BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA
Mining Engineering

3rd SEMESTER				4th SEMESTER			
THEORY		Contact Hours		*THEORY*		Contact Hours	
Code	*Subject*	*L-T-P*	*Credits*	*Code*	*Subject*	*L-T-P*	*Credits*
BSCM 1205	Mathematics – III	3-1-0	4	PCME4207	Machine Dynamics	3-1-0	4
PCME4201	Fluid Mechanics & Hydraulic Machines	3-1-0	4	BEEE2215	Energy Conversion Techniques	3-0-0	3
PCME4202	Mechanics of Solids	3-0-0	3	BECS2208	Database Management System	3-0-0	3
BECS2212	C++ & Object Oriented Programming	3-0-0	3	HSSM4202	Organizational Behaviour OR	3-0-0	3
				HSSM4201	Engineering Economics & Costing		
HSSM4201	Engineering Economics & Costing OR	3-0-0	3	PCMN4202	Geology	3-0-0	3
HSSM4202	Organizational Behaviour						
PCMN4201	Mine Survey - 1	3-0-0	3	PCMN4203	Mine Development	3-0-0	3
	Credits (Theory)		20		Credits (Theory)		19
PRACTICALS / SESSIONALS				*PRACTICALS / SESSIONALS*			
HSSM7203	Communication & Interpersonal Skills for Corporate Readiness Lab.	0-0-3	2	BECS7208	Database Management System Lab	0-0-3	2
BECS7212	C++ & Object Oriented Programming Lab	0-0-3	2	BEEE7215	Energy Conversion Techniques Lab	0-0-3	2
PCMN7201	Mine Survey - 1 Lab.	0-0-3	2	PCMN7202	Geology Lab.	0-0-3	2
	Credits (Practicals/ Sessionals)		6		Credits (Practicals/Sessionals)		6
	TOTAL SEMESTER CREDITS		26		TOTAL SEMESTER CREDITS		25

BSCM1205 **Mathematics - III**

Module-I (18 hours)
Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type, Monge's method, Second order partial differential equation The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

Module-II (12 hours)
Complex Analysis:
Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping, Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

Module –III (10 hours)
Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration method, evaluation of real integrals.

Text books:
1. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India Reading Chapters: 11,12(except 12.10),13,14,15
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, 2008 Reading chapter: 18

Reference books:
1. E.B. Saff, A.D.Snider, " Fundamental of Complex Analysis", Third Edition, Pearson Education, New Delhi
2. P. V. O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

PCME4201 Fluid Mechanics and Hydraulic Machines

Module I   **(13 Lectures)**

Introduction : Scope of fluid mechanics and its development as a science

Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer.

Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

Fluid kinematics : Introduction, description of fluid flow, classification of fluid flow. Reynold's number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity,

Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net

Module II   **(12 Lectures)**

Fluid dynamics : Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orificemeter, pitot tube.

Flow in pipes and ducts: Loss due to friction, Minor energy losses in pipes Hydraulic Gradient Line (HGL), Total Energy Line (TEL), Power transmission in the fluid flow in pipes, fluid flow in pipes in series and parallel. Flow through nozzles.

Module III   **(15 Lectures)**

Hydraulic turbine: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine.

Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves.

Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation

Centrifugal Pump: constructional features, vane shape, velocity triangles, Efficiencies, Multi stage centrifugal pumps, Pump Characteristic, NPSH and Cavitation.

Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram

Text Books
1.   Fluid Mechanics and Hydraulic Machines, Modi & Seth
2.   Introduction to Fluid Mechanics and Fluid Machines by S.K. Som and G. Biswas, TMH
3.   Fluid Mechanics, A.K.Jain, Khanna Publishers

Reference Books:

1.   Fluid Mechanics by A.K. Mohanty, PHI
2.   Introduction to Fluid Mechanics by Fox, McDonald, Willey Publications
3.   Fluid Mechanics by Kundu, Elsevier
4.   An Introduction to Fluid Dynamics by G.K.Batchelor, Cambridge University Press
5.   Engineering Fluid Mechanics by Garde et. al., Scitech
6.   First course in Fluid Mechanics by Narasimhan, University press
7.   Fluid Mechanics by J.F.Douglas, J.M.Gasiorek, J.A.Swaffield and L.B.Jack, Pearson Education

PCME4202 **Mechanics of Solids**

MODULE - I (14 Lectures)

1. Load, Stress, Principle of St.Venant, Principle of Superposition, Strain, Hooke's law, Modulus of Elasticity, Stress-Strain Diagrams, Working Stress, Factor of safety, Strain energy in tension and compression, Resilience, Impact loads,
   Analysis of Axially Loaded Members : Composite bars in tension and compression - temperature stresses in composite rods, Statically indeterminate problems.
   Shear stress, Complimentary shear stress, Shear strain, Modulus of rigidity, Poisson's ratio, Bulk Modulus, Relationship between elastic constants.

2. Members in Biaxial State of Stress : Stresses in thin cylinders, thin spherical shells under internal pressure - wire winding of thin cylinders. Analysis of Biaxial Stress. Plane stress, Principal stress, Principal plane, Mohr's Circle for Biaxial Stress.

3. Strain Deformation : Two dimensional state of strain, Mohr's circle for strain, Principal strains and principal axes of strain measurements, Calculation of principal stresses from principal strains.

MODULE - II (13 Lectures)

4. Shear Force and Bending Moment for Simple Beams :
   Shear force and bending moment. Types of load and Types of support. Support reactions, Relationship between bending moment and shear force, Point of inflection. Shear Force and Bending Moment diagrams.

5. Simple Bending of Beams :Theory of simple bending of initially straight beams, Bending stresses, Shear stresses in bending, Distribution of normal and shear stress, beams of two materials, Composite beams.

6. Deflection of Beams :Differential equation of the elastic line, Slope and deflection of beams by integration method and area - moment method.

MODULE - III (12 Lectures)

7. Theory of Columns:
   Eccentric loading of a short strut, Long columns, Euler's column formula, Lateral buckling, Critical Load, Slenderness ratio

8. Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, strength of solid and hollow circular shafts. Stresses due to combined bending and torsion, Strength of shafts in combined bending and twisting.

9. Close - Coiled helical springs.

TEXT BOOKS

1.   Elements of Strength of Materials by S.P.Timoshenko and D.H.Young, Affiliated East-West Press
2.   Strength of Materials by G. H. Ryder, Macmillan Press
3.   Strength of Materials by James M. Gere and Barry J. Goodno, Cengage Learning

REFERENCE BOOKS

1.   Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
2.   Mechanics of Materials by R.C.Hibbeler, Pearson Education
3.   Mechanics of Materials by William F.Riley, Leroy D.Sturges and Don H.Morris, Wiley
        Student Edition
4.   Mechanics of Materials by James M. Gere, Thomson Learning
5.   Engineering Machanics of Solids by Egor P. Popov, Prentice Hall of India
6.   Strength of Materials by S.S.Rattan, Tata Mc Graw Hill
7.   Strength of Materials by R.Subramaniam, Oxford University Press
8.   Strength of Materials by Sadhu Singh, Khanna Publishers

BECS2212 **C++ & Object Oriented Programming**

Module I **(08 hrs)**
Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

Module II **(16 hrs)**

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.
Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.
Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.
Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.
Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

Module III **(08 hrs)**

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.
Template: template classes, template functions.
Namespaces: user defined namespaces, namespaces provided by library.

Text Books:
1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

Reference Books:

1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
3. "C++ and Object Oriented Programming" – Jana, PHI Learning.
4. "Object Oriented Programming with C++ "- Rajiv Sahay, Oxford
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)
6. "Object Oriented Programming with C++", David Parsons, Cengage Learning.

HSSM3204 **Engineering Economics & Costing**

Module-I: **(12 hours)**

Engineering Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Determination of equilibrium price under perfect competition (Simple numerical problems to be solved). Theory of production, Law of variable proportion, Law of returns to scale.

Module-II: **(12 hours)**

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

Module-III: **(12 hours)**

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

Text Books:

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
2. M.D. Mithani, Principles of Economics.

Reference Books :
1. Sasmita Mishra, "Engineering Economics & Costing ", PHI
2. Sullivan and Wicks, " Engineering Economy", Pearson
3. R.Paneer Seelvan, " Engineering Economics", PHI
4. Gupta, " Managerial Economics", TMH
5. Lal and Srivastav, " Cost Accounting", TMH

HSSM 3205 **Organizational Behaviour**

Module I :

The study of Organizational Behaviour : Defination and Meaning, Why Study OB
Learning – Nature of Learning, How Learning occurs, Learning and OB.
Foundations of Individual Behaviour : Personality – Meaning and Defination, Determinants of Personality, Personality Traits, Personality and OB.
Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB.
Motivation – Nature and Importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

Module II :

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness, Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership-Leadership & Management, Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader, Confict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

Module-III :

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books :

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.

