ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS
M.TECH (WATER AND ENVIRONMENTAL TECHNOLOGY)

(Effective for the students admitted from academic year 2019-2020 onwards)

CENTRE FOR WATER RESOURCES

JNTUH INSTITUTE OF SCIENCE AND TECHNOLOGY (AUTONOMOUS)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

Kukatpally, Hyderabad, Telangana State, INDIA-500085.

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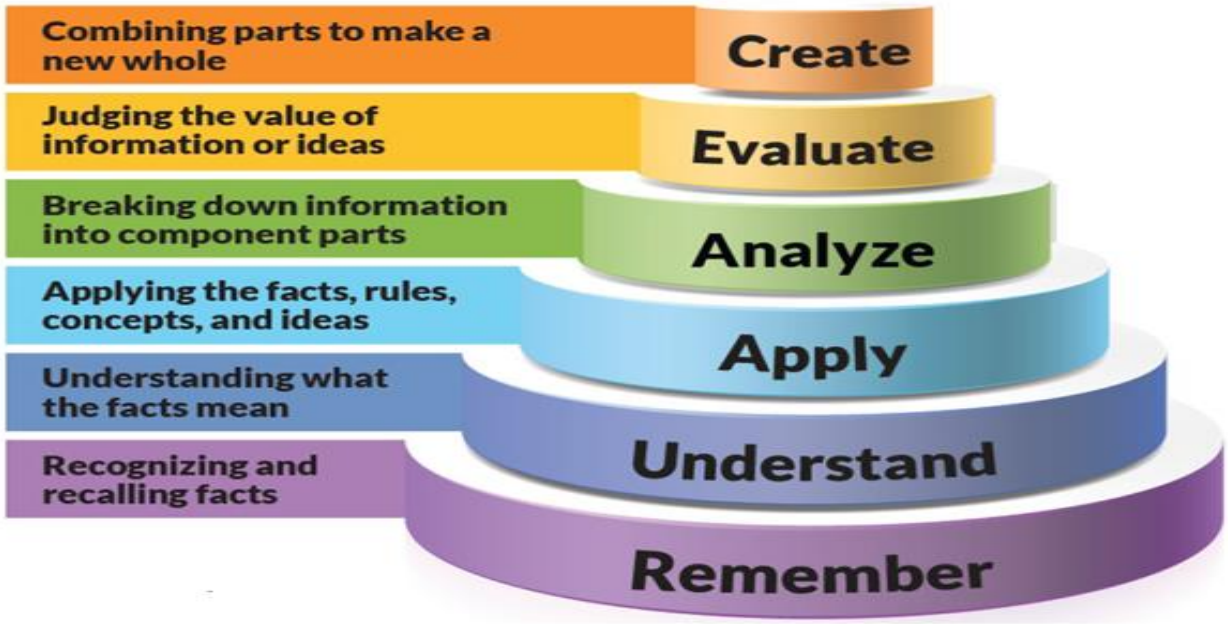
BLOOM'S TAXONOMY



KNOWLEDGE LEVELS

Self-Assessment of a student is based on the answers given to the Blooms level of questions

The Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Facts	list	paraphrase	classify	outline	rank	categorize
Concepts	recall	explains	show	contrast	criticize	modify
Processes	outline	estimate	produce	diagram	defend	design
Procedures	reproduce	give an example	relate	identify	critique	plan
Principles	state	converts	solve	differentiates	conclude	revise
Meta-cognitive	proper use	interpret	discover	infer	predict	actualize

Vision of the Institution

Imparting technical education that encourages independent thinking, develops strong domain of knowledge, hones contemporary skills and positive attitudes towards holistic growth of young minds.

Mission of the Institution

- Student-centered Teaching-learning processes and a stimulating R&D environment.
- Providing Quality Education and ethics to students.
- State-of-art Infrastructure for professional aspirants.

Vision of Centre for Water Resources

To generate advanced technical man power in order to develop techniques and methodologies by undertaking advanced research in the field of water and environment and to achieve university symbiosis by undertaking participatory approaches.

