Department of
Environmental Science & Engineering

Syllabi for:
B.Tech Environmental Engineering

Effective from 2012-13

Indian School of Mines
Dhanbad- 826004
Jharkhand, India

PHYSICS (GROUP-I)

Sr No	Course Number	Course offering Department	Name of the course	L	T	P	Total Credit Hours
			SEMESTER I – Physics Group				
			THEORY				
1	AMC 11101	AM	Mathematics-I	3	1	0	7
2	APC 11101	AP	Physics	3	0	0	6
3	MMC 11101	ME & MME	Engineering Graphics	1	4	0	6
4	EEC 11101	EE	Electrical Technology	3	1	0	7
5	MMC 11103	ME & MME	Engineering Mechanics	3	1	0	7
6	GLD/CMD 11301	AGL & ESE	Earth System Science (S) [AGL 2-0-0 & ESE 1-0-0]	3	0	0	6
7	HSC 12305	HSS	Value Education, Human Rights and Legislative Procedure (S)	3	0	0	6
			PRACTICAL				
8	APC 12201	AP	Physics Practical	0	0	3/2	1.5
9	EE 12201	EEC	Electrical Technology Practical	0	0	3/2	1.5
			Total	**19**	**7**	**3**	**48**

CHEMISTRY (GROUP-II)

Sr No	Course Number	Course offering Department	Name of the course	L	T	P	Total Credit Hours
SEMESTER I – Chemistry Group							
			THEORY				
1	AMC 11101	AM	Mathematics-I	3	1	0	7
2	ACC 11101	AC	Chemistry	3	0	0	7
3	MMC 11102	ME & MME	Manufacturing Process	1	4	0	6
4	ECE 11101	ECE	Electronics Engineering	3	0	0	6
5	CSE 11301	CSE	Computer Programming (S)	3	0	0	6
6	DMS/AP 11301	DMS & AP	Disaster Management [DMS 2-0-0] & Energy Resources [AP 1-0-0] (S)	3	0	0	6
7	HSC 11103	HSS	English for Science & Technology	3	0	0	6
			PRACTICAL				
8	ACC 12201	AP	Chemistry Practical	0	0	3/2	1.5
9	ECE 11201	ECE	Electronics Engineering Practical	0	0	3/2	1.5
10	CSE 12301	CSE	Computer Programming Practical (S)	0	0	2	2
			Total	**19**	**5**	**5**	**48**

CHEMISTRY (GROUP-I)

Sr No	Course Number	Course offering Department	Name of the course	L	T	P	Total Credit Hours
		SEMESTER II – Chemistry Group					
			THEORY				
1	AMC 12101	AM	Mathematics-II	3	1	0	7
2	APC 11101	AP	Physics	3	0	0	6
3	MMC 11101	ME & MME	Engineering Graphics	1	4	0	6
4	EEC 11101	EE	Electrical Technology	3	1	0	7
5	MMC 11103	ME & MME	Engineering Mechanics	3	1	0	7
6	GLD/CMD 11301	AGL & ESE	Earth System Science (S) [AGL 2-0-0 & ESE 1-0-0]	3	0	0	6
7	HSC 12305	HSS	Value Education, Human Rights and Legislative Procedure (S)	3	0	0	6
8	SWC 12701	DSW	Co-Curricular Activities (Only for 2nd Semester)	0	0	0	(3)
			PRACTICAL				
8	APC 12201	AP	Physics Practical	0	0	3/2	1.5
9	EE 12201	EEC	Electrical Technology Practical	0	0	3/2	1.5
			Total	19	7	3	48 + (3)

PHYSICS (GROUP-II)

Sr No	Course Number	Course offering Department	Name of the course	L	T	P	Total Credit Hours
			SEMESTER II – Physics Group				
			THEORY				
1	AMC 12101	AM	Mathematics-II	3	1	0	7
2	ACC 11101	AC	Chemistry	3	0	0	7
3	MMC 11102	ME & MME	Manufacturing Process	1	4	0	6
4	ECE 12101	ECE	Electronics Engineering	3	0	0	6
5	CSE 11301	CSE	Computer Programming (S)	3	0	0	6
6	DMS/AP 11301	DMS & AP	Disaster Management [DMS 2-0-0] & Energy Resources [AP 1-0-0] (S)	3	0	0	6
7	HSC 11103	HSS	English for Science & Technology	3	0	0	6
8	SWC 12701	DSW	Co-Curricular Activities (Only for 2nd Semester)	0	0	0	(3)
			PRACTICAL				
8	APC 12201	AP	Chemistry Practical	0	0	3/2	1.5
9	ECE 12201	ECE	Electronics Engineering Practical	0	0	3/2	1.5
10	CSE 12301	CSE	Computer Programming Practical (S)	0	0	2	2
			Total	19	5	5	48 + (3)

THIRD SEMESTER

S. No	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1.	ESC 131 01	Environmental Chemistry	3-1-0	7
2.	ESC 131 02	Environmental Biology and Ecology	3-1-0	7
3.	ESC 131 03	Geology for Environmental Engineers	3-1-0	7
4.	MMR 131 01	Mechanical Engineering -1	3-1-0	7
5.	AMR 131 01	Methods of Applied Mathematics I	3-1-0	7
Practicals/Etc.				
1	ESC 132 01	Environmental Chemistry	0-0-2	2
2	ESC 132 02	Environmental Biology and Ecology	0-0-2	2
3	ESC 132 03	Geology for Environmental Engineers	0-0-2	2
4	ESC 134 01	Project Work	0-0-2	2
		Total	**15-5-8**	**43**
		Contact Hours	**28**	

FOURTH SEMESTER

S.No	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1.	ESC141 01	Environmental Microbiology	3-1-0	7
2	ESC 141 02	Air Pollution	3-1-0	7
3	ESC141 03	Environmental Hydraulics	3-0-0	6
4.	MMR 141 01	Mechanical Engineering –II	3-1-0	7
5.	AMR 141 01	Numerical and Statistical Methods	3-1-0	7
Practicals / Etc.				
1	ESC142 01	Environmental Microbiology	0-0-2	2
2	ESC142 02	Air Pollution	0-0-2	2
3	ESC 142 03	Environmental Hydraulics	0-0-2	2
4	AMR 142 01	Numerical and Statistical Methods	0-0-2	2
5	ESC 144 03	Industrial Visit/Report	0-0-0	(1)
6	ESC 145 01	Composite Viva -Voce	0-0-0	(4)
7.	SWC 147 01	Co-Curricular Activity	0-0-0	(3)
8	ESC 144 01	Project Work	0-0-2	2
		Total	**15-4-10**	**44 +(8)**
		Contact Hours	**29**	

Note: Industrial visits conducted in III and IV Semesters will be credited together in IV Semester only.

FIFTH SEMESTER

S. No	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1	ESC 15101	Environmental Geotechnology	3-1-0	7
2	ESC 15102	Land Resource Management	3-1-0	7
3	ESC 15103	Water Resources Planning and Management	3-1-0	7
4	ESC 15104	Design of Air Pollution Control System	3-1-0	7
5	ACC 151 04	Instrumental Methods for Environmental Analysis	3-1-0	7
Practiclas /Etc.				
1	ESC 152 01	Environmental Geotechnology	0-0-2	2
2	ESC 152 02	Land Resource Management	0-0-2	2
3	ACC 152 04	Instrumental Methods for Environmental Analysis	0-0-2/2	1
4	ESC 156 01	Vocational Training *	0-0-0	(5)
5	ESC 154 01	Project Work	0-0-4	4
		Total	**15-5-9**	**44 +(5)**
		Contact Hours	**29**	

* Vocational training taken at the end of IVth Semester is credited in V[th] Semester.

SIXTH SEMESTER

S. No.	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1	ESC161 01	Principle and Design of Water Supply System	3-1-0	7
2	ESC161 02	Solid Waste Management	3-1-0	7
3	ESC161 03	Remote Sensing and GIS	3-1-0	7
4	ESC161 04	Environmental Policy and Legislation	3-1-0	7
5.	ESC161 05	Environmental Aspects of Industries	3-1-0	7
Practicals/Etc.				
1	ESC 16201	Principle and Design of Water Supply System	0-0-2	2
2	ESC 16202	Solid Waste Management	0-0-2	2
	ESC 16203	Remote Sensing and GIS	0-0-2	2
3	ESC 16105	Seminar	0-0-0	(2)
4	ESC 16401	Industrial Visit/Report	0-0-0	(1)
6.	ESC165 01	Composite Viva -Voce	0-0-0	(4)
7.	ESC 16402	Project Work	0-0-4	4
		Total	**15-5-10**	**45 + (7)**
		Contact Hours	**30**	

Note: Industrial visits conducted in V and VI Semesters will be credited together in VI Semester only.

SEVENTH SEMESTER

S. No	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1.	ESC171 01	Environmental Impact Assessment	3-1-0	7
2.	ESC171 02	Municipal Wastewater Engineering	3-1-0	7
3.	ESC171 03	Noise Pollution and its Control	3-1-0	7
4.	ESC 171 04	Environmental Systems Optimisation and Modelling	3-1-0	7
5. *Elective Papers*		***(any one)***	3-0-0	6
	ESE 171 01	Hazardous and Biomedical Waste Management		
	ESE 171 02	Climate Change and its Mitigation		
	ESE 171 03	Environmental Economics		
	HSS 17345	Social and Ethical Issues in Engineering		
Practicals/Etc.				
1	ESC 172 01	Environmental Impact Assessment	0-0-2/2	1
2	ESC 172 02	Municipal Wastewater Engineering	0-0-2	2
3	ESC 172 03	Noise Pollution and its Control	0-0-2/2	1
4	ESC 174 02	Seminar	0-0-0	(2)
5	ESC 176 01	Vocational Training *	0-0-0	(5)
6	ESC 174 01	Project Work	0-0-6	6
		Total	**15-4-10**	**44 +(7)**
		Contact Hours	**29**	

* Vocational training taken at the end of VIth Semester is credited in VIIth Semester.