Reference Books :
1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" Organizational Behaviour" , TATA McGraw- Hill.
5. D.K. Bhattachayya, "Organizational Behaviour", Oxford University Press
6. K.B.L.Srivastava & A.K.Samantaray, "Organizational Behaviour" India Tech
7. Kavita Singh, "Organizational Behaviour", Pearson

PCMN4201 **Mine Survey – I**

Module I
Linear Measurements and chain Survey: uses of various types of chains and tapes. Measurement of correct length of line. Direct and Indirect ranging. Chaining along sloping ground. Obstacles in chaining. Errors and their elimination.

Module II
Compass Surveying – Uses of prismatic compass, temporary adjustment, bearing of a line, local attractions, correction of bearing.
Plane table surveying- Methods of plane table, radiations, intersection, traversing and resection, 2-point and 3-point problem.
Use of Mining type theodolite, Measurement of horizontal and vertical angles.

Module III
Levelling – use of dumpy level and levelling staff. Temporary and permanent adjustment of dumpy level. Reduction of levels by HI and rise & fall method. Error due to curvature & refraction. Sensitiveness of bubble tube, reciprocal levelling, levelling difficulties and common errors.
Contouring – Contour interval and horizontal equivalent. Characteristics of contours and application of contours. Contouring methods.

Books Recommended:
1) Surveying & Labelling. Vol-I by T.P.Kanethar & S.V.Kulkarni.
2) Surveying- Vol.I, by B.C. Purmia
3) Surveying – by Husain & Nagnas.

HSSM7203 Communication & Interpersonal skills for Corporate Readiness Lab.

Lab   **30 hours**

This course will focus on communication in professional (work-related) situations of the kind that BPUT graduates may expect to encounter on entering the professional domain.

Some typical forms of work-related communication, oral or written, are listed below. Practice activities for all four skills can be designed around these or similar situations.

1.   Gaining entry into an organization

     i.   Preparing job-applications and CVs

     ii.   Facing an interview

     iii.   Participating in group discussion (as part of the recruitment process)

2   In-house communication

a.   Superior/ Senior ➔ subordinate / junior (individual ➔ individual / group)
    i.   Welcoming new entrants to the organization, introducing the workplace culture etc.
    ii.   Briefing subordinates / juniors : explaining duties and responsibilities etc.
    ii.   Motivating subordinates / juniors ('pep talk')
    iii. Instructing/ directing subordinates/ juniors
    iv. Expressing / recording appreciation, praising / rewarding a subordinate or junior
    v   Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.

b.   Subordinate / Junior ➔ Superior / Senior
    i.   Responding to the above
    ii.   Reporting problems / difficulties / deficiencies
    iii. Offering suggestions

BECS7212 **C++ & Object Oriented Programming Lab**

1. Programs on concept of classes and objects.(1 class)
2. Programs using inheritance.(1 class)
3. Programs using static polymorphism.(1 class)
4. Programs on dynamic polymorphism.(1 class)
5. Programs on operator overloading.(1 class)
6. Programs on dynamic memory management using new, delete operators.(1 class)
7. Programs on copy constructor and usage of assignment operator.(1 class)
8. Programs on exception handling .(1 class)
9. Programs on generic programming using template function & template class.(1 class)
10. Programs on file handling.(1 class)

PCMN7201 **Mine Survey – 1 Lab**

1. Testing of chain and measurement of correct length of the line.
2. Traversing by chain survey.
3. Traversing by Compass survey.
4. Intersection method of plane table survey.
5. Traversing by plane table.
6. Use of dumpy level and fly levelling.
7. Longitudinal Section and Cross Section of Road.
8. Contouring
9. Measurement of horizontal and vertical angle of theodolite.
10. Traversing by theodolite.

4th Semester

PCME4207 Machine Dynamics (3-0-0)

MODULE – I   (12 Hours)

1. Mechanisms : Basic Kinematic concepts and definitions, Mechanism, Link, Kinematic Pair, Classification of kinematic pairs, Degrees of freedom, Kinematic chain, Binary Ternary and Quaternary joints and links, Degrees of freedom for plane mechanism, Grubler's Equation, Inversion of mechanism, Four bar chains and their inversions, Single slider crank chain, Double slider crank chain and their inversion.

2. Kinematic Analysis : Determination of velocity using graphical and analytical techniques, Instantaneous centre method, Relative velocity method, Kennedy theorem, Velocity in four bar mechanism, Slider crank mechanism, Rubbing velocity at a Pin-joint.
   Acceleration Diagram for a slider – crank mechanism, Corili's component of acceleration and its application.

MODULE – II   (12 Hours)

3. Inertia forces in reciprocating Parts : Velocity and acceleration of piston by analytical method, Angular velocity and angular acceleration of connecting rod by analytical method and by graphical metho, Piston effort, force acting along the connecting rod, Crank effort, Turning moment on crank – shaft.

4. Dynamically equivalent system, compound Pendulum, correction couple.
   Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed.

5. Friction of a screw and nut, Square threaded screw, V-threaded screw, Pivot and collar friction, friction circle, Friction axis, Friction clutches, Transmission of power by single plate, mutiplate and cone clutches.

MODULE – III   (12 Hours)

6. Brakes & Dynamometers : Classification of brakes, Analysis of simple block, Band and internal expanding shoe brake, Braking of a vehicle.
   Absorbing and transmission dynamometers, Prony brake, Rope brake, Band brake dynamometer, Belt transmission dynamometer, Torsion dynamometer.

7. Gear Trains : Simple Train, Compound train, Reverted train, Epicyclic train and their applications.

8. Belt, rope and chain drives, Initial tension, Effect of centrifugal tension on power transmission, Maximum power transmission capacity, Belt creep and slip.

TEXT BOOKS

L.A Textbook of Theory of Machines (In S. I. units) – R. K. Bansal, Laxmi Publication
Chapter : 1, 3, 4, 7, 8, 10, 11, 12.

REFERENCE BOOKS :

L. The Theory of Machines – Thomas Bevan.

BEEE7215 **Energy Conversion Techniques**

MODULE- I   (10 Hrs)

1. <u>DC GENERATORS</u>: Constructional features and operating principles, EMF equation, No Load Characteristics for Separately Excited DC Generator and DC Shunt Generator, Conditions for Self Excitation, Critical Resistance and Critical Speed, Losses and Efficiency.

2. <u>DC MOTORS</u>: Speed~Armature Current, Torque~Armature Current and Speed~Torque Characteristic for (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, Starting, Speed control and application of DC motor.

MODULE- II   (10 Hrs)

3. <u>SINGLE PHASE TRANSFORMERS</u>: Constructional Features, EMF Equation, Turns Ratio, Open Circuit Test and Short Circuit Test, Losses and Efficiency, Introduction to Three Phase Transformers: Three Single Phase Transformers Connected as a Bank of Three Phase Transformer.

4. <u>INDUCTION MOTORS</u>: (a) Three Phase Induction Motors: Constructional Features of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Principle of Operation, Concept of Slip, Slip~Torque Characteristics, Starting of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Speed Control of Induction Motors.

    (b) Introduction to Single Phase Induction Motors: Construction, Principle of Operation and Application.

MODULE- III   (10 Hrs)

5. <u>THREE PHASE SYNCHRONOUS GENERATORS</u>: Constructional Features, Principle of operation as Alternator, Synchronous reactance, Equivalent circuit of alternator, Power-Angle curve, Synchronization of alternators.

6. <u>THREE PHASE SYNCHRONOUS MOTORS</u>: Constructional Features, Principle of Operation, Torque Expression and Phasor Diagram for Synchronous Motor, Electrical Power and Mechanical Power, Starting and application of Synchronous Motor.

Text Book :

1. Electric Machines – D P Kothari & I J Nagrath – Tata McGraw Hill.

Reference Book(s):

2. The Performance and Design of DC Machines – A E Clayton.

3. Theory and Performance of AC Machines – M G Say

4. Electrical Machinery – P S Bimbhra – Khanna Publishers.

5. Electrical Machines – P K Mukherjee and S Chakravorti – Dhanpat Rai Publications.

6. Electric Machinery – Fitzgerald, Charles Kingsley Jr., S. D. Umans – Tata Mc Graw Hill.

7. Electric Machinery And Transformers – Guru & Hiziroglu – Oxford University Press.

8. Electric Machines – Charles Hubert – Pearson Education.

BECS2208 **Database Management System**

Module I : (10 hours)

Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages. Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II : (12 hours)

Relation Query Languages, Relational Algebra and Relational Calculus, SQL.

Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Query Processing Strategy.

Module III: (10 hours)

Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers. Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques

Text Books:
1. Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

References Books:
(1) An introduction to Database System – Bipin Desai, Galgotia Publications
(2) Database System: concept, Design & Application by S.K.Singh (Pearson Education)
(3) Database management system by leon &leon (Vikas publishing House).
(4) Fundamentals of Database Management System – Gillenson, Wiley India
(5) Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, "", 4th Edition, 2005, Elsevier India Publications, New Delhi

PCMN4202 **Geology**

Module I   **14 hours**
Physical Geology:
Introduction, weathering, erosion, transportation, deposition, Geological action of wind, river, glacier and underground water, Earth quakes and volcanoes.
Structural Geology:
Elementary knowledge of rock deformation, structural characteristics of deformed rocks, attitude of rock beds strike, dip: true and apparent, folds and faults, their description, classification, joints, un-conformities, simple forms of igneous rocks, dykes, sills, batholiths, laccoliths, Iropolithis, phacoliths.