Mission of Centre for Water Resources

- Student centered Teaching learning processes and a stimulating R&D environment.
- To build advanced laboratories for conducting research and to design sustainable systems for water and environment.
- To establish state of art infrastructure for professional training and to establish networking among the user agencies.

Program Outcomes (POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Students should be able to cope with changing technological environment to meet the challenges emanating out of Climate change and Environment

Note: Program may add up to three additional POs.

Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) are as follows:

PEO1: To prepare the students as one of the problems solving engineers/technologists in water, land and environmental fields.

PEO2: To generate technical man power at advanced level to maintain and manage the existing infrastructure of water, land and environment of the nation.

PEO3: To impart technical training to the students that empowers them to withstand changing technological environment in order to cope with the natural climate change and environment.

PEO4: To develop the students' personality in such a manner that they become responsible citizens in the society.

CENTRE FOR WATER RESOURCES
INSTITUTE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
M.Tech (Water and Environmental Technology), COURSE STRUCTURE AND SYLLABUS (CBCS) -2019

M. TECH SEM -I

Course Number	Subject	Scheme of Studies per Week			Credits	Int Marks	Ext Marks
		L	T	P			
WET – 01	**Programme Core-I** Surface Water Hydrology	3	0	0	3	30	70
WET-02	**Programme Core-II** Ground Water Hydrology	3	0	0	3	30	70
WET-03	**Programme Elective-I** 1. Advanced Fluid Mechanics 2. Water Quality Modeling and Management 3. Environmental Chemistry and Microbiology	3	0	0	3	30	70
WET-04	**Programme Elective –II** 1. Water Resources Systems Analysis 2. River Basin Management 3. Air Pollution and Control Technologies	3	0	0	3	30	70
WET -05	Hydrology Laboratory	0	0	4	2	30	70
WET-06	Environmental Laboratory	0	0	4	2	30	70
WET-07	Research methodology and IPR	2	0	0	2	30	70
WET -08	Audit Course - I	2	0	0	0	-	-
		16	0	**08**	**18**	**210**	**490**

M. TECH SEM -II

Course Number	Subject	Scheme of Studies per Week			Credits	Int Marks	Ext Marks
		L	T	P			
WET – 09	**Programme Core-III** Geospatial Applications in Water Resources	3	0	0	3	30	70
WET- 10	**Programme Core-IV** Water and Wastewater Treatment Technologies	3	0	0	3	30	70
WET- 11	**Programme Elective-III** 1. Irrigation Management 2. Fluvial Hydraulics 3. Urban Hydrology	3	0	0	3	30	70
WET- 12	**Programme Elective –IV** 1. Sustainable Water Resources Development 2. Environmental Impact Assessment 3. Climate Change Adaptation and Mitigation	3	0	0	3	30	70
WET –13	GIS and Image Processing Laboratory	0	0	4	2	30	70
WET- 14	Water Resources Modeling Laboratory	0	0	4	2	30	70
WET- 15	Mini-Project with Seminar	2	0	0	2	30	70
WET - 16	Audit Course -II	2	0	0	0	-	-
Total		**16**	0	**08**	**18**	**210**	**490**

***Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break**

M.TECH SEM -III

Course Number	Subject	Scheme of Studies per Week			Credits	Int Marks	Ext Marks
		L	T	P			
WET – 17	**Programme Elective-V** 1. Solid and Hazardous Waste Management 2. Hydro Power Development 3. Micro Irrigation Technologies	3	0	0	3	30	70
WET- 18	**Open Elective** 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy 7. Environmental Statistics	3	0	0	3	30	70
WET- 19	Dissertation – I	0	0	20	10	0	0
	a) Project Review – I				0	0	0
	b) Project Review – II				0	100	0
		06	0	**20**	**16**	**160**	**140**

