond Drilling, Oxford-IBH, 1984.
4. Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987

MI 113

SURFACE MINE ENVIRONMENTAL ENGINEERING
(Program Elective -III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To study the physics of mechanical ventilators and the parameters governing their performance.
- To study various methods of ventilation data collection.
- To study about mine illumination, pollution and ecological systems.

Course Objectives:

1. The students will have knowledge on mechanical ventilators, influencing parameters and various methods of data collection.
2. They will also know about illumination, pollution and ecological systems.

UNIT I
INTRODUCTION **9**

Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guideline – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation – desertification – Industrialization, Objectives of Sustainable Development. Structure of the atmosphere – ozone layer depletion – Acid rain – Green house gases and global warming Ambient Air quality and emission standards, Air quality Sampling and monitoring, Dispersion of air pollutants.

UNIT II
ENVIRONMENTAL POLLUTION - I **9**

Environmental Pollutants due to surface – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust, Air born dust modeling, Control and preventive measures for air pollution including for dust, , Water pollution standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to blast and equipment vibrations their monitoring, prevention and control.

UNIT III
ENVIRONMENTAL POLLUTION - II **9**

Land pollution, land for alternation dealing with mind out land , re-vegetation, tailing management, tailing dams, method and construction, land use plan, Mine closure planning. Textural classification and properties of soil. Impact of pollution on human health, miner's diseases and their social impact.

UNIT IV
ENVIRONMENTAL MANAGEMENT **9**

Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 – EIA Notification – Sitting of Industries – Environmental management plans, Environmental impact assessment, Environmental management system audits, Environmental economics – Principles of cost

benefit analysis – Valuing the Environment – Environmental Accounting, Environmental administration- training awareness and competence, Mine subsidence, its prediction and control.

UNIT V

ENVIRONMENTAL LEGISLATIONS **9**

Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regularity agencies and occupation consent to establish and operate wild life protection act and rules , Environmental clearance procedure for a mining Project.

TEXT BOOKS:

1. Manahan S.E. Environmental Science and Technology.
2. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications, London, 1998.

REFERENCES:

1. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York, 1995
2. Anjaneyulu,Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India, 2002.
3. Nick Hanley, Jaison F. Shogren and Ben White. Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
4. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addision Wesley Longman Ltd, Singapore, 1997.
5. Christopher Sheldon and Mark Yoxon, Installing Environmental Management System – a step by step guide, Earthsecan Publications Ltd, London, 1999.
6. Lee Kuhre, ISO 14001 Certification –Environmental Management Systems, Prentice Hall, USA, 1995.
7. Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Oxford University Press, New Delhi. (2001)
8. Gregor I. Mcgregor. Environmental Law and Enforcement, Lewis Publishers, London, 1994.

MI 114

MODERN SURVEYING TECHNIQUES
(Program Elective -III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the working of Total Station equipment and solve the surveying problems.
- To introduce the concepts of Space Borne, Air Borne and Terrestrial LASER
- Scanners for Topographic Mapping

Course Outcomes:

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

1. various techniques available for surveying and mapping along with working principles, functioning and applications of total station and GPS instruments
2. Propagation of EMR through atmosphere and corrections for its effects.
3. Concepts of ALTM and working principle
4. Available types of ATLM sensors and components of ALTM system. Process of data acquisition, data processing and possible applications. The fundamentals of terrestrial scanners and their applications.

UNIT I

FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9

Types and working principles of Machines, Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI. Care and Maintenance of total stations.

Electro-optical system: working principle, Sources of Error, Infrared and Laser Total Station instruments. COGO functions, offsets and stake out-land survey applications.

UNIT II

SATELLITE, GPS SYSTEM and data processing 9

Basic concepts of GPS, GNSS, IRNSS and GAGAN - Different segments - space, control and user segments - satellite configuration – GPS signal structure, Anti Spoofing and Selective Availability - GPS receivers. Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -satellite geometry & accuracy measures - applications.

UNIT III

MINE AND CADASTRAL SURVEYING 9

Reconnaissance – Route surveys for highways, railways and tunnels –Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out – Transfer of azimuth – Gyro Theodolite – Shafts and audits - Cadastral survey- Legal – Real – Tax cadastre – Land record system – Settlement procedure – deformation studies. Mine plan preparation - mapping process - use of mapping softwares, VAVIks mapping.

Route surveys of water ways, Hydrographic survey Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge.

UNIT IV

AIRBORNE LASER SCANNERS **9**

Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser – First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of a Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software. Merits of ALS in comparison to Levelling, echo sounding, GPS levelling, Photogrammetry and Interferometry

UNIT V

DATA ACQUISITION, PRE and Post PROCESSING **9**

Various Scanning Mechanism – Synchronization of GPS, IMU and ALS Data - Reflectivity of terrain objects – Laser Classification – Class I to Class IV Laser – Eye Safety. Ground Point filtering – Digital Surface Model and Digital Elevation Model. Overview of LIDAR Applications in various domains - 3D models – Corridor Mapping Applications – Forestry Applications. Terrestrial Laser Scanners (TLS) – Working Principle – Commercial TLS Specifications – Applications of TLS, Drone based Mapping - derivatives from drone surveying.