Module II   **16 hours**
Mineralogy: Crystals, Axial relationship, symmetry elements and forms of normal classes of cubic Tetragonal, Hexagonal, Orthorhombic, monoclinic and Triclinic, Minerals and their physical properties determinative properties and occurrence of common rock forming minerals, Quartz orthoclase, muscovite, bio tite, Olivine, augite, hornblende, Calcite, dolomite, beryl, tourmaline.
Petrology: General characters of igneous, sedimentary and metamorphic rocks; Description of rocks Viz; granite, diorite, gabbro, dunite, peridofite, peg matite, dolerite, basalt, conglomerate, sand stone, shale, lime stone, quartzite, marble, slate, schist, gneiss, Khondalite and their Indian occurrence.

Module III   **6 hours**
Engineering Geology: Geological considerations in connection with-
   a) Dam and associated reservoirs
   b) Tunnels
   c) Bridges
   d) Ground water.

Text Books:
   1. Text Book of Geology – P.K.Mukherjee
   2. General and Engineering Geology- Parvin Singh
   3. Text Book of Geology- G.B. Mahapatra

Reference Books:
   1. Element of Petrology-Tyrell
   2. Structural Geology- Marland P. Billings
   3. Ruffles Elements of Mineralogy- H.H.Reid
   4. Physical Geology – Sainder Singh

PCMN4203 **Mine Development**

Module I
Exploratory drilling and blast hole drilling: Different types of exploratory drills and methods of core recovery, different types drills bits used. Different types of drills machines used for blastholes and methods of drilling.

Module II
Classification and properties of explosive, detonators, detonating cords and detonating fuse. Nonel detonator. Mechanics of Rock blasting. Blasting practice in u/g and surface mines using modern initiation system.

Module III
Acess to the mineral deposit. Selection, location, size and shape, conventional and special method of shaft sinking, shaft lining. Deepening and widening of shaft.
Raising and winzing.

Books recommended:
1) Surface Mining – Dr. G.B.Mishra
2) Blasting Manual – Sandhu & Pradhan
3) EMT volume – 1
4) SME Hand Book

BECS7208 **Database Managements System Lab**

1. Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)

2. Programs on join statements and SQL queries including where clause. (1 class)

3. Programs on procedures and functions. (1 class)

4. Programs on database triggers. (1 class)

5. Programs on packages. (1 class)

6. Programs on data recovery using check point technique. (1 class)

7. Concurrency control problem using lock operations. (1 class)

8. Programs on ODBC using either VB or VC++. (1 class)

9. Programs on JDBC. (1 class)

10. Programs on embedded SQL using C / C++ as host language. (1 class)

BEEE7215 **Energy Conversion Techniques Lab**

Select any 8 experiments from the list of 10 experiments

1. Determination of critical resistance and critical speed from no load test of a DC shunt generator.
2. Plotting of external and internal characteristics of a DC shunt generator.
3. Starting of DC shunt motors by 3-point/ 4-point starter.
4. Speed control of DC shunt motor by armature control and flux control method.
5. Determination of Efficiency by Open Circuit and Short Circuit test on single phase transformer.
6. Polarity test and Parallel operation of two single phase transformers.
7. Open circuit and Short circuit test of an alternator.
8. Load test of three phase induction motors.
9. Calculation of slip and efficiency of three phase squirrel cage induction motor at full load.
10. Starting of single phase induction motors

PCMN7202 **Geology Lab**

The student will have to go for four weekends for geological tour besides sessional / practical classes in 3rd semester.
1) Study of Physical properties of minerals.
2) Study of important igneous sedimentary and metamorphic rocks.
3) Interpretation of folds and faults from maps.

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BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

MINING ENGINEERING

5th Semester				6th Semester			
Code	**Subjects** **Theory**	**L-T-P**	**Credit**	**Code**	**Subjects** **Theory**	**L-T-P**	**Credit**
HSSM3303	Environmental Engineering & Safety			HSSM3302	Optimization in Engineering		
HSSM3302	OR Optimization in Engineering	3-0-0	3	HSSM3303	OR Environmental Engineering & Safety	3-0-0	3
PCMN4304	Surface Mining	3-0-0	3	PCMN4305	Mine Surveying - II	3-1-0	4
PCMN4303	Under Ground Coal Mining	3-0-0	3	PCMN4307	Under Ground Metal Mining	3-0-0	3
PCMN4301	Mine Machinery	3-0-0	3	PCMN4308	Rock Mechanics & Ground Control	3-1-0	4
PCMN4302	Mine Climate and Ventilation	3-0-0	3			3-0-0	3
					Free Elective-II (Any one)	3-0-0	3
	Free Elective-I (Any one)	3-0-0	3	FEMN6301	a)Electrical Equipments in Mines		
FEML6302	Mining Geology				***Professional Electives(Any One)***	3-0-0	3
FESM6301	Numerical Methods			PCML4304 PEMN6301	a) Material Handling System b) Mine Hazards		
	Theory Credits		**18**		**Theory Credits**		**23**
	Practical/Sessional				Practical/Sessional .		
PCMN7301	Mine Machinery Lab	0-0-3	2	PCMN7305	Mine Surveying - II Lab	0-0-3	2
PCMN7302	Mine Climate and Ventilation Lab	0-0-3	2	PCMN7307	Rock Mechanics & Ground Control Lab	0-0-3	2
PCMN7303	Design Project	0-0-3	2				
PCMN7304	Industrial Training		1	PCMN7306	Mine Hazards Lab	0-0-3	2
			07				
	Practical/Sessional Credits				Practical/Sessional Credits		06
	TOTAL SEMESTER CREDITS		**25**		**TOTAL SEMESTER CREDITS**		**29**
	TOTAL CUMULATIVE CREDITS				**TOTAL CUMULATIVE CREDITS**		

HSSM3303 ENVIRONMENTAL ENGINEERING & SAFETY
(3-0-0)

Module – I
Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution-Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

Module – II
(a)Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.
(b)Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.
(c) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing,

Module – III
Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integratednsteel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipments.

Text Book :
1.   Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2.   Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack
3.   Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

Reference Books
1.   Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2.   Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3.   Environmental Science, Curringham & Saigo, TMH,
4.   Man and Environment by Dash & Mishra
5.   An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6.   Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New Delhi.

HSSM3302 **OPTIMIZATION IN ENGINEERING** (3-0-0)

Module-I   **(10 Hours)**
Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling.
Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming

Module-II   **(10 Hours)**
Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method
Assignment problems: Hungarian method for solution of Assignment problems
Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems
Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

Module-III   **(10 Hours)**
Non-linear programming: Introduction to non-linear programming.
Unconstraint optimization: Fibonacci and Golden Section Search method.
Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method
Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming
Introduction to Genetic Algorithm.

Recommended text books
1. A. Ravindran, D. T. Philips, J. Solberg, *" Operations Research- Principle and Practice"*, Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, *" Optimization for Engineering Design"*, PHI Learning Pvt Ltd

Recommended Reference books:
1. Stephen G. Nash, A. Sofer, *" Linear and Non-linear Programming"*, McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," *Engineering Optimization"*, Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, *"Operations Research"*, Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, *" Operations Research"*, Eighth Edition, Tata McDraw Hill
5. P.K.Gupta, D.S.Hira, *"Operations Research"*, S.Chand and Company Ltd.

PCMN4304 **SURFACE MINING (**3-0-0)

Module-I

Development of Mineral Deposit by open cast method factors affecting for choice of open cast method advantage and disadvantages. Drilling, blasting, loading and transportation in open cast mines, method of stripping, bench parameters, Equipment used for different operations, choice and application   **(21 hrs)**

Module-II

Planning and design of surface mining operations with single bucket excavators, shovel and dragline, ultimate pit configuration, Development of face geometry for B.W.E. continuous surface miners, simulation of surface mining operations and transportation, productivity calculation.   **(18 hrs)**

Module-III

Placer mining and Sea- bed mining, Environmental problems in Surface mining.

(9 hrs)

Books :
1. Surface Mining by Dr. G. B. Mishra
2. Mining of Mineral Deposit by Dr. L. Shevyakov
3. Surface Mining by Dr. S. K. Das.
4. EMT Vol. I by Dr. D. J. Desmukh
5. Winning coal and iron ore by Dr. Deshmukh & Deshmukh.

PCMN4303 **UNDER GROUND COAL MINING** (3-0-0)

Module-I

Coal Mining: Selection of mining methods, classification of method of coal mining.