***Students going for Industrial project/Thesis will complete these courses through MOOCs.**

M.TECH SEM -IV

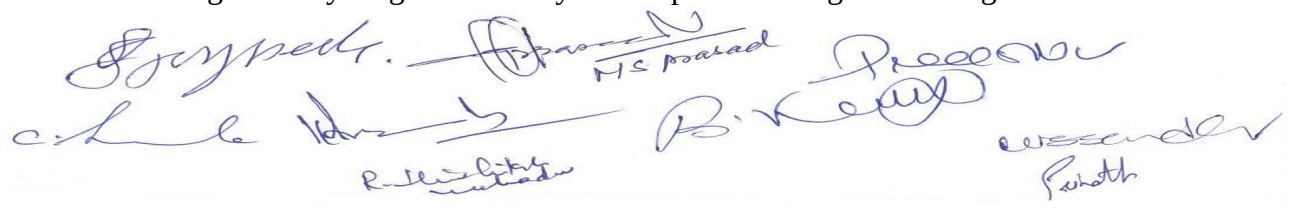
	Subject	Scheme of Studies per Week			Credits	Int Marks	Ext Marks
		L	T	P			
	Dissertation –II (Project review –III 30 marks + Project Evaluation 70 Marks = 100 Marks)	0	0	32	16	0	0
	c) Project Review – III				0	30	0
	d) Project Evaluation (Viva Voice)				0	0	70
		0	0	**32**	**16**	**100**	**100**

(L: Lecture periods, T: Tutorial periods, P: Practical periods)

Total credits of the Programme = 68

List of Audit Courses 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga Personality Development through Life Enlightenment Skills



SEMESTER-I

PROGRAMME CORE-I / WET- 01

SURFACE WATER HYDROLOGY

OBJECTIVES:

1. The students acquire knowledge about hydrologic cycle, precipitation its measurement and analysis along with its abstractions
2. Students understand infiltration, constitution of stream flow and hydrographs
3. The students understand floods, analysis, routing along with its mitigation and management
4. It creates awareness regarding surface water pollution ,causes, prevention and remedial measures
5. The students are made to understand different disasters and its management. In addition, they study about climate change, drought and water harvesting

UNIT-I: Components of Hydrologic Cycle: Hydrologic Cycle, Precipitation, Cloud Seeding, Rain Gauge Net Work, Estimation of Missing Rainfall Data, Mean Precipitation Over an Area by Arithmetic Mean, Thiessen Polygon and Isohyetal Methods, Checks of Rainfall Data, Double Mass Curve, Evaporation, Transpiration, Methods of Estimation of Evapotranspiration.

UNIT-II: Initial Abstractions & Hydrograph Analysis: Infiltration, Factors affecting Infiltration, Measurement of Infiltration, Infiltration Curve and Infiltration Indices. Runoff: Stream flow Hydrograph, Hydrograph Separation, Unit Hydrograph.

UNIT-III: Hydrology of Floods: Definition: Hydrology of Floods: Causes of Floods, Flood Discharge Formulae and Envelope Curves, Flood Frequency Analysis, Flood Control- Flood Control Dams, Detention Basins, Levees, Diversion Channels, Flood Channel Improvement Schemes. Flood Routing: Routing Through a Reservoir by I.S.D. Method, Channel Routing by Muskingum Method.

UNIT-IV: Surface Water pollution: Introduction, Causes of Water Pollution, their Effects, Remedial Measures, Pattern of Pollution, Self Purification Processes in Streams. Raw and Treated Water Quality Monitoring and Surveillance Including Various Standards.

UNIT-V: Disaster Management: Types of Natural Disasters and Manmade Disasters, Effects of Drought, Combating Drought, Reducing Runoff Losses, Reducing Evaporation and Deep Percolation, Efficient use of Stored Soil Water, Early Warning Systems, Evacuation Plans and Post Disaster Management and Administration, Climate change and its impact on Water Resources, Overview of rainwater harvesting.

COURSE OUTCOMES

The student is expected to

CO1: To learn about precipitation and its measurement, analysis and interpretation.

CO2: Know about abstractions to rainfall, infiltration, evaporation and transpiration along with their estimation and derivation of unit hydrograph from hydrograph.

CO3: Gain Knowledge about floods, its estimation, combat floods and flood routing.

CO4: Familiarize with surface water pollution, causes, effects and remedial measures.