TOTAL: 45 PERIODS

Textbooks

:

1. Satheesh Gopi, Rasathishkumar, N.Madhu, – Advanced Surveying, Total Station GPS and Remote Sensing – Pearson education, 2007 ISBN: 978-81317 00679 52.
2. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
3. Jie Shan and Charles K. Toth, Topographic Laser Ranging and Scanning – Principles and Processing, CRC Press, Taylor & Francis Group, 2009.

References:

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1996.
2. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013.
3. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

MI 115

SUSTAINABLE MINERAL INDUSTRY
(Program Elective -III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives: To learn about

- Electrical instruments
- Pressure and flow measurements
- Temperature and Environmental parameters measuring instruments
- Rock mechanics and ground control instruments

Course Outcomes:

1. The students will get knowledge on mining industry scenario and policy matters, and also get a knowledge about various types of pollutions and their controls. They will also know about ecological systems and environmental damage and its preventions.

UNIT I

Concept of Sustainable development for mining industry-Sustainable development –a perspective of mineral professional community. International sustainability reporting and tools for measurement of sustainability. Milos statement on Sustainable mineral industry. Legislative measures for sustainable development- MMRD Act- star rating of Indian mines (Non-coal), Environmental responsibility – Corporate social responsibility. District mineral fund , its collection, utilisation etc.

UNIT II

Current status of mining practices and their impact on sustainability. Mining and environmental frame work , National mineral policies in mineral based countries. Indian national mineral policy, its historical development with the changing goals and sustainable practices. Issues of leases , auctions for mineral development in India.

UNIT III

Clean coal technologies, Coal bed methane, Abondoned coal mine methane, Underground gasification of coal. Leaching of old dumps and recovery of metals. Recyling of metals. Application of new techniques for sustainable development.

UNIT IV

Mine water- Water conservation Acts and rules in India.New Initiatives in mines. Underground mine water, Water pollution and control measures, Phyto-remediation, Sewage and effluent treatment plants, their use and benfits.Waste management- processing of overburden material for underground stowing and innovative methods for utilisation of waste from mines.

Air quality in open pit mines, dust control measures, noise levels- pollution, monitoring and control.

Bio-divrsity- Land reclamation and plantation. Mine closure plan- Collection and disbursement of Mine closure fund for both open pit and underground mines in India.

UNIT V

Best mining practices for Sustainable mining.- Case studies .Innovative practices for achievement of sustainability. Benefits of sustainability.

References

1. MMRD Act 2015 and amendments, Ministry of Mines.
2. Mineral concession Rules.
3. Guidelines of MOEF and Climate change,- Annual reports of MOEF&CC, Ministry of Mines, Ministry of Coal in India,
4. Sustaianble mining practices –A global perspective by Vasudevan Rajaram, Subijoy Dutta, Krishna Paremeswaran,ISBN-90-5809-689-0.

MI 107

MINE ECONOMICSAND INVESTMENT
(Program Elective-IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Study of estimation and valuation of mineral deposits
- Study of project appraisal
- Study of finance and accounting.

Course Outcomes:

1. The students will have knowledge on estimation and valuation of mineral deposits.
2. They will also possess skills about project appraisal, finance and accounting.

UNIT I INTRODUCTION 9

Mineral industry and its role innational economy;world and national mineral resources; Mining –A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy, International aspects of mineral industry and geopolitics, Export and Import of minerals, Demand and Supply of minerals, Conservation and substitution of minerals, low grade ores, use of scrap, Substitution of minerals, Changing pattern of mineral substitution, mineral and mineral based industries, Conservation of mineral resources.

UNIT II ORE RESERVE ESTIMATION 9

Methods of sampling, sampling frequency;analysisofsamplingdata,estimation of reserves, Classification of coal and ore reserves, strategic, critical and essential minerals, present and future mineral supplies of the world, Geo-statistical methods,. Grade variation, variogram modelling, Krigging, Application of Remote Sensing in mineral prospecting and ore reserve estimation

UNIT III
MINE VALUATION 9

Approaches to Mine Valuation, Time value of money; annuity; redemption of capital, netpresent value; selecting a discount rate, depreciation; inflation; ratesofreturn; Hoskold's Two rate method; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT IV PROJECTAPPRAISAL 9

Methods of project evaluation–payback,annual value, benefit/costratio, ERR and IRR, etc., Mine investment analysis – objectives, criteria, alternatives, handling risk, static and dynamic methods; evaluationof exploratory mining areas and operatingmines; mine project financing, its risks andconstraints; Royalties, duties and mineral taxation; critical impact of depreciation, depletion, type of funding, reserves, life, etc. on mine profitability, International Investment and Trade in mineral materials and products, Small mines and their socio-economic significance.

UNIT V FINANCEANDACCOUNTING 9

Sources of mine funds–shares, debentures, fixed deposit, sinking fund, capital gearing, P& Laccount, balance sheet, Project operating strategy, Project alternatives, Contract mining

bidding, Exploration and mine development funding, Operating Mine financing, Mergers and acquisitions, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods, capitaland operating cost of mining projects, including wages, incentives, material, etc.; assets; liabilities, Price forecasting and sensitivity analysis.

