



# 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 integrated steel 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, Dhanpat Rai & Co Publication
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.

**Unconstrained 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.

## PCML4301 **TRANSPORT PHENOMENA** (3-0-0)

### **Module-I: (12 hrs)**

Introduction: Transport Processes, Dimensional Analysis.

Momentum Transfer: Steady & Unsteady Flows; Overall mass, energy & momentum balance; Navier Stokes equation; Newton's Law, Non-Newtonian Fluids; Laminar flow in falling film, flow through conduits etc; Inviscid fluid flow, Viscous flow, Laminar & Turbulent Boundary Layer Theory, Friction Factor; Flow past immersed objects, packed and fluidized bed.

### **Module-II: (15 hrs)**

Mass Transfer: Steady state mass transfer and diffusion; molecular diffusion in gasses, liquid, biological gels and solids; Unsteady state mass transfer under different conditions, mass transfer coefficient, diffusion through porous medium and capillaries; Boundary layer flow and turbulence in mass transfer, Simulation heat, mass and momentum transfer.

### **Module-II: (18 hrs)**

Heat Transfer:

Conduction: Steady State: One Dimensional- Composite wall and cylinder; Multidimensional- Differential heat balance, shape factor, graphical and numerical methods.

Unsteady State: Analytical solutions of one dimensional lumped heat capacity system, heat flow in semi-infinite solid, convection boundary conditions, Heisler chart solutions.

Convection: Natural & forced convection, overall heat transfer coefficient, fouling factor, types of heat exchangers.

Radiation: Physical mechanism, radiation properties, shape factor, heat exchange between non-black bodies, infinite parallel planes, radiation shields, gas radiation.

## PCML4303 **PARTICLE TECHNOLOGY** (3-0-0)

### **Module-I:**

Sampling of solids and slurries- principle, methods, sampling theories, sampling for different application, Indian standards. Production of fine particles and their characterization, Concept of equivalent diameter for small particles. **(12 hrs)**

### **Module-II:**

Particle size distribution and quantification: Gaudin- Schumann, Gaudin-Meloy equation, Rosin-Rammler, Broadbent and Calcott equation . Methods of particle size measurement: Sieving, sedimentation and elutriation, Optical methods, On-line particle size measurement, Computer analysis of size distribution data. **(15 hrs)**

### **Module-III:**

Particle shape characterization – different methods, image analyzers, Surface area measurement – direct and indirect methods, permeability, gas adsorption., Volume and porosity measurements, Bulk solids packing density and ratio, Bulk solids properties – bulk density, true density abrasivity, voidage, friability and flowability. Fundamentals of blending. **(18 hrs)**

### **Books:**

Introduction to Particle Technology by Martin Rhodes

## PCML4302 **COMMINUTION AND CLASSIFICATION** (3-0-0)

### **Module-I:** **(10 hrs)**

Mining and its effect on rock size distribution, Fundamentals of size reduction, Comminution laws; Liberation studies-effect of size on liberation; drop shatter tests and shatter index, single particle breakage and packed bed breakage.

### **Module-II:** **(25 hrs)**

Crushing: Jaw, Gyratory, Cone, Roll crusher, Hammer mills and Rotary breakers, High compression rolls: their construction, operation maintenance and performance aspects. In-pit and portable crushers.

Grinding: Grinding mills principles, construction and their operation, Mill liners, Feed entry, and product discharge mechanisms. Open and closed circuit grinding: Ball, Rod, Pebble, Autogenous and Fluid energy mills. Application of these mills for specific processing requirements: Effect of process parameters on mill performance.

Industrial screening: Fundamentals of screening, Dry and wet screening, Classification of screens, operation and maintenance of different types of industrial screens. Pre-scrubbing and other processes to improve screening efficiency.

### **Module-III:** **(10 hrs)**

Classification: Introducing to different types of classifiers used in mineral industry; Hydrocyclones; construction, operation, maintenance. Efficiency of classifiers, solid and water balance calculations.

### **Books:**

Mineral Processing Technology by B.A. Wills and Tim Napier-Munn

# Free Electives

## PCML5303 **PHYSICAL SEPARATION PROCESSES** (3-0-0)

### **Module-I:**

Separation of particles using Wilfley Table. Performance analysis of a laboratory size mineral Jig, laboratory concentration table treating synthetic mixture samples. **(12 hrs)**

### **Module-II:**

Effect of irrigation water, inclination, angle on the performance of a Mozely Mineral Separator treating various minerals. Demonstration on Multi-gravity separator. **(13 hrs)**

### **Module-III:**

Determination of magnetic content of a given sample using Davis tube magnetic separator, Effect of feed rate, current intensity on separation of magnetic and non-magnetic particles with Low and high intensity magnetic separators. Recovery of minerals by using Electrostatic separator. **(20 hrs)**

### **Books:**

Mineral Processing Technology by B.A. Wills and Tim Napier-Munn

## 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

## FEML4301 **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.

PCML7301 **MATERIAL LAB.**

PCML7302 **COMMINUTION AND CLASSIFICATION Lab**  
(0-0-3)

Estimation of reduction ratios, capacities and efficiencies for various size reduction unit such as Jaw crushers, Roll Crushers, Ball mills etc. Determination of Bond and HGI work index values for the given samples. Performance analysis of laboratory model continuous screen. Calculation of setting velocity of particle.

PCML7303 **PARTICLE TECHNOLOGY Lab** (0-0-3)

Methods of sampling, accuracy and precision of sampling. Determination particle size distribution of powder by Dry sieving, Comparison of wet and dry sieving efficiencies for fine powders, Sieving by alpine air jet sieve sizer, Sub sieve sizing by: Warman cyclosizer, beaker decantation techniques, Andersen Pipette method. Surface area determination. Bulk density, true density and apparent, porosity, variability determination

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