EIGHTH SEMESTER

S. No	Subject Code	Name of the Course	L T P	Credits
Theory Papers				
1.	ESC 181 01	Environmental Management System and Auditing	3-1-0	7
2.	ESC 181 02	Industrial Wastewater Treatment	3-1-0	7
3.	ESC 181 03	Occupational Health, Safety and Risk Assessment	3-1-0	7
4.	MSC 17351	Managerial Economics	3-0-0	6
5. *Elective Papers*		***(any one)***	3-0-0	6
	ESE 181 01	Environmental Toxicology & Health		
	ESE 181 02	Environmental Biotechnology		
	ESE 181 03	Environmental Nanotechnology		
	ESE 181 04	*Rehabilitation and Resettlement Issues*		
Practicals/Etc.				
1	ESC 18201	Industrial Wastewater Treatment	0-0-2/2	1
2	ESC 18401	Seminar	0-0-0	(2)
3	ESC 185 01	Composite Viva –Voce	0-0-0	(4)
4	ESC 184 01	Project Work	0-0-6	6
		Total	**15-3-7**	**40 + (6)**
		Contact Hours	**25**	

CORE COURSE SYLLABI
(Effective from 2012-2013)
I & II SEMESTERS

AMC 11   MATHEMATICS-I   (3–1–0)

Calculus-I: Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurin's expansion of functions of single variable, Functions of several variables, partial derivatives, Euler's theorem, derivatives of composite and implicit functions, total derivatives, Jacobian's, Taylor's and Maclaurin's expansion of functions of several variables, Maxima and minima of functions of several variables, Lagrange's method of undetermined multipliers, Curvature and asymptotes, concavity, convexity and point of inflection, Curve tracing.

Calculus-II: Improper integrals, convergence of improper integrals, test of convergence, Beta and Gamma functions and its properties, Differentiation under integral sign, differentiation of integrals with constant and variable limits, Leibnitz rule.

Evaluation of double integrals, Change of order of integrations, change of coordinates, evaluation of area using double integrals, Evaluation of triple integrals, change of coordinates, evaluation of volumes of solids and curved surfaces using double and triple integrals. Mass, center of gravity, moment of inertia and product of inertia of two and three-dimensional bodies and principal axes.

Trigonometry of Complex Number, 3D Geometry and Algebra: Function of complex arguments, Hyperbolic functions and summation of trigonometrical series.

3D Geometry: Cones, cylinders and conicoids, Central conicoids, normals and conjugate diameters.

Algebra: Convergency and divergency of Infinite series. Comparison test, D' Alembert's Ratio test, Raabe's test, logarithmic test, Cauchy's root test, Alternating series, Leibinitz test, absolute and conditional convergence, power series, uniform convergence.

AMC 12101   MATHEMATICS- II   (3–1–0)

Vector Calculus and Fourier Series:

Vector Calculus: Scalar and vector fields, Level surfaces, differentiation of vectors, Directional
derivatives, gradient, divergence and curl and their physical meaning, vector operators and expansion formulae, Line, surface and volume integrations, Theorems of Green, Stokes and Gauss, Application of vector calculus in engineering problems, orthogonal curvilinear coordinates, expressions of gradient, divergence and curl in curvilinear coordinates.

Fourier Series: Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Perseval's formula, complex form of Fourier series.

Matrix Theory: Orthogonal, Hermitian, skew- Hermitian and unitary matrices, Elementary row and column transformations, rank and consistency conditions and solution of simultaneous equations, linear dependence and consistency conditions and solution of simultaneous equations, linear dependence and independence of vectors, Linear and orthogonal transformations, Eigen values and Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to normal forms, quadratic forms, reduction of quadratic forms to canonical forms, index, signature, Matrix calculus & its applications in solving differential equations.

Differential Equations: Differential Equations of first order and higher degree, Linear independence and dependence of functions. Higher order differential equations with constant coefficient, Rules of finding C.F. and P.I., Method of variation of parameter Cauchy and Legendre's linear equations, Simultaneous linear equations with constant coefficients, Linear differential equations of second order with variable coefficients; Removal of first derivative (Normal form), Change of independent variable, Applications of higher order differential equations in solution of engineering problems.

Partial Differential equations: Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations, and Charpit's method, Homogeneous and non-homogeneous linear P.D.E. with constant coefficients, Rules for finding C.F. & P.I.

Recommended books for Mathematics I & II:

1. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw-Hill.
2. Advanced Engineering Mathematics by R.K. Jain and S.R.K. Iyengar, Narosa Publishing House.
3. Calculus and Analytic Geometry by G.B. Thomas and R.L. Finney, Narosa Publishing House.
4. Advanced Engineering Mathematics by M.D. Greenberg, Pearson.
5. Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers.

APC11101/APC12101   PHYSICS   (3–0–0)

Thermal Physics: Concepts of distribution of molecular velocities; Distribution laws and statistics MB, FD and BE, mean free path; Transport phenomena-viscosity, diffusion; thermal conductivity, measurement of thermal conductivity; periodic and aperiodic flow of heat; Wiedemann-Franz law. Heat radiation; black body and black body radiation; Planck's distribution law and its application to classical distribution (Rayleigh-Jeans and Wiens) and total radiation (Stefan-Boltzmann) laws.

Modern Physics: Brief idea of molecular spectra; Rigid rotator, spectra of simple molecules, rotation and rotation-vibration spectra. Brief idea of wave pocket and wave function, Schrödinger equation, Particle in a Box. Free electron theory; qualitative idea of band theory of solids and Hall effect, Laser and laser systems (He-Ne and Ruby Lasers).

Electromagnetics and Electrical Phenomena in Rocks: Maxwell's field equation, Equation of electromagnetic field, Propagation of electromagnetic waves in different isotropic media, energy of electromagnetic waves, Poynting's theorem & Poynting's vector. Rocks and minerals as dielectrics, electrical conductivity and electrical phenomena in rocks, Piezo-, ferro-, tribo-, and pyro-electricity.

Recommended Books:

1. Heat And Thermodynamics; Brij Lal & Subrahmanyam; S Chand & Co Ltd; 2001
2. Thermal And Statistical Physics; R B Singh; New Age Publications; 2009
3. An Introduction To Thermal Physics; Schroeder; Dorling Kindersley India; 2007
4. Thermal Physics And Statistical Mechanics; Roy & Gupta; New Age Publications; 2001
5. Concepts Of Modern Physics; Beiser; McGraw-Hill Science; 2010
6. Modern Physics; Sivaprasath & Murugeshan; S. Chand Publisher; 2009

APC11201/APC12201   PHYSICS PRACTICAL   (0–0–3/2)

Measurement of thermal conductivity of bad conductors, Optical experiments on Diffraction using diffraction grating, Experiments on Semi-conductors – Measurement of band gap and Hall Effect,

experiments using He-Ne Laser - Diffraction Experiments to measure diameter of circular aperture, Polarisation Experiments to measure Brewster's angle & refractive index.

ACC11101 / ACC11102   CHEMISTRY   (3- 0- 0)

Cement: Manufacturing, composition, setting and hardening of cement.

Glass : Types of Glasses, Manufacturing & properties of Glasses.

Polymer : Classification, structure-property relationship, conductive polymers.

Solid Fuel : Structure of coal, classification of coal, Effect of heat on coal, carbonization and pyrolysis. Recovery and purification of byproducts obtained from coke ovens; Distillation of coal tar; coal.

Liquid fuel: Composition of crude oil, processing of crude oil, distillation, sweetening and cracking (basic concepts), octane number, Cetane number. Additives to improve the quality of diesel and petrol, bio-diesel.

Gaseous fuel: Characteristics of good fuel; calorific value, theoretical calculations of calorific value of a fuel, natural gas and hydrogen gas.

Phase rule & Phase equilibrium: Phase rule; degree of freedom, one and two component systems, temperature and composition diagrams, liquid-liquid and liquid-solid phase diagrams.

Lubricants: General characteristics of lubricants, chemistry of lube oil and greases. Reclamation of lubricants.

Equlibrium: Electrochemistry; Electric potentials at interfaces, electrodes, batteries. electrochemical cells and their applications.

Corrosion: Chemical and electrochemical corrosion, classification, factors affecting corrosion, Form of corrosion and general methods of corrosion prevention.

ACC12101 / ACC12102 CHEMISTRY PRACTICAL (0- 0- 3/2)

1. Standards of HCl by Standard Sodium Carbonate solution

2. Determination of Temporary Hardness of tap water.

3. Estimation of Total Hardness of water.

4. Determination of Iron in Ferrous Ammonium Sulphate solution (Redox titration).

5. Determination of Copper in crystallized Copper-Sulphate.

6. Estimation of available Chlorine in Bleaching Powder.

7. Determination of Molecular Weight of Organic Acid by Titration method.

8. Estimation of Sodium Carbonate and bicarbonate in a mixture.

9. To determine the saponification number of an oil.

10. To determine the rate of hydrolysis of methyl /ethyl acetate.

11. To prepare Chrome Alum.

Recommended Books:

1. ATextbook of Engineering Chemistry-Sashi Chawla

2. Applied Chemistry:ATextbook for Engineers and Technologists - H.D.Gesser.

3. Engineering Chemistry - P.C.Jain & Monika Jain

4. Engineering Materials - K.G. Budinski

MMC 11101/ MMC 12101   ENGINEERING GRAPHICS (1 – 4 – 0)

Introduction: Drawing instruments and their uses; Indian standards for drawing. Lettering and Types of lines used in engineering graphics.

Curves used in engineering practice: Conic sections, ellipse, parabola, hyperbola, cycloid, epicycloid, hypocycloid, involutes and spiral.

Projections: Orthographic projection, projection of points in different quardrants, projection of lines, projection of lines parallel to one and inclined to the other reference plane, projection of lines inclined to both the reference planes.

Multi view orthographic projections: First angle and third angle projections, conventions used, Conversion of three-dimensional views to orthographic views.

Projection of Solids and Development of surfaces

Isometric projections: Isometric views, conversion of orthographic views to isometric views.

Recommended Books:
1. Engineering Drawing - N D Bhatt
2. Engineering Graphics - S C Sharma & Naveen Kumar
3. Engineering Drawing - P S Gill
4. Engineering Drawing with Auto-CAD - Parvez, Khan & Khalique

MMC 111021/ MMC 12102 MANUFACTURING PROCESSES (1-4-0)

Carpentry:- Classification of timber, seasoning & preservation to wood, description and application of the various tools used in carpentry, different joints and their practical uses.

Forming-Introduction to deformation and forming, types of forming processes and their applications, safety rule.

Casting: Introduction to foundry. pattern making, types of casting processes, purpose of runner and riser. application of casting, defects in casting. safety rules.

Fitting: Introduction to fitting jobs, fitting tools and their uses. safety rules.

Welding: Welding types, accessories. weldments.

Machine Tools: Types of cutting tools, types of machine tools and their specifications, safety rules.

Measurement: Use of measuring instruments etc for product measurement.

Recommended Books:

1. Workshop Technology part I, II & I IJ------------------ W A J Chapman
2. Workshop lechnology part I & II ------------------- Hazra Chowdhary
3. Workshop Technology part I & II ------------------- Raghuvanshi
4. Workshop Technology ------------------- S.K. Garg
5. Manufacturing Technology ------------------- P. N. Rao
6. A Text book of Workshop Technology --------------- R S Khurmi & J K Gupta

EEC 11102/12102   ELECTRICALTECHNOLOGY   (3 - 0 - 0)

Concepts of circuit elements: active and passive elements; resistance, inductance, capacitance; mutual inductance and coupling. Network theorems (KCL, KVL, Thevenin, Norton, Maximum power transfer). Mesh and nodal analysis of DC circuits.