CO5: Acquire knowledge about disasters and its management, conservation of water and climate change and its impact on water resources.

TEXT BOOKS:

1. Water Resources Engineering by Larry W.Mays, John Wiley & 2010.
2. A Text Book on Hydrology by P.Jayarami Reddy, Laxmi publishers, 2011.
3. A text book on Hydrology by H.M.Raghunadh.

REFERENCE BOOKS:

1. Water and Environment by U.Aswathanarayana, A.A. Balkema Publishers, 2001
2. Hydrology and Water Resources Engg by K.C.Parti, Narosa Publishers, 2001.
3. Water Resources-Environment Planning& development by A.K.Biswas, Tata McGraw Hill, 1997.
4. Hydrology Quantity & Quality by Wanisliste & Elenlin, John Wiley, 1997.
5. Applied Hydrology by Ven Te Chow, Maidenment & Mays, Mc Graw Hill, 1988.

PROGRAMME CORE-II/WET-02

GROUND WATER HYDROLOGY

OBJECTIVES:

1. To understand the fundamentals concepts of groundwater concepts for its storage movement governing laws with field and laboratory estimation of hydraulic properties.
2. To learn flow of water porous medium its governing equations and estimation of aquifer parameters with various types of pumping tests in tube wells and open wells.
3. To learn ground water exploration techniques by using geophysical methods such as electrical resistivity methods and seismic refraction method.
4. To learn various ground water management techniques such as artificial recharge, conjunctive use basin management and control of sea water intrusion.
5. To understand the ground water pollution, remediation and modeling of the aquifer with respect flow model and transport model.

UNIT-I: Fundamental Concepts: Types of Aquifers, Vertical Distribution of Soil Water below the Ground, Porosity, Specific Yield, Hydraulic Conductivity and Storage Coefficient, their Practical Significance, Darcy's Law and its Validity, Ground Water Flow Contours and their Applications, Tracer Techniques in Ground Water Flow Studies.

UNIT-II: Ground Water Hydraulics: Derivation of Basic Differential Equation and its Solutions, Steady and Unsteady Radial Flow of Ground Water towards a Well in Confined and Unconfined Aquifers, Analysis of Pumping Test Data, Theis type Curve Method, Jacob's Method for Time and Distance Draw Down Tests, Open Well Hydraulics, Recuperation Test.

UNIT-III: Groundwater Exploration: Remote sensing, hydrogeological methods, Electrical Methods, Expression for Apparent Resistivity in Four Electrode Arrangements viz. – Werner, Schlumberger Arrays, Field Surveys, Interpretation Techniques in Sounding, Profiling and Imaging for Ground Water Investigation, Seismic Refraction Method – Principle and Propagation of Refracted Energy in Two and Three Media Earth, Field Procedure and Interpretation Techniques, Ground Penetrating Radar principle field procedure and Interpretation, well logging.

UNIT-IV: Ground Water Management: Water Balance Studies, Perennial Yield, Concept of artificial recharge, Various types of artificial recharge techniques, Conjunctive use of surface and groundwater, Management of coastal aquifers – Ghyben Herzberg relation, upconing of Saline Water, Methods of control of salt-water intrusion.

UNIT-V: Ground Water Pollution and Modelling: Ground Water Quality, Ground Water Pollution, Elements and Source of Pollution, their Effects and Remedial Measures. Aquifer Modeling: Electrical Analog Models, RC Network Techniques, Principles of Digital Modeling of Aquifers, Flow Modeling Using Finite Difference Methods and Finite Element Methods, Advection Process, Diffusion and Dispersion Process, Solute Transport Modeling, Case Studies.

COURSE OUTCOMES

The student is expected to

CO1: To understanding the fundamentals concepts of groundwater for its storage movement governing laws with field and laboratory estimation of hydraulic properties.

CO2: Derivation of flow of Water through porous media its governing equations and estimation of aquifer parameters with various types of pumping tests in tube wells and open wells.

CO3: Application of ground water exploration techniques by using geophysical methods such as electrical resistivity methods and seismic refraction method to explore groundwater.