TOTAL: 45 PERIODS

References:

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Gentry, D.W. and O'Neil, T.J. Mine Investment Analysis, Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colorado. USA.
3. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
4. Hartman, H.L. (Ed.). SME Mining Engineering Handbook, Vol. I, Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colorado.
5. Sharma, N.L. and Sinha, R.K. Mineral Economics, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
6. Rudawsky, O. Minerals Economics – Development and Management of Natural Resources, Vol 20, Elsevier Publications,
7. Chatterjee, K.K., Mineral Economics, Wiley Eastern, 1992.
8. Indian MineralsYear Book 2017 – MMRDAct and Mineral Concession Rules.
9. Ray, S.C. and Sinha, I.N., Mine and Mineral Economics, Kindle Edition, PHI publications.

MI 117

UNDERGROUND EXCAVATION EQUIPMENT
(Program Elective -IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives: To learn about

- Electrical instruments
- Pressure and flow measurements
- Temperature and Environmental parameters measuring instruments
- Rock mechanics and ground control instruments

Course Objectives:

1. To give detail idea about the equipment used in underground excavation.
2. To make student aware about the latest techniques

UINT I
INTRODUCTION TO UNDERGROUND EXCAVATION EQUIPMENTS 9
Introduction to various types of drilling equipment for underground excavations; Roadheading machines - road headers, dintheaders, and Tunnel Boring Machines.

UINT II
UNDERGROUND LOADING EQUIPMENTS 9
Introduction to loading and transportation techniques; different types of loading machines, LHDs SDLs, LPDTs, CAVO loader, rocker shovel loader, gathering arm loader.

UINT III
SHAFT AND TUNNELING EQUIPMENTS 9
Roadheading machines - road headers, dintheaders, and Tunnel Boring Machines; their selection, construction & operation for underground excavation. Shaft drills and mucking system; shaft boring machines, raise boring machines.

UINT IV
AUTOMATION IN UNDERGROUND 9
Introduction to automation, robotics and radio control operations in excavation equipment, Fore-poling machines, Shotcrete machines, grouting pump.

UINT V
OPTIMIZATION OF EQUIPMENT UTILIZATION 9
House Keeping of equipment, performance optimization, Cost and downtime management, optimization of equipment utilization, workshop equipment management.

TOTAL: 45 PERIODS

Text Books:

1. H.L.Hartman SME, Mining Engineering Hand Book, Society of Mining Engg, USA
2. Hustrulid, Underground mining methods, SME

MI 118

FINITE ELEMENT ANALYSIS
(Program Elective -IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

Course Outcomes:

1. Upon completion of this course, the students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem.

UNIT I
INTRODUCTION **9**

Background - General description of the method - Analysis Procedure. Node numbering – Mesh generation - Linear constitutive equations - Plane stress, Plane strain and axisymmetric cases of elasticity - Energy principles - Variational methods – Raleigh-Ritz method – Galerkin Method.

UNIT II
ONE DIMENSIONAL PROBLEMS **9**

Finite element modelling – Coordinates and shape functions – Linear and quadratic elements - Applications to axial loadings of rods – Extension to plane trusses – Bending of beams Element, Finite element formulation of stiffness matrix and load vectors – Assembly for global equations – Boundary conditions.

UNIT III
TWO DIMENSIONAL PROBLEMS **9**

Convergence requirements - Constant Strain Triangular (CST) Element – Rectangular Element -Finite element modelling - Element equations, Load vectors and boundary conditions – Assembly - shape functions from Lagrange and serendipity family— Application to heat transfer.

UNIT IV
ISOPARAMETRIC FORMULATION **9**

Introduction – Coordinate Transformation –Basic theorem of Isoparametric concept – Uniqueness of mapping – Isoparametric, Subparametric and Superparametric elements – Assembling Stiffness matrix – Numerical Examples.

UNIT V
APPLICATIONS **9**

Application of displacement finite elements to the analysis of simple problems (one and two dimensional cases) in the area of structural mechanics. Computer Programs: Development of computer programs for an axial and beam bending elements – Programming and use of computer packages for design of underground excavations, mining structures, slope and dump stability, design of supports, etc..

Total: 45 Periods

Text Book:

1. J.N.Reddy, "An Introduction to the Finite Element Method", 3rd Edition, Tata McGrawHill, 2005.

References :

1. Krishnamoorthy, C.S, Finite Element Analysis Theory & Programming, McGraw-Hill, 1995.
2. Desai C.S and Abel,, J.F., Introduction to Finite Element Method, Affiliated East West Press Pvt. Ltd., New Delhi, 2000
3. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, 2011, 4th Edition.
4. Bhavikkatti, S.S. Introduction to Finite Element Analysis –Newage International (P) Limited Publishers, New Delhi, 2011.
5. Seshu, P., Textbook of Finite Element Analysis. New Delhi: Prentice-Hall of India, 2006.
6. Bathe. K.J., "Finite Element Procedure", Prentice Hall of India, New Delhi, 2006.
7. Logan, D.L., "A First course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
8. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
9. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butter worth Heinemann, 2004
10. Chandrupatla, R &Belagundu, A.D. "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div., 1990.
11. Cook R.D., "Concepts and Applications of Finite Element Analysis", John Wiley and Sons Inc., New York, 1989.
12. Zienkiewicz, O.C., Taylor, R.L. and Zhu, J.Z. "The Finite Element Method: Its Basics and Fundamentals", Seventh Edition, Volumes 1 &2, Elesevier Publications, 2013.