Single-phase AC circuits and concept of phasor diagram, series and parallel resonance. Three-phase AC circuits with balanced and unbalance loads. Measurement of three-phase power by two-wattmeter method.

Single-phase transformer: construction, types, e.m.f equation, equivalent circuit diagram, hysteresis and eddy current losses, efficiency, applications.

DC Machines – construction and types, e.m.f and torque equation. DC generator – operation, e.m.f. equation, OCC, losses and efficiency, applications. DC motor – operation, torque equation, starting, losses and efficiency, applications.

Three-phase induction motor: construction, types, operation, torque equation, torque slip characteristics, starting methods, applications.

Recommended Books:
1. Electrical Engineering Fundamentals - V Del Toro.
2. Basic Electrical Engineering (Special Indian Edition) - J J Cathey, S A Nasar, P Kumar.
3. Hughes Electrical and Electronic Technology - E Hughes, I M Smith, J Hiley, K Brown.
4. Basic Electrical Engineering - D P Kothari and I J Nagrath.
5. Electric Machinery - A E Fitzgerald, C Kingsley, S D Umans.

EEC11201/12201 ELECTRICAL TECHNOLOGY PRACTICAL (0 - 0- 3)

Experiments on Thevenin's theorem, R-L-C series circuit, Single phase power measurement, Characteristics of fluorescent lamp and incandescent lamp, OC and SC tests of single phase transformer, Open- circuit characteristics of DC separately excited generator, External Characteristics of separately excited DC generator, Three-point starter of DC shunt motor, Speed control of DC motor.

ECC 11101/12101   ELECTRONICS ENGINEERING (3-0-0)

Semiconductor Diodes and Applications – Introduction Characteristics, dc and ac resistances of a diode. Half wave and Full wave rectification. Zener Diodes and then use as regulators, Clippers and Clampers.

Bipolar Junction Transistor – Introduction, Transistor operation CB, CE and CC configuration, dc Biasing, Operating Point, Fixed Bias Circuit, Emitter – Stabilized Bias Circuit. Voltage Divider Bias.

BJT Transistor – Amplification in ac domain, Equivalent transistor model. Hybrid Equivalent model, RC coupled amplifier and its frequency response.

Operational Amplifiers – Introduction, Differential and Common Mode Operation, OPAMP Basics, Practical OPAMP Circuits.

Introduction to Field Effect Transistors and their applications.

Digital Electronics – Review of Basic Gates and Boolean Algebra, Introduction to Combinatorial Logic Design. Standard Representations of Logical Functions and their simplification. Combinatorial Logic Design, Half Adder and Full Adder.

Recommended Books:
1.   Electronic Device and Circuit Theory - Boylestad & Nashelsky
2.   Digital Principles & Applications   - Malvino & Leach

ECC 11201/12201   ELECTRONICS ENGINEERING (LAB) (3-0-0)
1.   Study of Electronic Equipment & Components.
2.   Study of diode characteristics.
3.   Study of regulated power supply.
4.   Study of BJT characteristics.
5.   Study of op-amp characteristics.
6.   Implementation of Boolean algebra using logic gates.
7.   Adder Circuits.

MMC 11103/MMC12103 ENGINEERING MECHANICS (3-1-0)
Fundamentals of Mechanics: Equivalent force systems, Equilibrium of rigid bodies.
Introduction to structural mechanics: Trusses, Frames, Machines, Beams, and Cables.
Friction force analysis: Sliding and Rolling friction, Screw, Belt and Collar friction
Properties of surfaces: Centroid of composite bodies, Pappus-Guldinus theorem, moment of

inertia of composite bodies, parallel axis theorem, product of inertia, principal axes, Mohr's
circles for moments and products of inertia.

Virtual work: Principle and applications, Stability of equilibrium.

Kinematics and kinetics of particles: Curvilinear motion, Dynamic equilibrium, Angular
momentum, Revision of Conservation of Energy, Energy and Momentum methods for Single
Particle and for a System ofPartic1es, Impulsive motion.

Kinematics of rigid bodies: General plane motion, Instantaneous center of rotation, Planer
motion relative to a rotating frame, Coriolis acceleration, Frame of reference in general motion.

Kinetics of rigid bodies: Application of the principle of impulse and momentum to the 3D
motion of a rigid body, Kinetic energy in 3D, Euler's equations of motion, Motion of a
Gyroscope, Eulerian angles.

Recommended Books:
1. Vector Mechanics for Engineers - Statics & Dynamic: Beer, Johnston.
2. Vector Mechanics - Statics & Dynamics: Nelson, Best, McLean.
3. Vector Mechanics - Statics & Dynamics: Shames. Rao, Pearson.
4. Engineering Mechanics: Timoshenko & Young.

CSC 11101/CSC 12101 COMPUTER PROGRAMMING(S) (3–0–0)

Programming in C

C Fundamentals: Introduction to C, Data types, Constants and variable declaration, Scope, Storage classes, Data input and output functions, Sample programs.

Operators & Expressions: Arithmetic, Relational, Logical, Bitwise operators, Conditional, Assignment, Library functions.

Control & Looping Statements: if, while, for, do-while, switch, break and continue statements, nested loops.

Arrays: Declaration, Initialization, Processing an array, 1D, 2D and multidimensional arrays, Strings and their Operations.

Functions: Defining functions, Function prototypes, Accessing a function, Passing arguments, Passing arrays and Recursive functions.

Pointers: Declaration, Operations on pointers, Passing pointers to a function, Pointers and arrays, Array of Pointers.

Structures & Unions: Defining a structure, Processing a structure, User defined data types, Structure and pointers, Passing structure to a function, Self referential structures, Unions.

File Management: File operations, Creating and processing a data file, Command line arguments.

Programming in JAVA

Fundamentals of Object-Oriented Programming: Basic concepts, Objects and classes, Data abstraction and encapsulation, Inheritance, Polymorphism and Dynamic binding.

JAVA Evolution: Java features, Java versus C and C++, Creating, compiling and running a Java program, Constants, Variables, Data types, Operators and Expressions, Decision making and branching, Decision making and looping, Classes, objects, and methods, Sample programs.

Recommended Book:

1) "Programming with C by Byron Gottfried" , *Second edition*, *Schaum's Outline Series* ,1998

2) "C programming by Kernighan and Ritchie", *Second edition*, *Prentice Hall*, April 1, 1988

3) "Java: The complete reference – Herbert Schildt", *Eight edition, McGraw – Hill*, 2011.

4) "The *C Programming* Language by Bjarne *Stroustrup", Pearson Education, 2000.*

5) "C: The complete reference – Herbert Schildt", *Fourth edition, McGraw-Hill,* 2000.

6) "Programming With *Java by E Balaguruswamy", 4th Edition, Tata McGraw-Hill,* 2008

7) *"Let us C – by Yashwant Kanitkar", BPB publications, 2008.*

CSC11201/CSC12201 COMPUTER PROGRAMMING PRACTICAL (0–0–2)

Laboratory experiments will be based on the materials covered in the theory of this paper emphasizing the following topics.
1. Control statements
2. Arrays with applications
3. String Handing
4. Structure with applications
5. Pointers with applications
6. File handling in C
7. Programs on Java

(GLD/CMD)(11301/12301)   EARTH SYSTEM SCIENCE (S) (3 0 0)

Part A :   **AGL**   **(2-0-0)**

Space Science : Solar System, Age of the Earth, Origin of Solar system. Meteors and Meteorites.

Earth Dynamics : Interior of the Earth, Composition of the Earth, Seismic waves, Seismograph, Plate Tectonics, Basics of Earthquake Engineering, Landslides, Volcanoes.

Geological Oceanography: Sea waves, Tides, Ocean currents, Geological work of seas and oceans, Tsunami and its causes, Warning system and mitigation.

Hydrogeology: Water table, Aquifer, Groundwater fluctuations and groundwater composition, Hydrologic cycle.

Glaciology: Glacier types, Different type of glaciers, Landforms formed by glacier.

Geological bodies and their structures: Rock, mineral, batholith, dyke, sill, fold fault, joint, unconformity.

Part B :   **ESE**   **(1-0-0)**

Earth's Atmosphere : Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and global warming, Carbon dioxide sequestration. Steps to maintain clean and pollution free atmosphere with governing laws, precautionary measures against disasters.

Biosphere: Origin of life, Evolution of life through ages, Geological time scale, biodiversity and its conservation.

Natural Resources : Renewable and non-renewable resources, Mineral and fossil fuel resources and their geological setting, mining of minerals and conservation, effect of mining on surface environment.

Recommended Books :
1. Earth's Dynamic Systems – W. Kenneth and Eric H. Christiansen
2. Exploring Earth: An introduction to Physical Geology – John P. Davidson
3. Holmes Principles of Physical Geology – A. Holmes (Revised Ed. Doris L. Holmes)
4. A Textbook of Geology – P K Mukherjee
5. Earth System Science from biogeochemical cycles to global changes – M. Jacobson, R.J. Charlson, H. Rodhe and G.H. Orians (2002)
6. Fundamentals of Geophysics – W. Lowrie.

DISASTER MANAGEMENT & ENERGY RESOURCES
DMS11301/DMS12301 DISASTER MANAGEMENT(S) (2-0-0)

Concepts of Disaster, Types of Disaster and Dimensions of Natural and Anthropogenic Disasters (cyclone, flood, landslide, subsidence, fire and earthquake);
Principles and Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes;
Introduction to Natural Disasters and Mitigation Efforts: Flood Control, Drought Management, Cyclones, Terror Threats;
Pre-disaster risk and vulnerability reduction; Post disaster recovery and rehabilitation; Disaster related Infrastructure Development;
Role of Financial Institutions in Mitigation Effort;
Psychological and Social Dimensions in Disasters;
Disaster Management Support Requirements – Training, Public Awareness.

APD11301/APD12301 ENERGY RESOURCES   (1-0-0)

Classification of energy resources and their availability; Renewable and non-renewable energy sources; World energy prospects; Environmental impacts; Energy, power and electricity; Energy scenario in India: Availability of conventional and nonconventional energy resources and future energy demand; Indian reserves and resources of natural oil and gas, coal and nuclear minerals; Potential of hydroelectric power, solar energy, thermal, nuclear, wind, tidal wave and biomass based power in India; Introduction to hydrogen energy and fuel cells.