CO4: Practicing various groundwater management techniques such as artificial recharge, conjunctive use basin management and control of sea water intrusion.

CO5: To understand the groundwater pollution, remediation and modeling of the aquifer with respect to flow model and transport model.

TEXT BOOKS:

1. Ground Water Hydrology by D.K. Todd, John Wiley & Sons, 1976.
2. Ground water Hydrology by H.M.Raghunath, Wiley Eastern Limited.
3. Numerical Ground Water Hydrology by Rasthogi.
4. Groundwater Assessment, Development and Management by K.R.Karanth, Tata Mc.Graw Hill.

REFERENCE BOOKS:

1. Concepts and Models in Groundwater Hydrology by Domenice.
2. Regional Ground Water Modelling by M. Thangarajan, Capital Publishing Co., 2004.
3. Ground Water Resources Evaluation by W.C.Walton, Mc Graw Hill, 1976.
4. Geohydrology by Davis and Dewiest.

PROGRAMME ELECTIVE –I/ WET-03

ADVANCED FLUID MECHANICS

OBJECTIVES:

1. To understand basic knowledge about fluid properties.
2. To learn and apply fluid statics for solving fluid problems.
3. To acquire the fluid kinematics knowledge for solving fluid kinematics problems in fluid mechanics.
4. To understand and solve problems on dynamics of ideal and real fluids.
5. To understand concepts of boundary layer theory and apply in boundary layer flows.

UNIT-I: Fluid Properties And Fluid Statics: Density, Specific weight, Specific gravity, viscosity, Vapour pressure, compressibility, Pressure at a point, Pascal's law, pressure variation with temperature, density and attitude. Hydrostatic law, Piezometer, Simple and differential manometers, pressure gauges, total pressure and center of pressure plane, vertical and inclined surfaces.

UNIT-II: Fluid Kinematics: Mathematical Descriptions of Fluid Motion, Classification of Flows, Stream line, path line, streak line, stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, one, two and three dimensional flows Continuity equation in 3D flow, stream function, velocity potential function.

UNIT-III: Dynamics of Ideal Fluids: Three Dimensional Continuity and Energy Equations For Steady Incompressible Flow, Applications to Simple One Dimensional Problems, Impulse-Momentum Equations for Steady Incompressible Flow, Problems of Pipe Bend, Flow through Venturimeters and Orificemeter, Pitot tube.

UNIT-IV: Dynamics of Real Fluids: Navier Stokes Equations, Flow between Parallel Plates, Hagen Poiseuille flow, Karman- Prandtl Equations for Velocity Distribution.

UNIT-V: Boundary Layer Flows: Boundary layer definitions and characteristics, displacement thickness, momentum thickness and energy thickness, expressions for Boundary Layer Thicknesses, Prandtl's Boundary Layer Equations, Laminar and Turbulent Boundary Layer Equations, Boundary Layer Separation and its control.

COURSE OUTCOMES

The student is expected to

CO1: Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.

CO2: Develop understanding on the dynamics of Ideal fluids, applications to one dimension problems and evaluate the problems on pipe bend, venturimeter and orifice meter.

CO3: Imbibe the equations of real fluids like Navier Stokes equation, Stokes flow and Hagen Poiseuille flow.

CO4: Acquire knowledge on boundary layer flow for various expressions and equation on laminar and turbulent boundary, Integral momentum and boundary layer separation.

CO5: Grasp the basic idea of turbulence in fluid flow.

TEXT BOOKS:

1. Fluid Mechanics by F.M. White, Mc Graw Hill, 2005.
2. Fluid Mechanics by Streeter, Mc Graw Hill.
3. Fluid Mechanics by D.Ramadurgaiah.

REFERENCE BOOKS:

1. Fluid Mechanics by Massey, ELBS Publishers.

PROGRAMME ELECTIVE –I/ WET-03

WATER QUALITY MODELLING AND MANAGEMENT

OBJECTIVES:

1. To know concepts of water quality.
2. To know about sources of water and estuaries.
3. To know about modeling and transport processes
4. To know about contaminant transport models.
5. To understand about water quality management.