CE 311

GROUND IMPROVEMENT TECHNIQUES
(Program Elective -IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the objectives, necessity and scope of ground improvement techniques
- To learn different methods of in-situ densification of cohesive, cohesionless soils
- To learn the classification, functions and applications of Geosynthetics in ground improvement
- To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

Course Outcomes

1. Ability to understand the necessity of ground improvement and potential of a ground for improvement
2. To gain comprehensive understanding about the improvement of in-situ cohesive soils as well as Cohesion less soils
3. Competence to analyze an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its planning , design, implementation and evaluation of improvement level

UNIT – I **9**

General : Formation of rock, soils and soil profiles, soil distribution in India and other countries - marine, black cotton soils (expansive)., lateritic, alluvial, desert soils peat etc., factors affecting the alteration of ground after formation – natural and man-made – reclaimed soils – methods of geotechnical processes.

UNIT – II **9**

Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vigor compaction methods, vibro-probes, stone columns, sand compaction, stone column piles, selection of methods – quality control – specifications for compaction process for solving field problems.

UNIT – III **9**

Drainage methods: seepage, ground water seepage control – filter requirements methods of dewatering – well point methods of discharge computations – design of steps for dewatering – design of well screens – selection of pumps and accessories – deep bored wells.
Pre-compression methods: compressibility and consolidation properties of soils estimation of rate of consolidation settlements – accelerating methods – monitoring compressions – design of vertical drains – consolidation by electro osmosis and vacuum compression methods.

UNIT – IV **9**

Grouting and injection methods: principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

UNIT – V **9**

Stabilization methods: mechanical, cement, lime, chemical methods of stabilization of soils – use of admixtures – polymers – geosynthesis – reinforcements thermal slurry trenches, void filling – prewetting – improving rock stability methods – exercise quality control to achieve desired results.

TOTAL: 45 PERIODS

Suggested Reading:

1. J.E. Bowles – Foundation Design &Analysis.McGraw-Hill Edition 1995.
2. Ground improvement techniques by P. Purushottam Raj, Laxmi Pub., 1999.
3. F. S. Fang Handbook of Foundation Engg. CBS Pub., 1985.

AC 035

STRESS MANAGEMENT BY YOGA
(AUDIT COURSE-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *Creating awareness about different types of stress and the role of yoga in the management of stress.*
- *Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).*
- *Prevention of stress related health problems by yoga practice.*

Outcomes: *Students will be able to*

1. *To understand yoga and its benefits.*
2. *Enhance Physical strength and flexibility.*
3. *Learn to relax and focus.*
4. *Relieve physical and mental tension through Asanas*
5. *Improve work performance and efficiency.*

UNIT-I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT–II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT-III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT-IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT-V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama – Kapalabhati-Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT).

Suggested Reading:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or Conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
3. Nagendra H.R nad Nagaratna R, "Yoga Perspective in Stress Management", Bangalore, Swami Vivekananda Yoga Prakashan

Online Resources:

https://onlinecourses.nptel.ac.in/noc16_ge04/preview
https://freevideolectures.com/course/3539/indian-philosophy/11

AC 036

PERSONALITY DEVELOPMENT THROUGH LIFE ENHANCEMENT SKILLS (AUDIT COURSE-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives :

- *To learn to achieve the highest goal happily*
- *To become a person with stable mind, pleasing personality and determination*
- *To awaken wisdom in students*

Outcomes: *Upon completing this course, students will be able to:*

1. *Develop their personality and achieve their highest goal of life.*
2. *Lead the nation and mankind to peace and prosperity.*
3. *To practice emotional self regulation.*
4. *Develop a positive approach to work and duties.*
5. *Develop a versatile personality.*

UNIT-I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT-II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT-III

Introduction to Bhagavad Geetha for Personality Development - Shrimad Bhagawad Geeta: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT-IV

Statements of basic knowledge - Shrimad Bhagawad Geeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT-V

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 – Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Suggested Reading:

1.. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Web resource:

1. NTPEL:http://nptel.ac.in/downloads/109104115/

AC 037

CONSTITUTION OF INDIA
(AUDIT COURSE-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *The history of Indian Constitution and its role in the Indian democracy.*
- *Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*
- *Have knowledge of the various Organs of Governance and Local Administration.*

Outcomes: *Upon completing this course, students will be able to:*

1. *Understand the making of the Indian Constitution and its features.*
2. *Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.*
3. *Have an insight into various Organs of Governance - composition and functions.*
4. *Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.*
5. *Understand Electoral Process, special provisions.*

UNIT-I

History of making of the Indian constitutions: History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II

Contours of Constitutional Rights and Duties Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance": Parliament: Composition, Qualifications, Powers and Functions, Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, ayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

Suggested Reading:

1. "The Constitution of India", 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Web Resource:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

AC038

PEDAGOGY STUDIES

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 0

Course Objectives:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in Developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I

Introduction and Methodology:

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

UNIT-II

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

UNIT-III

- Evidence on the effectiveness of pedagogical practices
  Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school
- Curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV

- Professional development: alignment with classroom practices and followup support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

UNIT-V

- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact

Suggested reading:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of
   Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal
   Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. ww.pratham.org/images/resource%20working%20paper%202.pdf.