Books Recommended:

1. Non-Conventional Energy Sources by G.D.Rai, Khanna Publishers.
2. Fundamentals of Renewable Energy Resources by G.N. Tiwari & M.K. Ghosal, Alpha Science International.
3. Solar Energy: Fundamentals and Applications by H P Garg & J Prakash, Tata McGraw-Hill Publishing Company Ltd.
4. Solar Energy: Principles of Thermal Collection and Storage by S P Sukhatme, Tata McGraw-Hill Publishing Company Ltd.

HSS11305/HSS 12305   VALUE EDUCATION, HUMAN RIGHTS AND LEGISLATIVE PROCEDURE   (3-0-0)

Social Values and Individual Attitudes, Work Ethics, Indian Vision of Humanism, Moral and Non-moral Valuation, Standards and Principles, Value Judgements.

Rural Development in India, Co-operative Movement and Rural Development.

Human Rights, UN declaration, Role of various agencies in protection and promotion of rights.

Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive and Judiciary : Their Composition, Scope and Activities.

The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of the States, Composition of the House of People, Speaker.

Legislative Procedure: Oridinary Bills, Money Bills, Private Member Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/Governor.
Vigilance: Lokpal and Functionaries.

HSS 11101/HSS12101 ENGLISH FOR SCIENCE AND TECHNOLOGY   (3-0-0)

Language Resource Development : Using appropriate grammatical lexical forms to express meaning-accuracy, range and appropriacy in grammatical lexical exercises.

Reading, Interpreting and Using Written, and Graphic Information : Using (reading and writing) academic texts, articles in technical journals, instruction manuals/laboratory instruction sheets, safety manuals and regulations, and reports; Using maps, graphs, plan diagrams, flow-charts, sketches, tabulated and statistical data.

Writing Appropriately in a Range of Rhetorical Styles i.e. Formal and Informal : Writing instructions, describing objects and processes; defining, narrating, classifying exemplifying, comparing, contrasting, hypothesizing, predicting, concluding, generalizing restating, and reporting; Note making (from books/journals); Writing assignments; summarizing, expanding, paraphrasing; Anaswering examination questions; Correspondence skills; Interpreting, expressing and negotiating meaning; Creating coherent written tests according to the conventions.

Receiving and Interpreting the Spoken Word : Listening to lectures and speeches, listening to discussions and explanations in tutorials; Note taking (from lectures); Interacting orally in academic, professional and social situation; Understanding interlocutor, creating coherent discourse, and taking appropriate turns in conversation; Negotiating meanings with others (in class room, workshop, laboratory, seminar, conference, discussion, interview etc.).

Recommended Books:
1. Robert, E. Dewey and Robert, H, Hurlbutt III. An Introduction to Ethics, Macmillan Publishing co. int., New York, 1977.

2. Radakrishnan, S. Mahatma Gandhi: Essays and Reflections. Jaico Publishing House, Mumbai, 1957.
3. Gandhi, M K. An Autobiography; The Story of My Experiment with Truth. Navjeevan Trust, Ahmadabad, 1927.
4. Leah Levin. Human Rights: Questions and Answers, National Book Trust, New Delhi, 1998.
5. Basu, Durga Das, Introduction to Constitution of India, Prentice Hall of India Pvt. Ltd., New Delhi, 1994.

ESC 13101: Environmental Chemistry   [3-1-0]

Structure of atmosphere, Properties of Air, Types of Air Pollution Sources: Natural and Anthropogenic Sources, Classification and Chemistry of Major Air Pollutants, Thermodynamics of air pollutants, Atmospheric photochemistry, Chemical and Photochemical Reactions in atmosphere, PAH, VOCs, Acid Rain, Depletion of Stratospheric Ozone. Control of Gaseous Pollutants, Green fuel and their environmental impacts.

Principles and Application of Water Chemistry, Unique Properties of Water, Water Quality Parameters: physico-chemical, biological and bacteriological parameters, Water Quality Criteria and Standards, Water Pollution: Heavy Metal Pollution and its Abatement, Detergents and Phosphates, Eutrophication, Chemical Methods of Water and Wastewater Treatment, Removal of Dissolved Organics and Inorganics, Removal of Nitrogen and Phosphates, Water disinfection, Xenobiotics

Nature and Importance of Soil, Soil Properties, Acid-Base and Ion-exchange Reactions in Soils, Macro and Micronutrients, Colloidal chemistry of Soils, Fertilizers and Other Soil Amendments, Soil Pollution: Heavy Metals and Radio-nuclides in Soil, Degradation of natural substances, Remediation of Metal Contaminated Soil.

Characteristics of Hazardous Wastes, Classification of Hazardous Wastes, Effects and fate of Hazardous wastes.

ESC 13102: Environmental Biology and Ecology   [3-1-0]

Classification: plant and animal kingdom, Binomial nomenclature. Plant morphology. Cell and Tissue systems: Cell structure and functions, cell divisions. Simple & complex tissue, Meristems, Primary & secondary growth. Bio-molecules: Carbohydrate, Protein, Lipid, Fatty acid, Enzymes. Mineral Nutrition in plants: Plant water relationships, Diffusion,

Osmosis, Imbibitions, Ascent of sap, Transpiration, Essential elements.

Photosynthesis: Pigment systems, Chloroplast, Photosynthetic unit, Light and dark reaction, Phosphorylation and electron transport system, C2, C3 & C4 cycle, photorespiration, CAM, Factors affecting photosynthesis.

Components of Ecosystem: Biotic and abiotic factors, Food chain & web, Ecological pyramids, Ecosystem stability -inertia and resilience, fragile ecosystem, Hot spots. System ecology, Energy flow. Biogeochemical cycling: C, N, P and S cycle, Nutrient cycling in tropics, Limiting factors, Bio-monitoring, Biotic indices, Indicator species.

Aquatic ecology: Lentic and lotic habitat, stratification, productivity, community & life form, Wetland, marine and estuarine ecosystem. Population and community ecology: Habitat, Ecological niche and ecotone, Ecological successions, Biodiversity indices.

Eco-toxicology: Background, Importance & measurement, Ecosystem response to de-oxygenation, Eutrophication, Pesticides & Bio-accumulation. Ecosystems and the Millennium Development Goals, Landscape ecology. Biodiversity conservation methods: In situ and Ex situ techniques.

ESC 131 03 Geology for Environmental Engineers [3-1-0]

Physical Geology: Branches of Geology, Earth- its origin, internal constitution, and age; Atmosphere, hydrosphere, lithosphere and their constituents; Structural features such as folds, faults, unconformities.; Processes of weathering, Earthquakes, volcanoes; Geological work of river, wind, Overview of toposheets and geological maps and contouring.

Mineralogy: Minerals: its properties, Properties of common rock forming minerals. Crystals and crystal systems. Classification of minerals and study of common silicate minerals (Quartz, Feldspar, Pyroxene, Mica), sulphide (Pyrite, Chalcopyrite, Galena, Sphalerite) and Oxides (Haematite, Magnetite, Chromite, Pyrolusite, Psilomelane).

Petrology: *Igneous rocks ;* Classification of rocks; Magma- its composition and constitution; Classification of igneous rocks; Description of some common igneous rocks (Perioditite, Dolerite, Basalt, Granite, Rhyolite). *Sedimentary rocks:* Sedimentation process; Classification and Sedimentary rocks; Description of some common sedimentary rocks (Conglomerate, Sandstone, Shale, Limestone). *Metamorphic rocks:* Processes of metamorphism;; Description of some common metamorphic rocks (State, Schist, Gneiss, Quartzite, Marble).

Hydrology: Aquifers-types; Porosity and Permeability; Delineation of watershed and its characteristics; Calculation of Total Annual Replenish able Recharge value; Overview of Pumping Test studies.

Economic Geology: Ore and gangue minerals; Mode of occurrence, distribution and uses of some important minerals.

Coal Geology: Coal- its composition and origin; Distribution of Indian coals.

Stratigraphy: Geological time scale; Various stratigraphic units of India.

Paleontology: Fossils- their mode of preservation and uses.

MMR 13101: Mechanical Engineering - I   **[3-1-0]**

Stress and strain diagram; Elastic constants and their relation; Thermal stresses and strains; Principal stress and Principal planes.

Deflections of beams,

Analysis of stresses in pressure vessels,

Torsion of circular section.

Basic concepts: Degrees of freedom, Kinematic constraints, Linkages, Mechanisms.

Different types of gears, gear trains, reduction ratio and torque assessment, Application of gear boxes.

Basic principles and construction of Governors, Flywheels. Brakes, clutches and dynamometers. Case study based on laboratory setups on the above broad areas.

AMR 13101: Methods of Applied Mathematics -I [3-1-0]

Section A: **Analysis of Complex Variables:** Limit, continuity and differentiability of function of complex variables, Analytic functions, Cauchy-Reimann's equations and Cauchy' integral theorem, Morera's theorem, Cauchy's Integral formula, Expansion of function of complex variables in Taylor's and Laurent's series, singularities and poles. Residues theorem, contour integration, conformal mappings and its application, Bilinear transformation.

Section B: **Special Functions:** Solution in series of ordinary differential equations, Solution of Bessel and Legendre equations, recurrence relations and generating function for $J_n(x)$. orthogonal property and Integral representation of $J_n(x)$. Legendre polynomial, Rodrigue's formula, orthogonality properties and generating function for $P_n(x)$. Elliptic integrals and Error function and their properties.

Section C: **Laplace Transform and PDE**-II: Laplace transform of simple functions, first and second shifting theorems, t-multiplication and t-division theorems; Laplace transforms of derivatives, integrals and periodic functions. Inverse Laplace transform and convolution property. Use of Laplace transform in evaluating complicated and improper integrals and solution of ordinary differential equations related to engineering problems.

Partial Differential Equations: Classification of partial differential equations, solutions of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation in Cartesian and polar coordinates by variable separable method with reference to Fourier trigonometric series and by Laplace transform technique.

ESC 13201: Environmental Chemistry (Practical)   [0-0-2]

Calibration and Standardisation of pH meter, Conductivity meter, Nephelometer and other water quality monitoring instrument; Demonstration of UV-VIS Spectrophotometer, Flame photometer, AAS, GC, TOC etc.

Determination of pH, Acidity-Alkalinity, Total suspended solids (TSS), Total dissolved solids (TDS), Total hardness and Ca & Mg hardness, Chloride, Sulphate, Nitrate, Oil and grease, DO, BOD, COD, Chlorine demand, Break-point chlorination and Free residual chlorine.

Soil sampling, Description of the soil horizon, Determination of soil pH, Conductivity and Salinity; Organic carbon, Nitrogen and Phosphorus; Sodium and Potassium; CEC, Available sulphur.

Sampling and analysis of inorganic and organic particulates, SO_x, NO_x, NH_3 etc.