UNIT-I: Water Quality Parameters: Water quality description, various characteristics of water, water quality criteria and standards, elements of reaction kinetics, spatial and temporal aspects of contaminant transport, transport mechanism-advection, diffusion, dispersion.

UNIT-II: Surface Water Quality: River and streams, convective diffusion equation and its application. Estuaries, Estuarine hydraulics, Estuarine water quality models; Lakes and reservoirs, eutrophication.

UNIT-III: Mathematical modelling of environmental systems: Numerical/mathematical modelling of environmental systems, subsystems, and pollutant transport processes Contaminant transport in unsaturated flows, solute transport models for conservative species, solute transport in spatially variable soils.

UNIT-IV: Contaminant transports: Contaminant transports in ground water advection, dispersion, one dimensional transport with linear adsorption, dual porosity models, numerical models, bio degradation reaction.

UNIT-V: Water quality management: Water quality management, socio-economic aspects of water quality management, management alternatives for water quality control, waste load allocation process, lake quality management, and groundwater remediation.

COURSE OUTCOMES

The student is expected to

CO1: Become familiar with water quality standards, contamination of water along with contaminant transport mechanism.

CO2: Know about sources of water, water quality models and eutrophication.

CO3: Gain knowledge about solute transport models and contaminant transport in unsaturated flows.

CO4: Learn about different mechanisms like advection, dispersion and different models like dual porosity model and numerical models.

CO5: Acquire knowledge about water quality management, control including groundwater remediation

TEXT BOOKS:

1. Ramaswami A., Milford J. B., Small M. J., Integrated Environmental Modeling - Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons, 2005.
2. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, 1998.
3. Snape J.B., Dunn I.J.,Ingham J., and Prenosil J., Dynamics of environmental bioprocesses, modelling and simulation Weinheim: VCH, 1995.

REFERENCE BOOKS:

1. International Water Association - Activated sludge modelling ASM1 and ASM2
2. Chapra S. C., Surface Water Quality Modeling, McGraw-Hil, Inc., New York, 1997.
3. Garde R. J., and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi
4. Thomann, R.V. and Mueller, J.A. Principles of surface water quality modeling and control, Pearson, 1987
5. Chapra, S.C. Surface water quality modelling, Waveland Press, INC., 1997
6. Schnoor, J.L., Environmental Modeling Wiley, John & Sons, 1997
7. Thomann, R.V., Systems Analysis and Water Quality Management, McGraw Hill, 1972

PROGRAMME ELECTIVE –I/ WET-03

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

OBJECTIVES:

1. To understand the concepts concerned to ecosystem and balance in nature.
2. To learn the energy flow in the ecosystem and its influence in the ecosphere.
3. To understand the relationship between the biochemistry of water and wastewater with the organic chemistry.
4. To acquire knowledge about waste disposal and chemistry of different chemicals.
5. To understand the concepts of microorganisms prevailing in different environments.

UNIT-I: Ecology: Introduction, Levels of Organization in Nature and Scope of Ecology, Structure of Ecosystem, Ecosystem Function, Population Ecology, Photosynthesis and Respiration, Gross and Net Primary Production, Balance in Nature.

UNIT-II: Energy in Ecosystem: Earth's Energy Budget, Ecosystem Energy Budget, Energy Flows through Ecosystem, Efficiencies of Energy Transfer in Ecosystem, Pyramids, Food Chains and Food Webs, Biogeochemical cycles in ecosphere, Natural Resources, Role of an individual in conservation of Natural Resources.

UNIT-III: Environmental Chemistry: Chemical Reactions in Water and Wastewater Treatment, Analysis, Significance and Interpretation of Different Characteristics of Water and Wastewater. Organic Chemistry and Biochemistry of Water and Wastewater, Buffers, Organic Reactions involved in Water and Wastewater, Bio-Chemical Reactions, Solubility Product, Order of Equations, Rate Control Step, Factors affecting Biochemical Reactions, Chemistry of Biodegradation, BOD, Kinetics of BOD, Factors affecting BOD.