MI 119

MINI PROJECT

Instruction: 6 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 3

Objectives:

- *To review available literature and formulate structural engineering problems*
- *To learn the technique of writing reports and prepare presentation*

Outcomes:

1. *Identify structural engineering problems reviewing available literature*
2. *Study different techniques used to analyse complex structural systems.*
3. *Able to work on the solutions given problem*
4. *present solution by using his/her technique applying engineering principles.*
5. *Prepare technical report and presentation*

Syllabus Contents:

Mini Project will have mid semester presentation and end semester presentation. Mid semester Presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee

ME 120

GEOTECHNICAL ENGINEERNIG LABORATORY

Instruction: 3 periods per week *CIE: 50 mark*
Credits: 1.5

Course Objectives:

- *Expose the students to different types of soils and learn to classify them*
- *Hands on experience of the laboratory test procedures to determine compaction, strength and permeability characteristics.*
- *Knowledge of Rock Mass Classification and procedure to find uniaxial compressive strength of Rock Specimen*

Course Outcomes:

1. *Competence in performing the laboratory experiments for determination of Index properties and for classification of soils*
2. *Ability to determine the compaction / shear strength / permeability characteristics in the laboratory*
3. *Hands on experience in Rock mass classification and determination of its UCS*
4. *Understanding about the application of Geotechnical Engineering properties of soils and rocks in Mining Engineering theory and practice*

I. TESTS ON SOILS

1. **Particle Size Analysis using**
   a. Dry Sieve analysis
   b. Wet Sieve Analysis

2. **Consistency of Clays**
   a. Determination of Liquid Limit
   b. Determination of Plastic Limit

3. **Classification of soils** using IS:1498-1970

4. **Compaction Characteristics using**
   a. IS Light Compaction Test
   b. IS Heavy Compaction Test

5. **Shear Strength Characteristics using Direct Shear Test**

6. **Permeability Characteristics using**
   a. Constant Head Permeability test
   b. Variable Head Permeability test

II. TESTS ON ROCK

1. Determination of Core Recovery Ratio (CRR) and Rock Quality Designation (RQD)
2. Determination of Rock Mass Rating (RMR)
3. Rock specimen preparation- Core drilling, cutting and grinding

4. Determination of density, porosity and water absorption
5. Determination of Uni-axial Compressive Strength

Suggested Reading:

1. IS:2720 – Relevant Parts.
2. Lambe, T.W., "*Soil Testing for Engineers*", Wiley Eastern Ltd., New Delhi, 1969 (Reprint in 2012).
3. Jaeger, J.C. and Cook, N.G.W., *Fundamentals of Rock Mechanics*", Chapman and Hall, 1976
4. Goodman, R.E. *Introduction to Rock Mechanics*, John Wiley and Sons, 1989

MI 109

SEMINAR

Instruction: 3 periods per week *Duration of SEE: --*

CIE: 50 marks *SEE: --*

Credits: 1.5

Objectives:

- Identify appropriate topic of relevance.
- Update literature on technical articles of selected topic and develop comprehension.
- Prepare a technical report.
- Deliver presentation on specified technical topic.

Outcomes:

1. Review literature on technical articles and develop comprehension.
2. Recognize appropriate topic of relevance
3. Prepare review repot of literature studied
4. Write a technical report.
5. Give presentation on specified technical topic

1. Seminar will be conducted on different topics to improve the student in collection of data on various new technologies, preparation of power point presentation and presentation skills.
2. Seminar will be conducted in two phases.

MI 121

BLASTING TECHNOLOGY IN ROCK EXCAVATION
(Program Elective - V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Description of the concepts of blasting in UG and OC mines.
- Exposure to the principles of drilling and blasting.
- An overview regarding Special blasting techniques and mitigation of socio-economic and environmental impacts of blasting.

Course Outcomes:

1. The students will get knowledge on types of explosives, theories of rock breakage by explosives, special blasting techniques, and selection of initiating system impacts and safety in blasting and remedial measures and safety against blasting.

UNIT – I
EXPLOSIVES

Chemistry and physics of explosives; Classification of explosives; Properties of explosives; Explosives and blasting agents; Initiation and priming systems; Bulk explosives; Explosives selection; performance evaluation of explosives and accessories. Parameters influencing mine and ground excavations.