Pillar Mining Method: Panel system of working, incubation, period, Relation between depth of deposit & size of pillar, percentage of extraction, Man- power calculation, Productivity calculation, Application, development & extraction by B&P Method of mining, Depillaring.   **(15 hours)**

Module-II

Long wall Mining Method: Classification, Application on Development and extraction, face mechanization, Power support.   **(10 hours)**

Module- III

Horizon Mining, Contiguous Mining.. Application & Layout   **(10 hours)**

BOOKS RECOMMENDED:
1. EMT Volume -1
2. Coal Mining: Principles and practices of modern coal mining, New age international 1st Ed, 1997 by R.D.Singh
3. Underground winning of Coal, Oxford and IBH New Delhi, 1992 by T.N.Singh

PCMN4301 MINE MACHINERY (3-0-0)

Module-1:
Prime mover for mining machinery, I.C. Engine, Hydraulic power Pneumatic power, Element of mechanical power transmission gears, coupling, clutch and brake. **(12 hrs)**

Module-II
Wire rope and winding system, Mine hoist: Different types of winders, their constructional features, kinematics, torque and power calculation, speed control, safety devices, cage, skip head gear structure, cage guide, shaft fittings, Man riding system in mines. **(18 hrs)**

Module-III
Belt conveyors, rope haulage, chain conveyor and locomotive their constructional features, power calculation and safety appliances.Mine pump and drainage. **(15 hrs)**

BOOKS :
1. Mine Transport by L. T. Kerelin
2. EMT Volume III by D. J. Desmukh

PCMN4302 MINE CLIMATE AND VENTILATION (3-0-0)

Module-I
Thermal Environment & Psychrometry,: Sources of heat load sources in mines.Effect of heat and humidity on miners. Psychrometry, Cooling power of mine air, Methods of improving of cooling power of mine air, Air conditioning- basic vapour cycle:Mechanics of air flow through mine openings Resistances of airways, Equivalent orifice, distribution of air current control devices in ventilation system. Sampling dust & dust diseases. **(15 hrs)**

Module-II
Natural Ventilation Calculation of NVP, Thermodynamics aspects, Artificial aids to natural ventilation. Mechanical Ventilation Principal types of mine fans, Installation , Operation, Characterstics and selection of mine fans, Fan testing and Out put Control, Fan laws and fan drives, Evasees, Diffusers, Booster fans,Auxiliary ventilation Reversal of currents and controlled recirculation. **(23 hrs)**

Module-III
Ventilation survey: Quantity and Pressure survey: Planning and Design of Ventilation Systems: Mine ventilation design criteria and ventilation design factors, ventilation standards, Ascensional, descensional homotropal, antitropal, central and boundary ventilation systems, Ventilation layouts for coal and metal mining , Network analysis :Hardy-Cross method. Computer application in mine ventilation. **(7 hrs)**

BOOKS:
1. Subsurface Ventilation and Environmental Engineering, Chapman & Hall, 1993
2. Mine Environment and Ventilation, Oxford Press, 5th Impression, 1993.
3. Mine ventilation by Hartman.

FEML6302 MINING GEOLOGY (3-0-0)

Module-I   **(12 hrs)**
Process of formation of mineral deposits. Controls of mineral deposition. Principles and methods of geological, Geophysical and geochemical prospecting.
Module-II   **(15 hrs)**
Mineralogy, mode of occurrence, distribution and commercial uses of important Mineral deposits of India i.e Iron, Chromite, Buxite, Manganise, Copper, Lead- Zinc, Industrial mineral- Mica, Gypsum, Kyanite, Limestone.

Module-III   **(18 hrs)**
Mine Sampling, Estimation of ore reserves and grades, tenor, impurities and quality control.
Engineering Geology: Geological considerations in connection with -
   1. Dam and associated reservoirs
   2. Tunnels.
   3. Bridges.
   4. Ground water.
BOOKS:

FESM6301 NUERICAL METHODS (3-0-0)

Unit –I   **(10 hors)**
Approximation of numbers, Significant figures, Accuracy and precision, Error definition, Round off errors, Error propagation, Total numerical error
Roots of equation: Bisection ethos, False-position method, Fixed point iteration, Newton-Raphson method, Secant method, Convergence and error analysis, System of non-linear equations
Linear algebraic equation: LU decomposition, The matrix inversion, Error analysis and system conditions, Gauss-Siedel method

Unit-II   **(10 hours)**
Interpolation: Newton's divided difference interpolating polynomial, Lagrange interpolating polynomial, Spline interpolation.
Numerical integration: The Trapezoidal rule, Simpson's rule, Newton-Cotes algorithm for equations, Romberg integration, Gauss quadrature

Unit-III   **(10 Hours)**
Ordinary differential equation: Euler method, Improvement of Euler's method, Runge-Kutta methods, System of equations, Multi step methods,
General methods for boundary value problems, Eigen value problems
(Algorithm and error analysis of all methods are included)
Text Book:
   1. S.C. Chapra, R.P.Canale," *Numerical methods for Engineers*", Fifth edition, THM Publication.
Reference Books
   1. S. Kalavathy, " *Numerica methods*", Thomson/ Cengage India K.E. Atkinson," *Numerical analysis,*" Second edition, John Wiley & Sons.

PCMN7301 **MINE MACHINERY LAB** (0-0-3)

1. Model study of Direct rope haulage, Main & Tail rope haulage, Endless rope haulage, Endless rope haulage.

2. Model study of Belt conveyor, Chain conveyor, Shaker conveyor.
3. Study of King- detaching safety hook.
4. Study of rope capeling.
5. Study of Rope splicing.
6. Study of head gear structure.
7. Study of cage guide
8. Study of shaft fittings(cage fittings)
9. Study of centrifugal pump, turbine pump & mono pump.

PCMN7302 **MINE CLIMATE & VENTILATION LAB**. (0-0-3)

1. Determination of relative humidity of mine air using massion and whirling hygrometer.
2. Determination of dust concentration by G.D.S.
3. Determination of dust concentration by conimeter.
4. Determination of cooling power of mine air using Kata Thermometer .
5. Measurement of fan pressure.
6. Plotting of fan characteristic curve.
7. Plotting of dust characteristic curve.
8. Model study of centrifugal fan with reversal arrangement, Axial flow fan.

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PCMN4305 MINE SURVEYING – II (3-1-0)

Module - I:
Triangulation correlation of surface & U/G surveys, verticality of shafts. Measurement of depth of shaft. Setting out of curves for surface & U/G, Stope surveying, Open-Pit surveying, mine plans, sections, projections & their statutory requirements, Mine Models.

Module-II:

Special mine surveys-survey of installations of Mine, EDM & Its Application, GPS ,total station, surveys for connecting National grid.

Module-III:

Elements of Photogrammetry, field astronomy: Principles & Definitions, Determination of true meridian, Latitude, longitude & time.

Books Recommended :
1. Mine Surveying by Mason
2. Surveying by B.C. Punimia
3. Plane & Geodetic Surveying by David Clarke
4. Metalliferous Mine Surveying by Winberg.

PCMN4307 UNDERGROUND METAL MINING METHODS (3-0-0)

Module - I:

Classification and choice of stoping methods, Methods of stoping: open stoping, Supported stoping – breast, underhand and overhand stoping, shrinkage stoping, cut and fill stoping method, sub-level stoping.

Module - II:

Introduction to caving methods: top slicing, sub-level caving, block caving.

Module - III:
Stope mechanization and level interval. Techno-economic analysis on choice of stoping methods, high productivity methods.

PCMN 4308 ROCK MECHANICS & GROUND CONTROL (3-1-0)

Module - I :
Physico-mechanical properties of rocks, elastic & time dependent behavior, Rock mass failure, stress analysis, in-situ stresses & stress distribution around mine openings; ground failure & pressure on supports, stability of wide openings; design of supports in mine openings.

Module - II :
Subsidence : Causes & impact of subsidence, mechanics of surface subsidence, discontinuous & continuous subsidence, monitoring prediction, control & management of subsidence.

Module - III :
Stability of slopes & Monitoring. Mechanics of rock burst & bumps. Instrument & measurement of in-situ stress & rock strength. Photo elasticity & scale model studies, Basics of numerical methods in geo-mechanics with applications.

Books Recommended :
1. Rock Mechanics & Ground control by Dr. B.S. Verma
2. Rock Mechanics by overl & Dual
3. S. M. E.
4. Coal Mine & ground control by s. Peng

FEMN6301 ELECTRICAL EQUIPMENT IN MINES (3-0-0)

Module-I :
Mine power supply: Choice of voltage, surface and underground supply : Tariff
Computation : Mine Cables- Construction, installation, fault location, Gate-end boxes and switch gears, Earthing Methods, protective devices, overload, under-voltage earth leakage, D.C. Supply- rectifiers, storage batteries .

Module-II:
Electrical Equipment: Mining transformer, lighting transformer, A.C. and D.C.Motors speed-torque characteristics, starting, braking, speed control, drives for haulage, ventilation fans, pumps, compressors, electrical locomotives, winders, Introduction to thyristor device, flame proof and intrinsic safety .