UNIT-IV: Sanitary Chemistry: Domestic Waste Disposal With and Without Water Carriage System, Household and Community Waste Disposals, Chemistry of Pesticides, Insecticides and Herbicides, Detergents, Chemistry of Rodent Control Chemicals, Fumigation and Disinfectants.

UNIT-V: Microbiology: Scope of Microbiology, Characterization and Classification of Microorganisms, Microscopic Observations of Microorganisms, Fundamentals of Microbial Ecology, Soil Microbiology, Microbiology of Air, Aquatic Microbiology, Microbiology of Domestic Water and Sewage, Water borne diseases, Microbiology of Foods, Microbiology of Milk and Milk Products, Industrial Microbiology, Virology important concepts.

COURSE OUTCOMES

The student is expected to

CO1: Develop an understanding of structure and formation of an ecosystem.

CO2: Gain knowledge on energy flow and to understand biogeochemical cycles and their significance in the sustainability ecosystems.

CO3: Gain competency and understanding of the significance of chemical and biological reactions in environmental problems.

CO4: Identify domestic waste, household, community waste disposals and also to familiarize with chemistry of pesticides, insecticides, herbicides, detergents, and rodent control chemicals.

CO5: Acquire knowledge on soil, air, aquatic, domestic water and sewage, foods, milk and industrial microbiology.

TEXT BOOKS:

1. Chemistry for Environmental Engineers by Sawyer, C.N. and Mc Carthy, P.L, McGraw Hill, 1990.
2. Ecology by Kormanday.
3. Text book of Microbiology by R.C.Dubey and D.K.Maheahwari, S.Chand and Co. Publishers, New Delhi.

REFERENCE BOOKS:

1. Environmental Studies by Dr.Suresh K. Dhameja
2. Essential Environmental Studies by S.P.Mishra & S.N.Pandey
3. Ecology by Odum, Mc Graw Hill,1997
4. Standard methods for examination of Water and Wastewater by American Public Health Association Inc. New York, 1989.
5. Water Supply and Sanitary Engineering G.S.Bridie & J.S.Brides, Dhanpat Rai & Sons 1993.
6. Microbiology - Pelzar, Reid and Chan. Tata - Mc Graw Hill Publishing Company Limited, 1996
7. A text book of Microbiology by Chakravarthy, New central Book agency Publishers, Kolkata, 2012.

PROGRAMME ELECTIVE –II/ WET-04

WATER RESOURCES SYSTEMS ANALYSIS

OBJECTIVES:

1. To understand the concepts of water resources planning and management and the role of optimization models
2. The various methods of linear programming are discussed in this unit.
3. The application of dynamic programming for resource allocation and goal programming are dealt in this unit.
4. Gradient based research techniques and simulation concepts are discussed here.
5. In this unit the economics and management of water resources are understand in detail.

UNIT-I: Introduction: concepts of systems analysis, definition, systems approach to water resources planning and management, role of optimization models, objective function and constraints, types of optimization techniques.

UNIT-II: Linear Programming: Formulation linear programming models, graphical method, simplex method, application of linear programming in water resources, Revised simplex method, duality in linear programming, sensitivity and past optimality analysis.

UNIT-III: Dynamics Programming: Belman's of principles of optimality forward and backward recursive dynamic programming, case of dimensionality, application of dynamic for resource allocation, goal programming.

UNIT-IV: Non-Linear Optimatization Techniques: Clerical of method optimization, Kuch-Tucleer, gradential based research techniques for simple unconstrained optimization and Simulation, application of simulation techniques in water resources.

UNIT-V: Water –Resources Economics and Management: Principles of Economics analysis, benefit cost analysis socio economic intuitional and pricing of water resources. Planning of reservoir system, optimal operation of single reservoir system, allocation of water resources, optimal cropping pattern, conjunctive use of surface and sub-surface water resources.

COURSE OUTCOMES:

The student is expected to

CO1: To develop objective function and constraints for various water resources optimization problems.