UNIT – II
ROCK BREAKAGE BY EXPLOSIVES

Detonation principle and rock breakage mechanisms, laws of comminution, methods for prediction and assessment of fragmentation; Design of blasting rounds for surface and underground excavations.

UNIT – III
SPECIAL BLASTING TECHNIQUES

Advanced theory and application of explosives in excavation. Secondary breakage, line drilling, pre-splitting, profiling, trenching, Throw/cast blasting. Emerging Blasting techniques; Blasting in mixed rock types, hard/soft rock, Air decking, Solid decking.

UNIT – IV
SELECTION OF INITIATING SYSTEM

Electric, Non electric initiating system, digital detonators, selection of initiating system. Safety in usages and handling of explosives & initiating systems.

Priming and Charging: Selection of primer and its effect on the blast performance. Influence of shape, size and quantity of primer on explosive performance.

UNIT – V
IMPACTS AND SAFETY IN BLASTING

Prediction, control and damage thresholds og ground vibration from Opencast Blasting; Structural Response and damage criteria for safety of strucures and stability of pit and dump slopes;Handling and storage of explosives;

Socio-economic and environmental impacts of blasting: Control of noise, vibration, air blast and fly rock.

Blast Monitoring and Instrumentation: Blast instrumentation for blast performance assessment and modification; Ritcher scale versus PPV, Peak particle velocity versus Strain; Low frequency response, Near field vibration monitoring.

Suggested Reading:

1. Rock Blasting and Explosives Engineering By Per-Anders Persson, Roger Holmberg, Jaimin Lee.
2. Rock Blasting: Effects and Operations by Pijush Pal Roy, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

MI 122

MINE SYSTEMS ENGINEERING
(Program Elective - V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To know basic of system engineering concept and analysis
- To study the various techniques of operations research, simulation and network analysis

Course Outcomes:

1. The students will learn the concept of system engineering and applicability in mining field.

UNIT I
INTRODUCTION **9**

Introduction to systems engineering, systems concept and analysis, models in systems analysis, tools and methodology of system analysis.

UNIT II
OPERATIONS RESEARCH **9**

Introduction to operations research, introduction to linear programming, application to mineral industry.

UNIT III
SIMULATION TECHNIQUES **9**

Introduction to Monto-carlo sampling and deterministic simulation of different mining subsystems and total system, simulation application for equipment selection and production scheduling.

UNIT IV
NETWORK ANALYSIS **9**

Network analysis, monitoring and control of developmental activities in mining project by CPM and PERT.

UNIT V
MISCELLANEOUS **9**

Inventory of mineral resources, basic models and optimisation, introduction to statistical decision theory and its application in mineral industry.

TOTAL: 45 PERIODS

References:

1. Syal, I.C., and Gupta, B.P., Computer Programming and Engineering Analysis, A.B., Wheeler and Company, Madras 1986.
2. Anon., Management by Network Analysis, The Institution of Engineers (India), 1976.
3. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press, 1982.
4. Cummings, A.B., and Given I.V. SME Mining Engg., Handbook Vol I and II, SME-41 ME, Inc, New York, 1973.

MI 123

ADVANCED METAL MINING AND MECHANIZATION
(Program Elective - V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

To understand the advanced methods of working and mechanization for metal mining.

OBJECTIVES:

- To introduce the recent advancement of metal mine development
- To understand the various advanced methods of metal mining

OUTCOME:

1. The students will have good knowledge about the various advanced methods of metal.
2. mining and special mining techniques to overcome the field issues.

UNIT I

ADVANCED MINE DEVELOPMENT **9**

Recent advances in raising, winzing, development of drives, tunnels, cross- cuts, drifts, stope preparations, opening up of mineral deposit, enlargement of drives and raises, recent trends in shaft sinking. Techno economic aspects.

UNIT II

ADVANCED METAL MINING AND STOPING PRACTICES **9**

Recent advances in stoping practices, VCR mining, deep mining, stoping practices in rock burst prone mines, back-filling, recent developments in metal mining in India.

UNIT III

MECHANISATION, SUPPORT SYSTEMS IN METAL MINES **9**

Mechanisation in metal mines – LHD declines, hydraulic transport, trackless mining, modern support system used in metal mines, recent developments in winding and transport

UNIT IV

SPECIAL MINING TECHNIQUES **9**

Marine mining methods – sea water, marine beaches, continental shelves, sea-bed sediments and polymetallic nodules, solution mining, ore leaching, in situ leaching techniques.

UNIT V

SPECIAL PROBLEMS OF ORE MINING **9**

Special problems of deep mines – rock pressure, heat, humidity, rock burst, noise and dust pollution, deep winding and transport, etc.