ESC 132 02: Environmental Biology and Ecology (Practical)   [0-0-2]

Microscopic study of cell divisions (mitosis and meiosis)
Microscopic study of tissue systems
Extraction of photosynthetic pigments
Measurement of water potential
Identification of C3 and C4 plants
Measurement of qualitative and quantitative characteristics of plant communities
Ecological sampling of an area (line transact and quadrate methods)
Species-area curve method
Field visit of aquatic ecosystem.

ESC 132 03: Geology for Environmental Engineers (Practical)   [0-0-2]

Toposheet Analysis; Preparation of drainage map; Study through GPS.

Drawing of strike line & determination of true dip & apparent dip. Study of some common minerals. Study of important igneous, sedimentary and metamorphic rocks. Preparation of

watershed map and calculation of TARR value. Water table fluctuation study and pumping test analysis.

ESC 134 01 Project Work **[0-0-2]**

Identification of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

FOURTH SEMESTER

ESC 141 01: Environmental Microbiology   [3-1-0]

General properties of microorganisms: Environmental importance of microorganisms, classification, Distribution, Enumeration of microbes, Prokaryotic and Eukaryotic cells.

Bacteria: Cell structure, Spore, Morphology and reproductions, Bacterial nutrition, Culture media and culture characteristics, Growth of bacteria, Batch culture, Specific growth rate and doubling time, Continuous culture, Synchronous growth, Effects of environmental factors on growth.

Control of microbes: Physical and chemical methods, Destruction and suppression.

Microbial metabolisms: Anabolism and catabolism, Glycolysis, TCA cycle and ETC, Fermentation and anaerobic respiration, Energy balances (ΔG) – Growth, Substrate Partitioning and theoretical yield, Electron acceptors, Enzyme, Monod and Halden kinetics.

Drinking water microbiology: Stream pollution, Water borne diseases and pathogens, MPN test, Faecal coliform and faecal streptoccoci, MF techniques, IMVIC test.

Air microbiology: Air borne diseases and pathogens.

Soil microbiology: Bio-fertilizer, VAM fungi, N-fixations, Bio-pesticides, Degradation of natural substances.Composting, Bio-energy from waste.

ESC 141 02 Air Pollution   [3-1-0]

Fundamentals of air pollution: Composition and physics of atmosphere; stationary and mobile sources; combustion process, fugitive emission; primary and secondary pollutants; POPs. Effects of air pollution on human being, animals, plants; air pollution episodes –causes and consequences; economic effects of air pollution.

Atmospheric meteorology: Wind and temperature profiles, atmospheric diffusion and turbulence, topographic effects,

atmospheric stability/instability, inversions, mixing heights, plume behavior.

Air quality monitoring: Air quality sampling network design; analysis and interpretation of data. Source emission monitoring; Stack, mobile, fugitive sources, and indoor air quality. Air pollution standards and indices. Emission factor, emission inventory and emission standards.

Dispersion of air pollutants and modelling: Atmospheric stability and instability, mixing height, ventilation co-efficient, theory and application of acoustic sounding (SODAR) technique. Box model; Derivation of Gaussian Dispersion model with respect to point, area and line sources; Prediction of effective stack height - plume rise concept and algorithm, e.g., Holland's equation, Briggs equation, etc.; Integrated air quality modelling algorithms.

Features and application of regulatory models, e.g., screening model, FDM, ISCST-3, Caline-4 and AERMOD Models

ESC 141 03: Environmental Hydraulics

Flow through pipe: Measurement of flow through pipes - Venturimeter, Orifice meter, Pitot tube, estimation of head losses in pipe flow, Water hammer Pressure and its application in design of pipe

Hydrostatic force on surfaces: total pressure and center of pressure for plane, inclined and submerged surfaces; practical application of total pressure and centre of pressure in design of Dams, Tanks and lock gates.

Flow through orifices: Introduction, classification of orifices, concept of C_c, C_v, and C_d.

Flow through notches & weirs: Introduction, classification of notches – rectangular, triangular, trapezoidal and stepped notches.

Design of Open Channel Flow

Flow through open channel, velocity distribution diagram, Design of most economical sections of channel, Hydraulic Jumps, Measurement of discharge in rivers

MMR 141 01 Mechanical Engineering -II

Analysis of various thermodynamic processes, P-V and T-S diagrams. Analysis of air standard cycles.

Classifications, applications and performance estimation of internal combustion engines, gas turbines and compressors, basic maintenance steps.

Performance study and power estimation on laboratory experimental data.

Properties of fluid, classifications, ideal fluid, Newtonian fluid and non-Newtonian fluids, Newton's law of viscosity.

Fluid statics: fluid pressure and its measurement.

Fluid Kinetics: Continuity equation, types of flow.

Fluid Dynamics: one dimensional equation of motion, Bernoulli's equation, applications of Bernoulli's equation, venturimeter.

Flow through pipes – Darcy- Weisbach's equation.

Classification, basic construction and applications of different types of pumps and water turbines. Performance study and power estimation based on laboratory experimental data.

AMR 141 01: Numerical and Statistical Methods   [3-1-0]

A.   Numerical   Methods: Solution   of   algebraic   and transcendental equations by bisection, iteration, false position, secant and Newton-Raphson methods, Generalised Newton's method for multiple roots.

Solution of system of linear simultaneous equations by Gauss elimination, Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss-Seidel methods. Finite differences, Symbolic relations, differences and factorial notation of a polynomial, data smoothing, Interpolation and extrapolation, Newton-Gregory forward and backward, Gauss forward and backward, Stirling, Bessel, Everett, Lagrange and Newton's divided difference formulae; Inverse interpolation by Lagrange's and iterative methods; Cubic splines. Numerical differentiation and integration, Trapezoidal, Simpson's $1/3^{rd}$, Simpson's $3/8^{th}$, Weddle and Gaussian quadrature formula.

Numerical solution of first order ordinary differential equations by Taylor's series, Picard's, Euler's, Modified Euler's, Runge-kutta, Adams-Moulton and Milne's methods. Solution of simultaneous first order and second order ordinary differential equations with initial conditions by Taylor's series, Runge-Kutta and Milne's methods. Numerical solution of boundary value problems by finite difference and shooting methods.

B. Statistical Methods: Concept of frequency distribution: Moments, skewness and kurtosis Probability: various approaches of probability-classical, frequency (statistical), subjective and axiomatic. Theorems on probability, conditional probability, independence, Bayes theorem. Random variable-discrete and continuous. Distribution functions and their properties, Probability mass and density functions, Mathematical expectation, Moment generating function and its properties. Probability distributions: Bernoulli, binomial, negative binomial, Poisson and normal distributions.

Theory of least squares and curve fitting. Correlation – Simple, multiple and partial, regression lines; regression coefficients; multiple and partial regression. Test of significance: Normal test, t-test chi-squire test and F-test.

ESC 142 01: Environmental Microbiology (Practical)

Apparatus used for a Microbiological laboratory.
Methods of Sterilisation and Disinfections.
Culture media: Media preparation– Semi-synthetic and Synthetic media. Liquid, Solid and semisolid media, Nutrient agar, PDA media.
Gram staining techniques for detection of gram positive and gram negative bacteria.
Bacteriology of drinking water and domestic sewage -MPN techniques for total coliform, Faecal coliform and Faecal Streptococci (FS), Membrane filtration techniques for faecal coliform and total coliform. IMViC test.
Microbiology of Air: Enumeration of microbes by exposure plate method.
Microbiology of soil: Isolation of microbes by serial dilution methods and colony count by colony counter.
Study of fungi (medium – Rose Bengal agar).
Study of fresh water and polluted water algae – (Blue green algae, Green algae and Diatoms).

ESC 142 02 Air Pollution (Practical)   [0-0-2]

Demonstration of Air Pollution monitoring instrument, Calibration of orifice of the RDS, Determination of PM_{10} & $PM_{2.5}$, Determination of SO_2 in ambient air, Determination of NOx in ambient air, Respirable dust monitoring by RAM-1 and GDS, Determination of CO in ambient air, Demonstration of Stack Monitoring Kits, Demonstration of Cascade Impactor for monitoring respirable dust, Elementary analysis of Particulate matter through AAS, Wind rose diagram, Demonstration and interpretation of SODAR ecogram

ESC 142 03: Environmental Hydraulics (Practical)

Experiments related to Bernoulli's theorem, Determination of friction losses in pipe flow including Minor losses, Experiments related to flow through orifices, mouthpieces, weir and notches, Calibration of Venturimeter and Pressure gauges; Flow

demonstration by Reynolds's experiment, impact of jet, display model of centrifugal pump

AMCP 142 01: Numerical and Statistical Methods (Practical)   [0-0-2]

A. Numerical Methods

Numerical solution of non-linear algebraic and transcendental equation by bisection, iteration, false position, secant and Newton Raphson methods.

Numerical solution of a system of linear simultaneous equation by Gauss elimination and gauss Seidel methods. Interpolation by Langrange's interpolation formula.

Numerical evaluation of definite integral by Trapezoidal, Simpson's $1/3^{rd}$, Simpson's $3/8^{th}$, Weddle and Gaussian quadrature formulae.

Numerical solution of first order ordinary differential equation by Euler's, Modified Eulers, second and forth order Runge-Kutta, Adams-Moulton and Milne's methods.

B. Scope of practice sessions:

Computation of raw moments; central moments, coefficients of variation, coefficients of skewness and kurtosis; fitting of straight line, second degree polynomial (parabola), power curve and exponential curve; computation of product moment correlation; multiple and partial correlation coefficients. Regression coefficients and regression line, plane of regression. Application of tests of significance base on numerical data.

ESC 146 03 Industrial Visit / Report/   [0-0-0](1)

Visit to different industries like mining, petroleum, chemical, metallurgy and allied industries. Preparation of report and presentation. Environmental issues related to different industry sectors. Careers in environmental engineering. Environmental awareness programs. Lectures from professional experts. Field trips, and seminars.

ESC 144 01 Project Work   **[0-0-2]**

Review of selected environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

FIFTH SEMESTER

ESC 151 01: Environmental Geotechnology   [3-1-0]

Soil, Complexity of soil nature, formation, regional deposits, solid-water-air relationships and index properties.

Classification of soil, soil structure and clay minerals, soil compaction, effective stress, capillarity and permeability, seepage through soils, flownets, drainage and dewatering, compressibility of soil and consolidation, shear strength of soils

Geotechnical applications in slope stability, factor of safety. Site investigation and subsoil exploration. Application of soil mechanics in environmental engineering, land reclamation, soil erosion and control. Application of Geotextiles.

ESC 151 02: Land Resource Management   [3-1-0]

Land use Planning – Objective and importance, Land use and capability classification systems, Land use Planning models and their limitations.

Impacts of natural and man-made activities on land characteristics and land use planning, Impact of soil Erosion and sedimentation control.