Module-III:
Control and instrumentation: Open and closed loop system, remote control, sequence control, winder control of open cast mine equipment, sensor for measurement of various operational, environmental and safety parameters in underground and open cast mines.
Communication and data transmission : Mine telephone system, signaling system, LAN.

Books recommended :
1. Electrical equipment in Mines by H.Cotton .

PCML4304 MATERIAL HANDLING SYSTEMS (3-0-0)

Module - I:
Property of bulk material vis-a-vis different bulk handling operation. classification of bulk material transportation systems.

Module - II :
Design, operation & maintenance aspect of belt conveyor & chain conveyor special conveyor : Their selection & application. Hydraulic & Pneumatic conveying.

Module - III :
Stacking, blending & reclaiming of bulk materials. Automation & on-line monitoring of bulk material handling system. Design of storage system : Silos, bins & Bunkers, Rapid loading system., Merry-go-round systems.

PCMN6301 MINE HAZARDS (3-0-0)

Module - I:

Mine gases: properties, physiological effects, occurrence, detection, and monitoring; Degassification of coal seams; Sampling and analysis of mine atmosphere;

Module - II:

Mine fires, Explosions from firedamp and coal dust.

Module - III:

Rescue and recovery; Inundation of mines and dewatering; Mine illumination, Noise and radiation hazards.

PCMN7305 MINE SURVEYING - II LAB

1. Triangulation survey.
2. Testing of verticality of shaft.

3. Curve setting.

4. Application of EDM, GPS & Total station.

5. Determination of True North.

6. Determination of latitude, Longitude & time of a place.
7. Survey camp for 2 weeks duration.

PCMN7307 ROCK MECHANICS & GROUND CONTROL LAB

1. Preparation of rock sample.

2. Determination of uniaxial tensile strength by braillian method.

3. Determination of point load index of given sample.

4. To determination of point load index of given sample

5. To determine the strength index of supplied specimen by impact strength index (ISI) Appartus.

6. Determination of uniaxial compressive strength by uniaxial compressive testing machine.

7. Determination of slake-durability index of coal & rock.

8. Determination of Triaxial compressive strength by universal testing Machine & plotting of Moh'r circle.

9. Determination of Angle of Internal Frication.

10. Determination of Shear strength of Rock Sample or Soil.

PCMN7306 MINE HAZARDS LAB (0-0-3)

1. Determination of CO, CO_2 ,CH_4, and O_2 in mine air.
2. Analysis of mine gases using Orsat/ Haldane apparatus.

3. Determination of constituents of mines gases using Gas chromatograph.

4. Determination of constituents of coal by proximate analysis.

5. Determination of CPT of coal samples.

6. Determination of inflammability of coal dust using Godbert-Greenwald apparatus..
7. Study of operation of gas mask and self rescuers.
8. Study of operation of BG-174/BG4 SCBA.
9. Measurement of illuminance levels using lux meter.
10. Measuring Leq and noise dose using sound level meters and noise dosimeter.
11. Measurement of radiation hazards using Scintillation counter/GM counter.

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BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

MINING ENGINEERING

7th Semester				8th Semester			
Code	**Subjects** **Theory**	**L-T-P**	**Credit**	**Code**	**Subjects** **Theory**	**L-T-P**	**Credit**
HSSM3401	Entrepreneurship Development	3-0-0	3	PCMN4402	Mine & Mineral Economics	3-0-0	3
PCMN4401	Mine Legislation & Safety	3-1-0	4		*Professional Elective-I (Any one)*		
				PEMN5406	Mine Planning	3-0-0	3
	Free Elective-I (Any one)	3-0-0	3	PEMN5407	Small Scale & Dimensional Stone Mining		
FEMN6401	Mineral Beneficiation						
FEMN6402	Coal Beneficiation				*Free Elective-I (Any one)*	3-0-0	3
	Professional Elective-I (Any one)	3-0-0	3	FEMN6403	GIS & Remote Sensing		
				PECI5416	Finite Element Method of Analysis		
PEMN5401	Advanced Underground Coal Mining						
PEMN5402	Advanced Underground Metalliferous Mining			PEEC5418	Satellite Communication Systems		
PEMN5403	Advanced Surface Mining				*Free Elective-III (Any one)*	3-0-0	3
	Professional Elective-II (Any one)	3-0-0	3	FEMN6404	Geostatistics		
PEMN5404	Computer Applications in Mining			FECE6405	Internet Technology & Applications		
PEMN5405	Computational Geomechanics						
	Theory Credits		**16**		**Theory Credits**		**12**
	Practical/Sessional				Practical/Sessional		
PCMN7401	Industrial Training (Training to be taken after 6th Semester during Summer Vacation)	0-0-3	1	PCMN7404	Project		7
	Free Elective LAB	0-0-3	2	PCMN7405	Comprehensive Viva-Voce		3
FEMN7401	Mineral Beneficiation LAB						
FEMN7402	Coal Beneficiation LAB						
PCMN7402	Project	0-0-3	3	PCMN7406	Seminar		1
PCMN7403	Seminar		1				
	Practical / Sessional Credits		**07**		**Practical / Sessional Credits**		**11**
	TOTAL SEMESTER CREDITS		**23**		**TOTAL SEMESTER CREDITS**		**23**
	TOTAL CUMULATIVE CREDITS				**TOTAL CUMULATIVE CREDITS**		

ENTREPRENEURSHIP DEVELOPMENT (3-0-0)

Module I: Understanding Entrepreneurship
Concept of Entrepreneurship, Motivation for Economic Development and Entrepreneurial Achievement, Enterprise and Society
Why and how to start Business – Entrepreneurial traits and skills, Mind Vrs Money in Commencing New Ventures, Entrepreneurial success and failures, Environmental dynamics and change.
Entrepreneurial Process
Step by step approach to entrepreneurial start up
Decision for Entrepreneurial start up.

Module II: Setting up of a small Business Enterprise.
Identifying the Business opportunity - Business opportunities in various sectors, formalities for setting up small enterprises in manufacturing and services, Environmental pollution and allied regulatory and non-regulatory clearances for new venture promotion in SME sector.
Writing a Business plan, components of a B-Plan, determining Bankability of the project.

Module III: Institutional Support for SME.
Central / State level Institution promoting SME.
Financial Management in small business.
Marketing Management, problems & strategies
Problems of HRM – Relevant Labour – laws.
Sickness in Small Enterprises.
Causes and symptoms of sickness – cures of sickness.
Govt. policies on revival of sickness and remedial measures.

Reference Books:
1. Entrepreneurship Development, Small Business Enterprises, Chavantimath, Pearson.
2. Entrepreneurial Development, S.S. Khanka, S Chand
3. Entrepreneurship, Barringer BR, Ireland R.D., Pearson
4. Entrepreneurship, David H Holt, PHI
5. Entrepreneurship, Kurilko, D.F. and Attodgets RM, Cengage
6. The Dynamics of Entrepreneurial Development & Management, Vasant Desai, HPH.
7. Entrepreneurship, Roy, Oxford
8. Entrepreneurship, Hisrich, Peters, Shepherd, TMH

MINE LEGISLATION AND SAFETY (3-1-0)

Objective:
To give the under graduate students an insight in to legislation related to safety and welfare of the personnel engaged in mining as well as the legislation related to the mineral laws for concession and conservation of the irreplaceable mineral reserves. It does not include the provisions of environmental law which is covered separately

Module I
Provisions of the Mines Act and the rules made there under, viz., the Mines Rules, Mine Vocational Training Rules, Mine Rescue Rules, Mine Crèche Rules and Indian Electricity Rules (selected chapters applicable to mining).
Introduction to Mine Safety – Mines accident reports, records and analysis.
(12 hours)

Module II
Coal Mines Regulations. Metalliferous Mines Regulations. Important circulars of DGMS. Important Bye-laws and standing orders. Recommendations of various mine safety conferences. **(12 hours)**

Module III
Mines and Minerals Regulation and Development Act and rules made there under, viz.: The Mineral Concession Rules, The Mining Lease Rules, Mineral Conservation and Development Rules.
Laws related to off shore Mining and restrictions on the setting up of mining operations or processing etc. in the said Coastal Regulation Zone (CRZ) coastal zone . Overview of the other laws applicable to mining. **(12 hours)**

Text Books: (Government publications)
1. Mines Act
2. Mines Rules
3. Mine Vocational Training Rules
4. Mine Rescue Rules
5. Coal Mines Regulations
6. Metalliferous Mines Regulations
7. Mines and Minerals (Regulation and Development) Act
8. Mineral Concession Rules
9. Mining Lease Rules
10. Mineral Conservation and Development Rules
11. Off shore Area Minerals (Development and Regulation) Act

References Parts applicable to mining only (Government publications)
1. Indian Electricity Rules
2. Workmen's Compensation Act
3. Industrial Disputes Act (Selected parts)
4. Indian Explosive Rules
5. Mines Crèche Rules
6. Industrial Disputes Act
7. Trade union Act

MINERAL BENEFICIATION

Objective
With the progressive depletion of the high grade mineral deposits and the corresponding lowering of the cut of grades for mining, it is desirable that the mining engineers should be familiar with the beneficiation methods. This course aims at such a familiarization so as to enable the graduate mining engineers to supervise the beneficiation plants attached to the mines.