TOTAL: 45 PERIODS

References:

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Vol.I and II,Society of Mining Engineers of American Institute of Mining, Metallurgical Petroleum Engineers, Inc., New York, 1994.
2. Hartman, H.L., Mine Ventilation and Air Conditioning, Wiley Inter Science Publication, New York, 1986
3. Peng, S.S, Ground Control, Wiley Interscience, New York, 1985
4. Underground Mining Methods Handbook, AMIE Publication, 1992
5. Karmakar, H., Mine Working, Vol. I and II, Lovely Prakashan, Dhanbad, 1995
6. Underground Mining Methods and Technology, Elsevier Science Publishers, 1990

OE 941

BUSINESS ANALYTICS
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Understanding the basic concepts of business analytics and applications*
- *Study various business analytics methods including predictive, prescriptive and prescriptive analytics*
- *Prepare the students to model business data using various data mining, decision making methods*

Outcomes: *Upon completing this course, students will be able to:*

1. *To understand the basic concepts of business analytics*
2. *Identify the application of business analytics and use tools to analyze business data*
3. *Become familiar with various metrics, measures used in business analytics*
4. *Illustrate various descriptive, predictive and prescriptive methods and techniques*
5. *Model the business data using various business analytical methods and techniques*

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming(LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Suggested Reading:

1. Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015
3. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

OE942

INDUSTRIAL SAFETY
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- *Causes for industrial accidents and preventive steps to be taken.*
- *Fundamental concepts of Maintenance Engineering.*
- *About wear and corrosion along with preventive steps to be taken*
- *The basic concepts and importance of fault tracing.*
- *The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry*

Course Outcomes:

1. *Identify the causes for industrial accidents and suggest preventive measures.*
2. *Identify the basic tools and requirements of different maintenance procedures.*
3. *Apply different techniques to reduce and prevent Wear and corrosion in Industry.*
4. *Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.*
5. *Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc*

UNIT-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT–II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT–III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT–V

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Suggested Reading:

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company
2. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication
3. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London

OE 943

OPERATION RESEARCH
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Introduce the concepts of optimization techniques*
- *Formulation of LPP models*
- *Basic concepts of Non-linear programming, Dynamic programming, Game theory are introduced.*

Outcomes:

1. *Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*
2. *Students should able to apply the concept of non-linear programming*
3. *Students should able to carry out sensitivity analysis*
4. *Student should able to model the real world problem and simulate it.*
5. *Student should able to apply graph theory, competitive models, and game theory simulations.*

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Suggested Reading:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

OE 944

COST MANAGEMENT OF ENGINEERING PROJECTS
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- Introduce the concepts of cost management, inventory valuation , decision making
- Fundamentals of cost overruns, project execution and technical activities
- Introduce the concepts of Quantitative techniques for cost management, Linear Programming, PERT/CPM

Outcomes:

1. Understanding of strategic cost management process, control of cost and decision making based on the cost of the project.
2. Ability to appreciative detailed engineering activities of the project and execution of projects
3. Preparation of project report and network diagram
4. Able to plan Cost Behavior , Profit Planning , Enterprise Resource Planning, Total Quality Management.
5. Applications of various quantitative techniques for cost management

UNIT I

Introduction and Overview of the Strategic Cost Management Process-Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System- Inventory valuation- Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning- Project execution as conglomeration of technical and non- technical activities- Detailed Engineering activities.

UNIT III

Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT IV

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems- Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector-Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints- Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control;

Flexible Budgets- Performance budgets- Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, PERT/CPM,- Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Suggested Reading :

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OE 945

COMPOSITE MATERIALS
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Study the concepts of composite construction.*
- *Learn analysis and designs of composite beams, floors, columns and trusses as per the recommendations of IS codes of practice.*
- *Apply the concepts for design of multi-storey composite buildings.*
- *Scope of analysis is restricted to skeletal structures subjected to prescribed dynamic loads.*

Outcomes :

1. *Understand the fundamentals of composite construction, and analysis and designs of composite beams.*
2. *Analyse and design the composite floors*
3. *Select suitable materials for composite columns,*
4. *Analyse composite trusses and understand connection details.*
5. *Analyse and design the multi-storey composite buildings*

UNIT-I

Introduction of composite constructions: Benefits of composite construction - Introduction to IS - BS and Euro codal provisions.

Composite beams: Elastic behaviour of composite beams - No and full interaction cases - Shear connectors - Ultimate load behaviour - Serviceability limits - Effective breadth of flange - Interaction between shear and moment - Basic design consideration and design of composite beams.

UNIT-II

Composite floors: Structural elements - Profiled sheet decking - Bending resistance - Shear resistance - Serviceability criterion - Analysis for internal forces and moments - Design of composite floors.

UNIT-III

Composite columns: Materials - Concrete filled circular tubular sections - Non-dimensional slenderness - Local buckling of steel sections - Effective elastic flexural stiffness - Resistance of members to axial compressions - Composite column design - Fire resistance.

UNIT-IV

Composite trusses: Design of truss - Configuration - Truss members - Analysis and design of composite trusses and connection details.

UNIT-V

Design of multi-storey composite buildings: Design basis - Load calculations - Design of composite slabs with profile decks - Composite beam design - Design for compression members - Vertical cross bracings - Design of foundation.