Design of tailings dams , overburden dump and ash pond

Land reclamation principles and requirement, Removal, storage and replacement of topsoil and subsoil on reclaimed lands, Bonding requirements for eco-restoration activities, Physical, chemical and biological methods of land reclamation, Planning for biodiversity on reclaimed lands, Post project land use monitoring, Restoration equipments, scheduling and cost; Green belt development plan

**ESC 151 03: Water Resource Planning and Management
[3-1-0]**

Water Resources: Introduction, hydrological cycle, World water distribution, need for conservation & development of water resources,

Hydrological analysis of precipitation: Precipitation, measurement of rainfall, index of wetness, design of rain gauge network, probable maximum precipitation curve, Infiltration, Infiltration Capacity Curve, Measurement & estimation of water losses, Runoff cycle, Runoff coefficients, Computation of runoff: unit hydrograph, Bernard`s distribution, Unit Storm Method, Evapo-transpiration.

Streams & reservoir: Stream flow measurement: Notches, weirs, control meters, Venture-Flumes, Velocity area method, slope area method, capacity elevation curve of river, Types of reservoirs, storage zones, catchment yield & reservoir yield, reservoir capacity, mass curve of inflow and outflow, reservoir sedimentations and losses, selection of site for a reservoir, economic height of dam, hydrological reservoir routing-Trial & Error Method, Modified Pul's method and Goodrich Method.

Groundwater hydrology: Measurement of yield, Laws of groundwater movement: Darcy`s law, Thiems equilibrium formula, Duipuits formula etc. Recharging of underground storage, infiltration galleries, infiltration wells, springs, wells.

Flood flows and management: Definition & causes of flood, estimation of design flood and flood flows for design of hydraulic structures, Flood control measures, Flood Routing

Water resources planning & management: Impact of climate change on water resources.

ESC 151 04: Design of Air Pollution Control System [3-1-0]

Review of general principles of air pollution control; Control of Particulate Matter; Fundamentals of emitted particulate matter and flue gas characteristics;
Design and operation of Gravity Settling Chambers, Cyclones, Wet Scrubber- Column Scrubbers, Jet Scrubbers, Vortex

Scrubbers, Rotating Disc Scrubbers, and Venturi Scrubbers, Electrostatic Precipitators, and Fabric Filters;
Dust control and abatement measures in industries and mines– fugitive dusts; dust suppression, dust extraction and dust consolidation.
Design of stack and duct system.
Design of control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation and combustion. Fuel and Flue gas desulphurization, sulphur recovery.
Control technologies of motor vehicle emissions and indoor air pollution. Economics and trends of air pollution control.

ACC 151 04: Instrumental Methods for Environmental Analysis [3-1-0]

Treatment of data in quantitative analysis: Accuracy, Precision, Standard deviation, and types of Errors, minimization of error, significant figures, criteria for rejection of data.

Principles of instrumentation; advantages, applications, and limitations of the following analytical techniques: Spectrophotometry, FTIR, NMR, Atomic absorption and Emission spectrophotometry, Flame photometry, Fluorimetry, Nepheleometry, Inductively coupled plasma spectrometry and MS.

Electrochemical methods: Polarography, Pulse polarography, Ion selective electrodes, Oscilloscopic Polarography, Cyclic voltametry, Anodic Stripping Voltametry.

Chromatography: Classification, general ideas about adsorption, partition, and column chromatography, paper and thin layer chromatography. Gas chromatography, High performance liquid chromatography (HPLC), Ion chromatography. Particle size and shape analyser. Auto-titration method

ESC 152 01: Environmental Geotechnology (Practical) [0-0-2]

Practical related to Moisture Content, Atterberg's limit test, Density and Specific Gravity, Particle Size analysis, Falling Head and Constant Head Permeability Tests, Compaction Tests, Consolidation Tests, Shear Tests, Triaxial Tests etc.

ESC 152 02: Land Resource Management (Practical)
[0-0-2]

Principles of land surveying, Leveling and angular measurement instruments. Distance, elevation, and angular measurement techniques, Traversing and triangulation survey, Analysis of errors during measurement, Curve surveying, Land/mine plan development

ACC 152 04: Instrumental Methods for Environmental Analysis (Practical)   [0-0-2/2]

Estimation of iron by Vis-spectrophotometer (including plotting of calibration curve using least square method), Detection of PAH by FTIR, Estimation by flame photometer, Conductometric titration, Potentiometric titration, Determination of distribution coefficient of I_2 in water and CCl_4, Estimation of free chlorine in water.

ESC 154 01 Project Work   [0-0-4]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

SIXTH SEMESTER

ESC 161 01: Principle and Design of Water Supply System [3-1-0]

Overview of Water Works- Sources, water quality requirements, treatment unit process and Indian standards;

Estimation of design discharge: Water Demand, factors affecting water demand, variations in water demand. design periods and design population, design capacities for various water supply components;

Design of Water Distribution system: Components, Overhead Reservoirs, Design of Distribution Network using Hardy Cross Method, Equivalent pipe method

Design of Unit operations for Treatment of Water: Aeration, Sedimentation tank: Coagulation & flocculation-clariflocculator Filtration: Filter hydraulics, slow and rapid sand filters, Pressure filter, Dual-media filter and mixed media filter.

Disinfection- chlorination and other methods of disinfection.

Water softening- Lime treatment, Lime soda Process, Ion exchange,

Removal of dissolved solids, Fluoride, Iron and Manganese

ESC 161 02: Solid Waste Management [3-1-0]

Municipal Solid Waste Management - Sources, nature and characteristics; quantitative and qualitative aspects; Engineering principles, assessment and management.

Solid waste problems - Industrial, Mining, Agricultural, Domestic (urban) wastes, Biomedical waste, E-waste, Plastic Waste and Construction Waste , Management of lead acid battery.

Hydrological aspects of solid waste.

Solid waste disposal - Sanitary landfill planning, site selection, design and operation, equipment, costs, landfill stabilization.

Thermal Conversion Technologies, Combustion, Pyrolysis; and Gasification, storage of refuse, waste reduction and environmental control.

Bio-Chemical Transformation, Aerobic and Anaerobic Composting, Chemical transformation processes
Source specific solid waste management: Agriculture, Process industry, Mineral and Metallurgical industry, Disposal of industrial and mill tailings,
Separation, Transformation and Recycling of solid waste. Resource and energy recovery; Waste minimization and utilization.
Regulatory aspects of solid waste management.

ESC 161 03 Remote Sensing and GIS   [3-1-0]
Introduction , Types , Application and importance of Remote Sensing; Physics of Remote Sensing; The Electromagnetic spectrum; Spectral Reflectance Curves; Spectral signatures; Resolution.

Remote Sensing Platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites.

Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; Satellite band designations and principal applications; Colour / False Colour; Aerial Photography/ Aerial Photo Interpretation.

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data;

Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image interpretation strategies.

Geographic Information System: Introduction; Preparation of thematic map from remote sensing data; Co-ordinate systems; GIS components: Hardware, software and infrastructures; GIS data types: Data Input and Data Processing; DEM/ DTM generation.

Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems. Spatial planning approach.

Global Positioning System – an introduction.

ESC 161 04: Environmental Policy and Legislation [3-1-0]

Environmental Policies - National and International trends, Changes in global perspective, International treaties. National Policies: National Environmental Policy, National Forest Policy, National Water Policy, Rehabilitation and Resettlement Policy; Evolution of environmental legislation in India, Legal provisions for environmental protection; various Acts, Rules and Regulations. Notifications issued under various Acts and Rules. Environmental standards, Criteria for Standards setting. Public Liability Insurance Act and legal aspects relating to hazardous and toxic substances.

ESC 161 05 Environmental Aspects of Industries   [3-1-0]

Mining : Mineral production, history of environmental problems. Mining Methods- Opencast and underground mining. Unit operations: site clearance, drilling, blasting, transportation, relamation.

Mineral beneficiation and their environmental impacts.

Air pollution, water pollution, noise and air blast, land degradation, subsidence due to mining activities and their control measures. Mining disasters, mine safety and role of DGMS.

Social impacts of mining & its management. R&R Policy.

Mine Closure: Principles, planning, financial provisions, implementation, standards for closure criteria, developing closure plans, progressive and final mine closure.

Environmental laws related to mining environment: Overview; provisions of MMDR Act, MCR and MCDR. EIA of Mining sector, general and specific environmental standards applicable to mining under various laws.

Metallurgical Industries and their Environmental Aspects: Unit operations, sources and management of pollution in integrated steel plants, ferrous and non-ferrous metals.

Thermal Power Plants: Introduction: site selection, layout and unit operations; Fuel and fuel handling -types of fuels, solid, liquid and gaseous. Fuel burning equipments; Pollution control devices- ash handling systems, electrostatic precipitation (ESP)

system; Fly ash management and its utilisation. Captive power plants.

Petroleum Industry: Production and consumption of the oil and gas, Unit operations involved in exploration and production of petroleum and natural gas; Major environmental problems in on-land and off-shore exploration; Oil Industry Safety Directorate (OISD); Standard guidelines; Environmental impacts; Dow and Toxicity index, Vapour Cloud Explosions (VCE), Boiling Liquid Vapour Cloud Explosion (BLEVE). Disaster management, Spill Response Program,

Environmental laws related to oil and gas exploration and production.

ESC 162 01: Principle and Design of Water Supply System (Practical)   [0-0-2]

Hardness removal through Lime-Soda Treatment Method; Determination of Chlorine Demand; Break-Point Chlorination and Residual Chlorine; Determination of Coagulation Dose by Jar Testing methodology; Removal of Iron and Manganese through aeration;
Removal of Fluoride; Removal of dissolved substances by Activated Carbon; Phosphorous removal; Nitrogen Removal

ESC 162 02: Solid Waste Management (Practical) [0-0-2]

Sample preparation; sampling techniques; conning and quartering method; overburden and other wastes sampling. Profile sampling, Characterisation of Solid Waste, Proximate Analysis and Ultimate Analysis, Calorific Value; Determination of coarse fraction,; pH & buffered pH, KCl & $CaCl_2$ solution; EC & CEC; exchangeable Na & K; non-exchangeable K & HNO_3-soluble-K. ESP and SAR. mineralisable -N and total nitrogen in profile samples. Determination of organic matter and organic carbon C:N ratio; Determination of plant available P and total P; DTPA -extractable micronutrients and trace elements in OB samples; Leachate Analysis.