Module I   12 hours
Size analysis of minerals. Laboratory sizing. Testing sieves of Indian standards and other standards used internationally such as BSS, Tyler series, ASTM sieves and IMM series. Differential and cumulative size distributions and plots. Size distribution equations. Industrial screens: their design, selection and operations. Sub sieve sizing. Newton's and Stoke's laws for settling of particles. Free and hindered settling. Design, selection and operation of hydraulic and mechanical classifiers such as Akin's spiral Classifier, Dorr rake classifier, rake and bowl classifier etc. Hydro cyclones and Pneumatic cyclones used for classification of minerals. Partition value curves for screens and classifiers.

Module II   12 hours
Liberation studies and their importance. Role of size reduction in mineral beneficiation. Operational features of different types of crushers such as jaw, gyratory, cone and short head cone crushers, rotary breakers, roll crushers, hammer mills and stamp mills. Principles of tumbling mills. Construction, selection and operation of pebble mills, rod mills and ball mills including tube mills and Hardginge mills. Autogenous and semiautogenous grinding. Kick's, Ritinger's and Bond's laws on energy requirements for size reduction. Open circuit and closed circuit operations in size reduction. Effects of circulating loads.

Module III   12 hours
Principles of density separation of minerals. Dense media separators, dense media cyclones, different types of jigs, spiral concentrators, vibrating tables, cone and tray concentrators, pans, corduories and winnows for mineral concentration. Electrical separation in High Tension rolls, plate and screen plate separators. Different types of dry and wet magnetic separators of low, medium and high intensity. Overview of the surface phenomena and froth flotation of minerals. Rougher, scavenger, cleaner and recleaner operations in mineral beneficiation processes. Dewatering and drying: thickening and filtration.

Text Books:
1. Mineral Processing Technology by B. A. Wills and T. N. Munn - Elsevier 2006
2. Principles of Mineral Dressing by A.M.Gaudin - McCraw-Hill, 1957
3. Mineral Processing Design and Operation by A.Gupta and D.S.Yan -   Elsevier 2006
4. Ore Dressing by R.H.Richards (4 volumes) – Engineering & Mining Journal 1909
5. Ore Dressing Principles and Practice by T.Simon – McGraw Hill Co., 1924
6. A Text Book of Ore Dressing by S.J.Truscott – London Macmillan. 1923

References:
1. Handbook of Ore Dressing by A.F.Taggart - John Wiley and Sons, New York. 1956
2. Handbook of Ore Dressing by A.W.Allen – McGraw Hill Co., 1920
3. Complete Technology Book on Mineral Processing by NPSC Board – Asia Pacific Business Press 2008

COAL BENEFICIATION

Objective:
With the progressive depletion of all the low ash coal deposits and the need of almost all the mined coal to be beneficiated, it is desirable that the mining engineers should be familiar with the coal beneficiation methods. This course aims at such a familiarization so as to enable the graduate mining engineers to supervise the coal beneficiation plants attached to the coal mines.

Module I
Over view of proximate analysis, ultimate analysis, calorific value, petrography and caking properties of coal. Crushing characteristics of coal and associated mineral matter. Rotary breakers, single and double roll crushers, hammer mills, impactors and other coal crushers. Differential breakage and partial deshaling in the coal crushing circuits. Types of screens for sizing of coal. Sink float tests and washability curves. Significance of NGM.
<div align="center">12 hours</div>

Module II
Different equipment and methods for the beneficiation of coal: dense medium separators, coal jigs, dense medium cyclones, water only cyclones, Vorsyle separators, Larcodems and other coal beneficiation equipment, their selection and operation. Media recovery circuits for dense medium drums, baths and cyclones. Froth flotation of coal.
<div align="center">12 hours</div>

Module III
Evaluation of the efficiency of the coal beneficiation processes: ash error, yield error and misplacement. Tests and computations for partition value curve for the coal beneficiation process. Definitions and significance of SG_{50}, Ekcart probable, imperfection value and error area. Effect of particle size on SG50. Use of partition value curves for prediction of coal washery performance. 12 hours

Text Books:

1. Coal Preparation by J.W.Leonard and D.R.Mitchel - American Institute of Mining, Metallurgical, and Petroleum Engineers, 1968.
2. Coal preparation Technology by D.G.Osborne - Kluwer Academic Publishers, 101 Philip Drive, Norwell, MA 02061 (USA)
3. An Introduction to Coal Technology by N.Berkowitz - USA Academic Press,New York, NY, 1979

References:

1. Coal age operating handbook of coal preparation by Paul C. Merritt - Coal Age Mining Informational Services, 1978
2. Coal Preparation for Plant Operators Handbook by South African Coal Processing Soceity
3. Proceedings of International Coal Preparation Congress 2010 - Edited by Rick Q. Honaker

ADVANCED UNDER GROUND COAL MINING

Objective:

For the students who have already studied underground coal mining, this course aims at familiarizing them with advanced methods for higher productivity and difficult mining conditions, as well as techniques to enhance recovery by minimizing mining losses. It is aimed in this course to familiarize the students with large-scale highly mechanized mining methods.

Module I
Advanced Longwall mining methods. Shortwall mining methods. Coal pillar extraction techniques. Application of coal ploughs in underground coal mines. Thick seam mining. Development by Horizon Mining Technique. **(12 hours)**

Module II
Mine back filling: materials and methods**:** mechanical, hydraulic and hydro-pneumatic. Face mechanization in winning, conveying and supporting systems, their selection and organization. Highwall mining. **(12 hours)**

Module III
Hydraulic mining of coal. Under ground gasification of coal. CBM and CMM in mines and their drainage techniques. Overview of coal mining industry in India. **(12 hours)**

Text Books:
1. SME Mining Engineering Handbook (2 Volume Set) by Peter Darling
2. Longwall mining by Syd.S.Peng - Department of Mining Engineering, West Virginia University, 2006
3. Longwall thick seam mining by R.V.Ramani & A.K.Ghosh – N.S.F. (U.S.) 1988
4. Longwall Mining - DIANE Publishing, 1995

Reference:
1. Coal Age Operating Hand Book of Underground Mining Nicholas P. Choronis BCOA/0-A N77.1;1
2. Coal Mining by C.F.Statham – English Universities Press 1961

ADVANCED UNDER GROUND METALLIFEROUS MINING

Objective:
For the students who have already studied under ground metalliferous mining, this course aims at familiarizing them with advanced methods for higher productivity and difficult mining conditions, as well as techniques to enhance recovery by minimizing mining losses. The students will learn about planning and scheduling of underground metalliferous mining, deep mining techniques and novel methods of mining.

Module I   (12 hours)
Responses of various types of rock masses to open stopes, filled stopes and caved stopes. Techno-economic analysis on the choice of stoping methods. Mass production methods: Blast hole stoping method, vertical retreat method (VRM), underground bench blasting, cascade mining method and raise stoping method..

Module II   (12 hours)
Special underground excavations: shaft pockets, ore bins, ore transfers. Special underground drivages: ramps, declines, step mining. Back fill materials: types, characteristics, preparation and filling operations. Problems associated with deep mining.

Module III   (12 hours)
Stope design and production planning, scheduling. Methods of extraction of pillars. Insitu leaching, bore hole mining, under sea mining. Overview of novel mining methods.

Text Books
1. Techniques in Underground Mining: Selection... by Richard E. Gertsch et al – SME 1998
2. Underground Mining Methods: Engineering Fundamentals and International Case Studies by William A. Hustrulid, 2001

References:
1. Elements of Mining by S.R.Lewis - Powell's Books (Portland, OR, U.S.A.)
2. Deep Mining by Jack Spalding – Amazon Books (http://trove.nla.gov.au/work/18076109)
3. An introduction to metalliferous mining by Sydney Higham. Publisher, C. Griffin, 1951.

ADVANCED SURFACE MINING

Objective:
This course aims at familiarizing the students who have already studied surface mining/ opencast mining/ open pit mining, them with advanced treatment of methods for higher productivity and mechanization under widely varied geo-mining conditions, as well as techniques to enhance recovery..