Suggested Reading:

1. R.P. Johnson, "Composite Structures of Steel and Concrete - Beams, Slabs, Columns and Frames in Buildings", Blackwell Publishing, Malden, USA, 2004.
2. "INSDAG Teaching Resources for Structural Steel Design", Vol-2, Institute for Steel Development and Growth Publishers, Calcutta, India.
3. "INSDAG Handbook on Composite Construction – Multi-Storey Buildings", Institute for Steel Development and Growth Publishers, Calcutta, India.
4. "INSDAG Design of Composite Truss for Building", Institute for Steel Development and Growth Publishers, Calcutta, India.
5. "INSDAG Handbook on Composite Construction – Bridges and Flyovers", Institute for Steel Development and Growth Publishers, Calcutta, India.
6. IS: 11384-1985, "Code of Practice for Composite Construction in Structural Steel and Concrete", Bureau of Indian Standards, New Delhi, 1985.

OE 946

WASTE TO ENERGY
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To know the various forms of waste*
- *To understand the processes of Biomass Pyrolysis.*
- *To learn the technique of Biomass Combustion.*

Outcomes: *Upon completing this course, students will be able to:*

1. *Understand the concept of conservation of waste.*
2. *Identify the different forms of wastage.*
3. *Chose the best way for conservation to produce energy from waste.*
4. *Explore the ways and means of combustion of biomass.*
5. *Develop a healthy environment for the mankind.*

UNIT-I:

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II:

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Suggested Reading:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OE947

INTERNET OF THINGS
(Open Elective)

Instruction: 3periods per week — Duration of SEE: 3 hours
CIE: 30 marks — SEE: 70 marks
Credits: 3

Course Objectives:

- To understand the concepts of Internet of Things and able to build IoT applications
- To learn the programming and use of Arduino and Raspberry Pi boards.
- To know about data handling and analytics in SDN.

Course Outcomes:

After Completion of the course Student will be able to:

1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT – I

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT – II

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT – III

Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT - IV

Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT - V

Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

Suggested Readings:

1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by PethuruRaj and Anupama C. Raman (CRC Press).
2. “Make sensors”: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.
3. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti Vijay Madisetti,
4. ArshdeepBahga, “Internet of Things: A Hands-On Approach”
5. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
6. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013

OE948

CYBER SECURITY

(Open Elective)

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives

- Learn the various threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and IT laws and policies

Course Outcomes:

After completion of this course, the students shall be able to:

1. Understand the various network threats.
2. Analyze the forensic tools for evidence collection.
3. Apply the firewalls for threat analysis.

UNIT-I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT-II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.

UNIT-III

Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, searc and seizure of computer systems, password cracking.

UNIT-IV

Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrival, Email analysis from mobile phones.

UNIT-V

Ethics, Policies and IT Act Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code , Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

Suggested Readings

1. Charles P. Fleeger, "*Security in Computing*", Prentice Hall, New Delhi, 2009.
2. BehrouzA.Forouzan, "*Cryptography & Network Security*", Tata McGraw Hill, India, New Delhi, 2009.
3. William Stallings, "*Cryptography and Network Security*", Prentice Hall, New Delhi, 2006.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "*Network Security: Private Communication in a Public Network*", Pearson Education, New Delhi, 2004.
5. Neal Krawetz, "*Introduction to Network Security*", Thomson Learning, Boston, 2007.
6. Bruce Schneier, "*Applied Cryptography*", John Wiley & Sons, New York, 2004.

MI 125

MAJOR PROJECT PHASE-I

Instruction: 6 periods per week *Duration of SEE: --*
CIE: 100 marks *SEE: --*
Credits: 10

Objectives:

- *Identification of the research problem*
- *Discussion of literature survey.*

Outcomes:

1. *Identification of the objectives of the Research Problem.*
2. *Ability to update the latest literature in chosen area of research & establishment of the scope of work.*
3. *Development of the methodology for the chosen research problem and perform basic theoretical /experiment studies.*

Each student will be attached to a faculty member/guide for project. The student will carry out the project which may be development of Software / Hardware / Simulation studies / Design analysis / Experimental related to his/her specialization. The work will be monitored regularly by the guide. At the end of the semester student will write the report on the work done and submit to the guide. Student has to present his/her work before two faculty members (one guide and other to be appointed by chairman BOS) on a fixed day during last week of the semester in which project is offered. The sessional marks will be awarded jointly by these examiners based on the report, presentation and viva voice

SEMESTER-IV

MI 126

MAJOR PROJECT PHASE-II

Instruction: 32 periods per week *Duration of SEE: --*
CIE: -- *SEE: 200 marks*
Credits: 16

Objectives:

- *Identification of the research problem*
- *Discussion of literature survey.*

Outcomes:

1. *Expand the defined Research Problem for the dissertation work.*
2. *Conduct of Laboratory/analytical/ software studies*
3. *Analysis of Data, development of models, offer solutions to the research problem and provide conclusions of the work.*

The student will carry out the project under allotted supervisor, which may be development of Software / Hardware / Simulation studies / Design analysis / Experimental related to his/her specialization. The work will be monitored regularly by the guide. At the end of the semester student will write the report on the work done and submit to the guide. Student has to present his/her work before two faculty members (one guide and other to be appointed by chairman BOS) on a fixed day during last week of the semester in which project is offered. The final marks will be allotted based on the report, presentation and viva voce conducted by the external examiner whose name is suggested by Chairman BOS