ESC 162 03 Remote Sensing and GIS (Practical) [0-0-2]

Study and Analysis of Aerial Photographs
Introduction of various GIS software's
Geometric Corrections and Geo-referencing of Data; Enhancements; Image Mosaicing
Creation of Shape Files, Layers; On-Screen Digitization of Polygons, Points and Lines and adding attributes; Topology Building
Sub setting; Vegetation Indices; Use of Filters and PCA;
Supervised and Unsupervised Classifications; Map Composition; DEM and 3D Visualization and Virtual Image
Source Data Registration; Query building; Network Analysis; TIN/DEM models and derivatives; 3D Virtual GIS; GPS and DGPS Survey and Plotting

ESC 16105 Seminar [0-0-0](2)

Seminar of Industrial Applications, Industrial Case studies, Environmental aspects of air, water, soil pollution. Global Warming, Current Issues, Environmental Disasters.

ESC 164 02 Project Work [0-0-4]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

ESC 171 01: Environmental Impact Assessment [3-1-0]

EIA for Sustainable Development. Framework for Environmental Impact Assessment. Screening, Scoping and Baseline Studies, Significance and Importance of Impacts, Impact prediction, Mitigation aspects, Assessment of alternatives, Public Hearing, Decision Making.

Impact assessment methodologies -various methods, their applicability. Strategic Environmental Assessment. Cumulative impact assessment. Risk and uncertainty in EIA. Environmental Management Planning. Disaster management planning.

ESC 171 02: Municipal Wastewater Engineering [3-1-0]

Introduction: Characteristics and flow Hydraulic Design of Sewer: Types & Design of sewerage, construction laying and testing of sewer lines

Design of Sewage Pumping Station, Maintenance of sewerage system

Conventional Treatment of Sewage: Design and operation of screening, flow equalisation and grit chamber; Design and operation of PST

Biological treatment: Operation and design aspects of ASP and its modifications types of aerators,; secondary settling tank, oxidation ditch, SBRs, trickling filter, RBC, Aerated lagoons, waste stabilization ponds,

Anaerobic Reactors: UASB and hybrid bioreactors,

Aquatic plant system: constructed Wetlands.

Design of sludge disposal facility: Gravity Thickener, Anaerobic digester, and Sludge drying bed.

Disposal and Reuse of Treated effluent, Effluent Standards

ESC 171 03 Noise Pollution and its Control   [3-1-0]

Fundamentals of Noise: Basics of Acoustics: Sound power, Sound intensity and Sound pressure levels; Plane, Point and Line sources, Multiple sources; Outdoor and indoor noise propagation; Effects of noise – noise induced deafness, presbycusis, acoustic trauma, other physiological and

psychological effects; Special noise environments – infrasound, ultrasound, impulsive sound and sonic boom. Noise standards and indices.

Noise monitoring: Occupational, ambient and road traffic noise monitoring; noise exposure/dose analysis; vibration monitoring, data analysis techniques and methods.

Noise Control measures - General principles of noise pollution control. Design of Sound Absorption, Acoustic Barrier, Vibration Isolation, Vibration Damping, Muffling, Personal Protector and Green Belt for noise attenuation.

Noise pollution and management in different industries, e.g., mines, power plants, etc.

Whole Body Vibration problems in surface mines and control measures.

Ground Vibration and Air Blast - Environmental impacts, strategic planning and abatement/ prevention.

Noise propagation and modelling

Atmospheric stability/instability and associated physics of sound wave propagation.

Derivation of noise model with due consideration of determination of source power levels of different noise sources; assessment of atmospheric attenuation with respect to enclosures, barrier, geometric spreading, air absorption, wind & temperature gradient, ground effect, shielding by vegetation/greenbelt; and projections of noise contouring of the concerned area.

Features and applications of salient noise models, e.g., ENM, Sound PLAN, etc..

ESC 171 04 Environmental Systems Optimization and Modeling   [3-1-0]

Systems approach - concept and analysis. Problems formulation, model construction and deriving solution from models using LPP-primal and Dual Simplex method, Limitations of LPP, sensitivity Analysis. Applications of LPP.

Lagrange multipliers- unconstrained and constrained optimisation, limitations of Lagrange's multipliers, Sequential search algorithms- box algorithm

Separable and integer programming- application to multiobjective planning. Application of integer programming

Transportation models, Dynamic programming models- application of Dynamic programming, Present value concepts- optimization over time.

Fate and Transport of contaminants in surface and sub surface environment, Streeter - Phelps model and introduction of various available software's.

Elective papers

ESE 171 01: Hazardous and Biomedical Waste Management   [3-0-0]

Hazardous Wastes: Landmark episodes, classification, generation, guidelines of HWM, Regulatory frame work, Basal Convention and other international statistics Monitoring of critical parameters/provide risk-analysis. HAZON, HAZOP, Consequence Analysis. Faculty and eventry analysis. Emergency Management: Indian and foreign legislation in respect of the above. Case studies, leakage, explosion, oil-spills and fire of hazardous chemical storage. Leakage in atomic reactor plants,

Hazardous Chemicals: Toxic chemicals, flammable chemicals, pesticides, explosives, reactive substances, Cyanide wastes, water-soluble chemical compounds of heavy metals, & toxic metals. Hydrocarbons, point pigment dyes, oil emulsion tars, phenols, asbestos, acid/alkaline slurry, Physical properties, and chemical composition and lethal dose and concentration on human life flora and fauna. Storage, collection, transport,

Hazardous Waste Treatment: waste reduction, neutralization, Incineration, combustion and Pyrolysis, unit operations, supply of air, products of combustion, furnace temperature, furnace calculation, and environmental control, disposal. Precautions in collection, reception, treatment, transport, storage, and disposal, and import procedure for environmental surveillance

Biomedical Waste: categorization, generation, collection, transport, treatment and disposal. Radioactive wastes generated during mining, processing of atomic minerals, and in

atomic reactors, and disposal of spent fuel rods. Treatment and disposal; remediation of contaminated sites.

ESE 171 02 Climate Change & its Mitigation   [3-0-0]

Climate Change Mitigation: Way and means, Concept of Carbon Sequestration. Carbon Sequestration projects, Carbon Sequestration Modalities and Procedures. Global Carbon Cycle: Stocks and Fluxes of Carbon in terrestrial and marine ecosystems and anthropogenic impact. Policy Perspective: UNFCC, Role and Function of IPCC, Kyoto Protocol and its implication on Developed and developing countries, function of Kyoto Protocol. National action plan on climate change; National missions on climate change..

Clean Development Mechanism (CDM) and its operation, modalities and procedures for CDM Project. Forestry Perspective: Source or Sink of Carbon, Measuring of Carbon Dioxide. The Climate Mitigation potential of Forest and its evaluation, Land use, Land use Change and Forestry (LULUCF), Evolution of LULUCF in CDM.

Emissions trading of clean development mechanism (CDM), Difficulties with the CDM, Financial issues with the CDM, prototype carbon funds (PCF), Carbon Credits and it's trading, carbon finance, and evaluation of Carbon Credit of solar energy systems. Emissions trading under different article, Carbon foot prints.

ESE 171 03: Environmental Economics   [3-0-0]

Economy and Environment -the historical development of environmental economics; circular economy, sustainable economy. Economics of Pollution: optimal level of pollution, market achievement of optimal pollution, Taxation and optimal pollution, Environmental standards, Taxes and subsidies, Marketable pollution permits, Measuring environmental damage -Total economic volume and valuation methodology, pollution control policy in mixed economics. Environmental Values Ethics; discounting the future, alternative to adjusting discounting rates.

Economics of Natural Resources;-Renewable resources, Extinction of species, Optimal use of exhaustible resources Measuring and mitigating natural resource scarcity. Development and Environment;- Development, Preservation and conservation, Irreversibility and sustainability, Environment and the developing countries. Carrying capacity based development planning. Cost Benefit Analysis of Environmental Change; Appraisal of Sustainable development Projects; Principles of Cost Allocation, Preventive, Punitive and social costs.

HSS 173 45: Social and Ethical Issues in Engineering [3-0-0]
Introduction to Ethical Theories and Ethical Analysis
Engineering as a Profession: a) some history; b) The workplace in which Engineering is situated;
c) Ethical Standards of the Profession, the Codes of Ethics.
Professional Ethics in relation to Law, Common Morality, and the Market.
Ethical Responsibility, Loyalty: critical and uncritical
The standard of reasonable care
The Engineer's Perspective alongside the Business Manager's Perspective
Professional dissent and whistle blowing.
Honesty, sharing and withholding information, confidentiality, secrecy.
Conflict of interest, Bribery, Extortion, Grease, Gifts
Managing risk to Humans and the Environment
How Government/ the Legal System influences Engineering Practice.
Design, Innovation, and Emerging Technologies, especially Disruptive Technologies, e.g, Information Technology, Nanotechnology, etc.
Engineering and Sustainable Development,
Issues associated with Globalization

ESC 172 01: Environmental Impact Assessment (Practical) [0-0-2/2]

Exercises on screening, scoping, prediction, identification and evaluation of impacts.

Review of EIA reports, case studies.

Arranging Mock Public Hearings related to EIA case studies.

ESC 172 02: Municipal Wastewater Engineering (Practical) [0-0-2]

Pre – and post chlorination, analysis of sewage, Determination of MLSS, MLVSS, SVI,; sludge settling characteristics curve, BOD_5: TKN ratio, Nitrifier fraction, Jar-test,. Total coliform, FS & FC in raw sewage.

ESC 17203: Noise Pollution and its Control (Practical) [0-0-2/2]

Demonstration of noise pollution monitoring instrument, Noise survey and development of noise profile in a multiple noise sources situation, Ambient noise monitoring, Frequency noise monitoring of machine noise, Audiometry survey for assessing hearing acuity, Traffic noise monitoring, Human vibration (whole body vibration) monitoring

ESC 174 01 Project Work   [0-0-6]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

EIGHTH SEMESTER

ESC 181 01: Environmental Management System and Auditing   [3-1-0]

Environmental Audit, Objectives, Types, Features, Planning and Organising Audits; Pre-visit data collection, Audit Protocol; Onsite Audit; Data Sampling - Inspections - Evaluation and Presentation; Exit Interview; Audit Report - Action Plan -

Management of Audits; Waste Management Contractor Audits; Life Cycle Approach (LCA).

Introduction and Formulation of ISO Guidelines in Environmental Management Systems; ISO 14000 Series, Principles; Accreditation Process, Environmental Auditor Criteria, Benefits of EMS; Aspect-Impact Analysis, Continual Improvement, Environmental Performance, Environmental Policy, Vision and Mission, Objective and Target, Environmental Management Planning, Implementing EMS, Plan-Do-Check-Act (PDCA), Quality Assurance(QA) and Quality Control (QC), Preventive and Corrective Action, Internal and External Audits, Documentation, Roles and Responsibilities, Management Reviews & Improvements; Legal and Regulatory Concerns; Integrating ISO 9000 & ISO 14000, BS 7750, EMAS. Preparation of ISO Manuals for Industry.