Module I
Ground preparation for surface mining: hill top deposits, deposits on plane ground. Latest developments on surface mining equipment: excavators, dozer – ripper, scraper, and ore hauling equipment. .Design of large scale bench blasting: coal and non coal: cast blasting, coyote blasting, chamber blasting.   **(12 hours)**

Module II
Design of opencast/ open pit mines: shovel – dumper, drag lines, bucket wheel excavators. Ultimate pit design, scheduling. Mining by surface miner. In pit crushing and cross pit conveying techniques. Application of skip transportation in open cast mines. Cross pit conveying.   **(12 hours)**

Module III
Design of mine solid waste dumps. Design of mine haul roads. Equipment used for haul road preparation, calculation of California bearing ratio. Pit slope analysis and design techniques. Reclamation of mined out areas by selective waste dumps. Application of stacker, and reclaimer. Application and use of GPS and Geomedia software. Dragline balancing technique.
(**12 hours)**

Text Books:
1. Surface Mining by G.B.Misra – Dhanbad Publishers 1978
2. Open pit Mine Planning and Design by W.A.Hurstrulid & Mark Kuchta – Amazon Books

References:
1. Safety and Health in Opencase Mines: ILO code of practice – Internationa Labour Organization 1991
2. Safety in opencast mining by N. V. Mel'nikov, M. M. Chesnokov – Alibris
3. Mine Planning and Equipment Selection By Raj K. Singhal -   1998
4. Surface Mining by B. A .Kennedy – SME 1990

COMPUTER APPLICATION IN MINING

Objective:
For undergraduate students who are familiar with the basics of mining engineering as well as the fundamentals of computer programming, this course aims at giving them an over view of how the software used in mining engineering works.

Module I
Overview of computer programming with reference to pseudo codes, C and C++ languages. Principles of plotting pixels and a brief introduction to lines and curves as orderly combinations of pixels. Coordinate system of plotting Mine Survey data and the use of computer graphics for such plotting. Overview of the common well known software packages like Surpac, Intellimine, Crystal etc. **(12 hours)**

Module II
Introduction to computer applications in rock mechanics and support design, blast design, prediction and assessment of blasting results, mine ventilation calculations, dispatch scheduling and other mining applications. Scope and limitations of networking mine offices, stores, work shops etc. to enhance productivity and cost control. **(12 hours)**

Module III
Application of System Simulation to study and solve mining problems. Modeling and simulation of mineral handling and mineral beneficiation systems. Overview of a few well known simulation packages to Mineral processing like JKSIMET, MODSIM etc. **(12 hours)**

Text Books:
1. Fundamentals of Database Systems**,** Elmarsi and Navathe, 3rd edition, Wesley 2000**.**
2. CAD/CAM : Computer Aided Design and Manufacturing**,** Mikell P. Groover, Emory W. Zimmers, Jr. PHI Inida, 1989.

References:
1. Fishman, G. S. (1995). *Monte Carlo: Concepts, Algorithms, and Applications*. New York: Springer
2. Ripley, B. D. (1987). *Stochastic Simulation*. Wiley & Sons.
3. Computer Simulations in Science and Technology Studies by Ahrweiler, Petra, Gilbert Nigel, and F. Ahrweiler editors.**,** Springer Verlag, 1998. ISBN# 3540648712
4. Advances in Stochastic Simulation Methods by Balakrishnan, N. et. al. editors., Birkhauser, 2000. ISBN# 0817641076
5. Simulation Fundamentals Bennett, Brian., Prentice Hall, 1995. ISBN#0138132623 [general]
6. Mineral Crushing and Grinding circuits, Simulation … by A.J.Lynch – Elsevier 2006
7. Modeling and Simulation of Mineral Processing Systems by Peter R. King – Amazon 2001
8. Mine Ventilation and Air Conditioning by Hartman – Wiley International 1961
9. Mine Environmental Engineering by V.S.Vutukuri& Lama – Cambridge University Press 1986

COMPUTATIONAL GEOMECHANICS (3-0-0)

Module-I
Principles of continuum mechanics, Transformation of vector and tensor, Analysis of stress and strain, Mohr's circle of stress and strain in two dimensions, Stress Equilibrium Equation, Airy Stress Function, Strain Compatibility Conditions, Stress-strain Relationship, Linear Isotropic Elasticity, Degree of Anisotropy, Non-linear Elasticity, Plasticity. **(14 hours)**

Module-II
Basics of FEM/FDM/BEM, Discretization of physical system with finite element, Nodal Shape function, Concept of Calculus of Variations, Numerical integration scheme, Assembly into Global Simultaneous unreduced equation, Application of Essential boundary conditions, Determination of Strains, stress and Reaction forces, Tunnel Example. **(14 hours)**

Module-III
Rock and Rock mass failure criterion, Mohr-Coulomb yield criterion, Drucker-Prager criterion, Hoek-Brown criterion, Tensile Yield criterion, Analysis and design of structures and excavations in rocks-surface and underground, Strength and deformability of jointed rock mass. **(8 hours)**

Suggested Books:
1. Deb, D., 2011, Finite Element Method: Concept and Applications in Geomechanics, second Eds., Prentice Hall of India, New Delhi, India.
2. Naylor, D.J. and Pande, G. N., 1981, Finite Elements in Geotechnical Engineering, Pineridge Press, Swansea, UK.
3. Brown, E. T., 1987, Analytical and computational Methods in Engineering Rock Mechanics, Springer.

MINERAL BENEFICIATION LAB. (0-0-3)

Suggested list of experiments:
1. Physical examination and identification of minerals.
2. Crushing of ore/ coal in a jaw crusher and to study the size analysis of the product.
3. To study the jaw crusher and determine the actual capacity and reduction ratio.
4. Verification of Rittinger's Law of crushing in a jaw crusher.
5. Crushing of ore/ coal in a roll crusher and to study the size analysis of the product.
6. Crushing of ore/ coal in a gyratory crusher / pulveriser and to study the size analysis of the product.
7. Crushing of ore/ coal in a cone crusher and to study the size analysis of the product.
8. To study the effect of grinding with grinding time in cylindrical ball mill and rod mill.
9. To separate coal from a mixture of coal and stones or quarts by zigging and determine the weight fractions of the products.
10. To separate a mixture of two minerals of different densities by gravity concentration using Wilfley Table and determine the weight and density of each fraction of the products.
11. Beneficiation of ore pulp mix using flotation cell.
12. To separate a mixture of iron and sand using magnetic separator and determine its efficiency.
13. Screening of ore/ coal using vibrating screen and determine its effectiveness.

COAL BENEFICIATION LAB. (0-0-3)

MINE PLANNING

Module - I:
Principle of Mine Planning, technical consideration in opening up & development of Mineral deposits, linear programming in mine planning.

Module - II:
Location of entries (Shaft, incline, Adit) & Lateral development, planning of mine workings & systems.

Module - III:
Production planning, Economic consideration, estimation of Mine cost & project.
Mine valutation, Mineral policies, conservation, Taxation, trading, company law, capital formation.

Book Recommended
1. Text Book of Mineral Economics by R. T. Desmukh
2. Mineral Economics

SMALL SCALE AND DIMENSIONAL STONE MINING

Objective:
Small-scale and artisan mining has been of considerable economic importance. Lately the mining of dimensioned stones has been increasing in tonnage, value and number of persons employed. This paper is meant for the students to get a clear perception in grasping the inner nature of small- scale and artisan mining intuitively an area of importance in the mining industry.

Module I
Definition and concept of artisan and small-scale mining. Special problems related to artisan and small scale mining. Overview of small scale mining in India: Locations, methods and machinery used. National Mineral Policy on small-scale mining: Concepts and application cluster mining, environmental impacts and mitigation measures.   **(12 hours)**

Module II
Mining of placer deposits: Dry and aqueous extraction, panning, sluicing, hydraulicking, dredging etc, Applicatio and treatment of these method in greater detail. Machinery used for placer mining.   **(12 hours)**

Module III
Mining of dimensional stone deposits: conventional and modern methods. Cutting, sawing, processing and polishing techniques for dimensional stones. Machines used. Legislation related to dimensional stone mining.   **(12 hours)**

Text Books:
1. Artisanal and small-scale mining: challenges and opportunities by Thomas Hentschel, Felix Hruschka, Michael Priester – IIED 2003
2. Small scale gold mining: processing techniques in developing countries by Michael Priester, Thomas Hentschel, German Appropriate Technology Exchange - Vieweg, 1992
3. The Profitable Small Mine, Prospecting to Operation by K.S.Stout - Hawthorne Blvd Books
4. Handbook for Small Mining Enterprises by Earll, F. N., et. al., Montana Bureau of Mines and Geology Bulletin 99, Butte, 1976

References:
1. Operating Ideas for Small Mines by K.S.Stout - MS Book and Mineral Company, 1956
2. Practical Guide for Prospectors and Small Mine Operators by K.S.Stout – MS Book and Mineral Company 1955

MINE AND MINERAL ECONOMICS

Objective:
The aim of this course is to give the students an overview of the economics of exploitation of mineral deposits including valuation of the deposits and mines, modes of financing, budgeting and impact of taxation policies.

Module I
Overview of the mineral industry in India: characterstics and special problems related to mining. Domain of Mineral Economics. Mine productivity concepts, principles and calculations. Mine Organization. Special considerations for strategic minerals. Indian National Mineral policy.   **(12 hours)**

Module II
Concepr of resource and reserve. Ore reserves: classification and estimation. Difference of tenor, grade and specifications of ore. Mineral sampling techniques and ore grade control. Sample salting and error in sampling. Concepts of strategic mineral.   **(12 hours)**

Module III
Mineral taxation systems. Concept of cashflow. Investment analysis: pay back period, accounting rate of return, net present value, internal rate of return, benefit cost ratio. Mining finance: sources and norms of financing. Capital budgeting, balance sheet, profit and loss statements. Mine costing systems, preparation of cost sheets. (This module has to be taught with mining examoles.)   **(12 hours)**

Text Books:
1. The economics of mining by Thomas Arthur Rickard, Walter Renton Ingalls, Herbert Hoover, R. Gilman Brown - Hill Pub. Co., 1907
2. The Cost of Mining by James Ralph Finlay - McGraw-Hill, 1920
3. Mining Economics and Strategy by Ians Charles Runge - SME, 1998
4. Mine Investment Analysis by Donald W. Gentry, Thomas J. O'Neil – SME1984
5. Valuing Mining Companies by Charles Kernot – CRC Press 1999

References:
1. Economic Mining by Charles George Warnford Lock - Spon & Chamberlain, 1895
2. Evaluating Mineral Deposits by Thomas F. Toeies – SME 1998
3. Management of Mineral Resources by Juan P. Camus – SME 2002

GIS & REMOTE SENSING

MODULE-I
Remote sensing- introduction, physics of remote sensing- electromagnetic radiations and their characteristics, thermal emissions, multi-concept in remote sensing, remote sensing satellites and their data products, sensors and orbital characteristics, spectral reflectance curves for earth surface features, methods of remotely sensed data interpretation- visual interpretation, concept of fcc, digital image processing- digital image and its characteristics, satellite data formats, image rectification and restoration, image enhancement- contrast manipulation, spatial feature manipulation, multi-image manipulation

MODULE-II
Fundamentals of GIS: introduction, definition of GIS, evolution of GIS, roots of GIS, definition, GIS architecture, models of GIS, framework for GIS, GIS categories, map as a model, spatial referencing system, map projections, commonly used map projections, grid systems, cartographic symbolization, types of maps, typography, map design, map productions, map applications, data management, models and quality issues: conceptual models, geographical data models, data primitives, data types - raster and vector approach, digital terrain modeling , approaches to digital terrain data modeling , acquisition of digital terrain data, data modeling and spatial analysis, sources of geographical data, data collectors and providers, creating digital data sets, data presentation, data updating, data storage.

MODULE-III
GIS data processing, analysis and visualization: raster based GIS data processing, vector based GIS data processing, human computer interaction and GIS, visualization of geographic information, principles of cartographic design in GIS, generation of information product, image classification and GIS, visual image interpretation, types of pictorial data products, image interpretation strategy, image interpretation process,

Reference Books:
1. Remote Sensing And GIS, M.A. Reddy, B.S. Publication, Hyderabad
2. Introduction Of GIS, Kang-Tsung Chang, Tata Mcgraw-Hill, New Delhi
3. GIS, N. Panigrahi, University Press, Hyderabad

SATELLITE COMMUNICATION SYSTEMS

Module – I (12 Hours)
Introduction to state of satellite communication: Orbital mechanics and parameters, look angle determination, Launches and Lunch vehicle, Orbital effects in communication system performance. Attitude and orbit control system(AOCS), TT&C , Description of spacecraft System – Transponders,
Equipment reliability and space qualification.
Satellite Link Design: Basics of transmission theory, system noise temperature and G/T ratio, Uplink and Downlink design, design of satellite links for specified (C/N) performance.

Module – II (10 Hours)
Analog telephone and television transmission: Energy dispersal, digital transmission
Multiple Access: Multiplexing techniques for satellite links, Comprehensive study on FDMA, TDMA and CDMA. Spread Spectrum Transmission and Reception. Estimating Channel requirements, SPADE, Random access
Application of Satellite communication: Network distribution and direct broad casting TV, fundamentals of mobile communication satellite

Module – III (12 Hours)
Propagation on satellite: Earth paths and influence on link design: Quantifying attenuation and depolarization, hydrometric & non hydrometric effects, ionosphere effects, rain and ice effects
Satellite Antennas: Types of antenna and relationships , Basic Antennas Theory – linear, rectangular & circular aperture. Gain, pointing loss,
Earth station Technology: Earth station design, Design of large antennas – Cassegrain antennas, optimizing gain of large antenna, antenna temperature, feed system for large cassegrain antennas,
Design of small earth station antennas: Front fed paraboloid reflector antennas, offset fed antennas, beam steering, Global Beam Antenna, equipment for earth station

Text Books:
1. Satellite Communication by T. Pratt, C. Bostian. 2nd Edition, John Wiley Co.

Reference Books:
1. Digital Communication with Satellite and Fiber Optic Application, Harlod Kolimbins, PHI
2. Satellite Communication by Robert M. Gagliardi, CBS Publishers

GEOSTATISTICS

Objective:
As the prior estimation of the ore reserves and their classification based on grades as well as categories (proved, indicated, inferred etc.) is being given progressively greater importance in making investment decisions, the course aims at giving the undergraduate students a brief introduction to statistical methods of ores reserve estimation

Module I
Review of probability theory and statistics. Statistical problem solving in geography. Statistical aspects of sampling of bulk materials. Introduction to Geostatistical ore reserve estimation.
(12 hours)

Module II
Brief introduction to Kriging, Indicator kriging, Aggregation, Dissagregation, Turning bands, Spectral simulation, Transition probabilities, Markov chain geostatistics, Markov mesh models, Support vector machine, Boolean simulation, Genetic models, Pseudo-genetic models, Cellular automata, Multiple-Point Geostatistics (MPS) (12 hours)

Module III
Definitions and tools**:** Regionalized variable theory, Covariance function, Semi-variance, Variogram, Kriging, Range (geostatistics), Sill (geostatistics), Nugget effect. Over view of Geostatistical software: gslib, sgems, mgstat, gstat (12 hours)

Text Books:
1. An Introduction to Applied Geostatistics by Isaaks, E. H. and Srivastava, R. M., Oxford University Press, New York, USA. 1989
2. Applied geostatstics with SGems, A Users' Guide By N.Remi et al. - Cambridge University Press, Cambridge 2009

References:
1. Armstrong, M and Champigny, N, 1988, A Study on Kriging Small Blocks, CIM Bulletin, Vol 82, No 923
2. Champigny, N, 1992, Geostatistics: A tool that works, The Northern Miner, May 18
3. Clark I, 1979, Practical Geostatistics, Applied Science Publishers, London
4. David, M, 1977, Geostatistical Ore Reserve Estimation, Elsevier Scientific Publishing Company, Amsterdam
5. Hald, A, 1952, Statistical Theory with Engineering Applications, John Wiley & Sons, New York
6. Honarkhah, M and Caers, J, 2010, Stochastic Simulation of Patterns Using Distance-Based Pattern Modeling, Mathematical Geosciences, 42: 487 - 517 (best paper award IAMG 09)
7. ISO/DIS 11648-1 Statistical aspects of sampling from bulk materials-Part1: General principles
8. Lipschutz, S, 1968, Theory and Problems of Probability, McCraw-Hill Book Company, New York.
9. McGrew, J. Chapman, & Monroe, Charles B., 2000. An introduction to statistical problem solving in geography, second edition, McGraw-Hill, New York.
10. Myers, Donald E.; "What Is Geostatistics?
11. Sharov, A: Quantitative Population Ecology, 1996, http://www.ento.vt.edu/~sharov/PopEcol/popecol.html
12. Yang, X. S., 2009, Introductory Mathematics for Earth Scientists, Dunedin Academic Press, 240pp.

INTERNET TECHNOLOGY & APPLICATIONS

Module – I (12 Hour)
The Internet and WWW
Understanding the WWW and the Internet, Emergence of Web, Web Servers, Web Browsers, Protocols, Building Web Sites
HTML
Planning for designing Web pages, Model and structure for a Website, Developing Websites, Basic HTML using images links, Lists, Tables and Forms, Frames for designing a good interactive website

Module – II (12 Hour)
JAVA Script
Programming Fundamentals, Statements, Expressions, Operators, Popup Boxes, Control Statements, Try…. Catch Statement, Throw Statement, Objects of Javascript: Date object, array object, Boolean object, math object
CSS
External Style Sheets, Internal Style Sheets, Inline Style, The class selector, div & span tag
DOM
HTML DOM, inner HTML, Dynamic HTML (DHTML), DHTML form, XML DOM

Module – III (12 Hour)
CGI/PERL
Introduction to CGI, Testing & Debugging Perl CGI Script, Using Scalar variables and operators in Perl

Java Applet
Introduction to Java, Writing Java Applets, Life cycle of applet

Textbooks
1. Web Warrior Guide to Web Design Technologies, Don Gosselin, Joel Sklar & others,Cengage Learning
Reference Books

1. Web Programming: Building Internet Applications, Chris Bates, Wiley Dreamtech
2. Programming the World Wide Web, Robert W Sebesta, Pearson
3. Web Technologies, Uttam K Roy, Oxford
4. Web Technology: A developer perspective, Gopalan & Akilandeswari, PHI

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