Corporate Social Accountability: Requirements, Social Accountability (SA) 8000, Certification, Elements of Social Management System, Social policy, Planning, Implementation, Business Benefits, Corporate Social Responsibility (CSR), different Models

ESC 181 02: Industrial Wastewater Treatment [3-1-0]

Sources and characteristics of industrial wastewater; management of Industrial wastewater- volume reduction, neutralization, equalization and proportioning, treatment and disposal, Chemical Treatment

Design and operation of advanced treatment process-adsorption, activated carbon column;, ion exchange, RO process, stripping towers (ammonia stripping), Ozonation

Unit operation, wastewater treatment methodologies and environmental issues for specific industries - chlor-alkali, electroplating, distillery, dairy, tannery, pulp and paper, textile, dye, fertilizer, refinery, pharmaceutical, iron & steel, coke ovens, coal washeries, mine wastewater.

Management and treatment of acid mine drainage;

Industrial complexing for zero pollution attainment,

Common effluent treatment plant (CETP): design, operation and maintenance aspects.

ESC 181 03: Occupational Health, Safety and Risk Assessment [3-1-0]

Occupational Health and Safety concern and problems. National and International protocols and concerns, policies and legislation.

Ergonomics; Stress-strain concept; Assessment of human capabilities and limitations; Human Physiological Work Capacity and its evaluation.

Sources of work stress (a) intrinsic to the jobs, (b) work environmental stressors like heat & humidity, noise & vibration, dust, illumination, etc.; Methodologies for evaluating different types of stresses.

Human Error and Accidents: Different Classification of Human Error, Theories of Accident Causation, Human Error Audit. Accident analysis.

Education and Training in Occupational Hygiene.

Need to evolve an integrated Occupational Health and Safety Programme for specific industries.

Occupational Health & Safety Management Systems: OHSAS 18001 guidelines, Legal requirements; Occupation Health and Safety Policy; OH & SMS Documentation.

Safety at work place: Managing health and safety in industries, slips and trips, general fire safety, work at height, building work, machinery safety, plant and equipment maintenance, gas and oil-fired equipment, flame-proof equipments, intrinsically safe equipments, pressurized plant and equipment, workplace transport, lifting and handling, noise, vibration, electricity, radiations, harmful substances, flammable and explosive substances, managing health, safe ways of working, selection and training; Special groups of workers, contractors and agency workers, personal protective equipment, accidents and emergencies, useful contacts and information for safety, role of health and safety executives.

Risk Assessment and Management: Perception of Risk in Industries: Theories and Human Adjustment. Environmental and Industrial Risk assessment: Introduction, identification of potential hazards, assessment of the risk, consequence analysis, hazard identification methods: check list, hazard and operability studies (HAZOP), hazard analysis methods, failure modes and effect analysis, hazard indices, models, regulatory priorities . Emergency preparedness and response.

MSC 17351: Managerial Economics　　　[3-0-0]

Nature, scope and methods of managerial economics.

Managerial Economics Concepts- Incremental concept; Opportunity Cost concept; Equi-marginal concept; Equi-marginal concept; Discounting concept; Risk & Uncertainty

Law of Diminishing Marginal Utility, Demand Analysis- Meaning & Type; Law of Demand- Features; Exceptions; Market Demand Schedule & Curve; Elasticity of Demand- Price elasticity, cross elasticity & income elasticity. Indifference Curve approach and its properties. Supply- its law, elasticity & curve. Types of markets; Pricing under various market conditions – Perfect competition, imperfect competition and monopolistic competition. Profit & Profit measurement. Inflation- meaning; Demand- pull, cost-push inflation; Inflationary gap; causes and steps to control inflation. National income- Concepts & methods of measurement; Difficulties in measuring national income.

ELECTIVE PAPERS

ESE 181 01: Environmental Toxicology & Health　[3-0-0]

Behavior of chemicals in the environment: physical and chemical properties, transformation and degradation process; Distribution of toxic chemicals in air, water, sediments, soil and biota; Routes and mechanisms of toxicant entry into organisms; Distribution of toxicants within organisms; Biotransformation of toxicant within organisms; Elimination of toxicants from organisms. Infections – Salmonella; Intoxications – Botulism, Staphylococcus aureus, Clostridium perfringens; Non-bacterial parasites - tapeworms-beef, pork, fish; Roundworms-

Trichinosis; Chemical Hazards-additives, pesticide residues, toxic metals.

Control of food and waterborne diseases: Introduction to major disease-causing microorganisms in the environment and their transmission through water, food, and air. Description of the organisms, pathogenesis, clinical disease, reservoirs, modes of transmission, and epidemiology. Transport, survival, and fate of pathogens in the environment; the concept of indicator organisms as surrogates for pathogens; and the removal and inactivation of pathogens and indicators by water and wastewater treatment processes. Examples of the public health impact of environmental transmission routes of these pathogens in developed and developing countries.

ESE 181 02: Environmental Biotechnology   [3-0-0]

Biotechnology – Principles and applications- Recombinant DNA technology, Cloning vector, PCR, Gel- electrophoresis.

Environmental impacts of GM crops, Genetic engineering. Microorganisms as food - SCP.

Cellular respiration- Enzymes; metabolism - Glycolysis, Kreb's cycle, ETS, Phosphorylation, ATP; Factors affecting respiration. Fermentation,

Bio Fuels: Microorganisms and energy requirements of mankind, Production of nonconventional fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons, Use of microorganisms in augmentation of petroleum recovery. Introduction, scope and importance: Production of non-conventional fuels- Methane, Hydrogen, Alcohols and algal hydrocarbons.

Mining and metal biotechnology: Microbial transformation, Accumulation and concentration of metals, Metal leaching, Extraction and future prospects. Coal bio-desulfurization processes.

Biological control: Bio-pesticides.

Microorganisms and microbial products- Antibiotic production,

Industrial microbiology General account: Maintenance of stock cultures, Culture collection Centers/microbial gene banks,

Inoculums build up, Industrial substrates, Design of a bioreactor, Batch and continuous fermentation and solid substrate fermentation.

Immobilization technologies.

Exploitation of Microorganisms for soil fertility: Biological nitrogen fixation and bio-fertiliser and crop productivity.

Bioremediation - Introduction, Constraints and priorities of Bioremediation, Bio-stimulation of Naturally occurring microbial activities, Bio-augmentation.

Application of Biotechnology in mineral Industries.

ESE 181 03: Environmental Nanotechnology [3-0-0]

Nanotechnology and the environment, nanotechnology and our energy challenge; nanomaterials fabrication; methods for structural and chemical characterization of nanomaterials; instrumentation for nanotechnology, reactive oxygen species generation on nanoparticulate material; principles and procedures to assess nanomaterial toxicity; toxicological impacts of nanomaterials; nanoparticle transport, aggregation, and deposition; nanomaterials for groundwater remediation; membrane processes; nanomaterials as adsorbents; assessing life-cycle risks of nanomaterials, longevity of nanoparticles.

ESE 181 04: Rehabilitation and Resettlement Issues [3-0-0]

Social impacts of industrial and developmental activities. Quality of life concept- and its use in development planning. Social surveys and socio-economic data generation. Social cost of environmental pollution. Rehabilitation and resettlement of project affected people. Laws related to social development. Policies and guidelines of rehabilitation planning, corporate social accountability/responsibility. Specific case studies from various sectors including mining.

ESC 182 01: Industrial Wastewater Treatment (Practical) [0-0-2/2]

Analysis of specific pollutants in different types of industrial wastewater, design of activated carbon column, coagulation and flocculation test. Zeta Potential Analysis, Ozonation of Textile Effluent, Hardness Removal by Ion Exchange, Reverse Osmosis.

ESC 184 01 Project Work   [0-0-6}(6)

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

CAPSULE COURSES TO BE OFFERED TO OTHER DEPARTMENTS (B.Tech).

Environmental Engineering - I   **[3-0-0]**

Environmental issues – National & global issues;

Industrial Pollution, pollutants and environmental problems

Biological environment: Ecology & ecosystem; biodiversity & its conservation;

Land Environment: Degradation of Land, factors, land use analysis.

Air pollution: air quality criteria & standards, air quality monitoring and assessment, Noise pollution.

Water pollution: water pollutants, water quality criteria & standards; microbiology and epidemiology, water treatment and management.

Ground water: resources, pollutants, sources and causes of pollution; remedial measures

Solid waste: Types and characteristics, management & resource recovery, source reduction, collection & transfer, composting, conversion of waste-to-energy, disposal of solid waste.

Hazardous wastes: disposal of hazardous waste, legislation of hazardous wastes management.

Societal environment; socio-economic impacts, population and economic growth, resettlement & rehabilitation policies.

Environmental Clearance Process of the Industries, EIA/EMP, EMS and Environmental Auditing.

Text books:
Introduction to Environmental Sc. & Engineering – GM Masters (2004)- PHI.
Environmental Chemistry for Scientist and Engineers – Sawayer and McCarty, TMH
Fundamentals of Ecology – E.P.Odum, Himalayan Publishers.

Environmental Engineering - II   **[3-0-0]**

Environmental issues –sustainable development, global warming, IPCC emission scenarios.

Industry specific environmental issues and discharge standards. Role of MOEF, CPCB, SPCBs.

Land Environment: Landscape Planning design and analysis; Use of Remote sensing.

Biological environment: Design of green belts, biological reclamation, bio-remediation

Air pollution: Design of air pollution control equipment. Noise pollution control mechanism.

Wastewater Engineering –Characteristics and Sources, primary, secondary and tertiary treatment processes, reuse and disposal, common effluent treatment plants (CETPs).

Ground water: aquifers, Porosity and Permeability, hydraulic gradient, fate and transport of contaminants in ground water, watershed and its characteristics; Calculation of Total Annual Replenish able Recharge value; Overview of Pumping Test studies.

Solid waste: Legislation, Solid waste management, landfill design, incineration, composting, e-waste, tailing waste management.

Hazardous wastes- legislation, storage, transportation, & disposal of hazardous waste (biomedical and radioactive wastes)

Societal environment; socio-economic impacts, population and economic growth, resettlement & rehabilitation policies.

Environmental and Forest Clearance Process; Screening, Scoping (TOR), Public Hearing, appraisal, EIA/EMP, EMS and Environmental Auditing .

Text books:
Environmental Science and Engineering – J. G. Henry & G.W. Henke Prentice Hall INT Edition, NJ, USA, 1996 (2nd Ed.)

Environmental Engineering – HW Peavy, DR Rowe & G Tchobanoglous, McGraw- Hill Int (1998).
Environmental Engineering – Gerard Kiely, McGraw- Hill Int (1998).
Environmental Impact Assessment- Larry Canter.