CO2: To develop linear programming models for water resources problems by using graphical and simplex and revised simplex techniques, to carry out sensitivity analysis and post optimality analysis.

CO3: To develop and solve forward and backward recursive dynamic programming models.

CO4: To understand optimization and simulation concepts and modeling and also apply simulation techniques in water resources problems.

CO5: To understand the fundamentals of economic theory as applied to water resources.

TEXT BOOKS:

1. Introduction to operation research – Tata Mc. Grawhill Publications.
2. Water Resources System Analysis – Vedula & Mujumdar.
3. Trang Web nay coi cung hay, vao coi thu di http://www.freewebtown.com/gaigoisaigon/

REFERENCE BOOKS:

1. Water Resources Economics - James & Lee.
2. Water System by Hall & Dracup.
3. Water Resources project Economic by Kuiper.E.
4. Water resources system planning and management, by Chaturvedi, M.C.

PROGRAMME ELECTIVE –II/ WET-04

RIVER BASIN MANAGEMENT

OBJECTIVES:

1. To discuss different aspects of water resource development and management.
2. To understand the concepts of River reach routing and reservoir routing.
3. To discuss about irrigation distribution systems, water conservation and technological innovation.
4. To learn about allocation of water to drinking, irrigation, hydropower and flood control.
5. To understand the theory of soil erosion and reservoir sedimentation.

UNIT-I: Management of Multiple System Objectives: Water Supply, Flood Control, Navigation, Recreation, Fish and Wildlife Habitats, Hydropower Production.

UNIT-II: Parameters Involved: River Gauging-Measured and Forecasted Flows, River Reach-Routing the Flow and Calculation of Gains and Losses, River Confluences-Mass Balance at River Confluences, Reservoirs - Storage Reservoirs, Power Reservoirs, Reservoir Routing, Groundwater Storage, Canals, Aggregation of Water Users, etc.

UNIT-III: Management of Irrigation Structures: Reservoirs, Irrigation Canal and Distribution Systems, Regulatory Structures, Regulatory Measures, Economic Instruments, Behavioral Changes, Water Conservation, Technological Innovation.

UNIT-IV: Water Allocations: Drinking Water Supply, Irrigation, Hydropower and Flood Control, Reservoir Operations, river basin organizations, functions and powers.

UNIT-V: Soil Erosion & Sedimentation: Theory of soil erosion, sediment transport, reservoir sedimentation, control measures, catchment treatment.

COURSE OUTCOMES

The student is expected to

CO1: To learn know about forecast of river flows, routing the flow and river confluences.

CO2: To understand river confluences and its balance, reservoir routing and aggregation of water users.

CO3: Be familiar with management of different irrigation structures, water conservation and concerned technological innovations.

CO4: Have thorough understanding of judicious water allocation for various purposes and reservoir operation.

CO5: Gain knowledge about soil erosion and sedimentation, control measures and catchment treatment.

TEXT BOOKS:

1. Water Resources Management and the Environment by U. Aswathanarayana, A.A. Balkema, The Netherlands, 2001.
2. Water Resources and Land-use Planning: A systems Approach by P. Laconte and Y.V. Haimes (eds.), Martinus Nijhoff Publishers, The Hague, 1982.

REFERENCE BOOKS:

1. Mechanics of Sediment Transport and Alluvial Stream Problems by Garde, R.J. and Rangaraju, K.G.,
2. Flow through Open Channels by Ranga Raju, K.G.

PROGRAMME ELECTIVE –II/ WET-04

AIR POLLUTION AND CONTROL TECHNOLOGIES

OBJECTIVES:

1. To understand different types of air pollutants and their effects on the environment.
2. To learn about types of pollutant sampling and collection as well as analysis of the pollutants.
3. To understand different types of control methods adopted for air pollutants.
4. To acquire knowledge on control of sulphur-dioxide and nitrogen oxides emissions.
5. To understand the concepts of vehicular emissions and their mechanism of origin.

UNIT-I: Air Pollution & Global issues: Classification and Properties of Air Pollutants, acid rain, Global warming Importance of Anthropogenic Sources, Photochemical Smog, Effects of Air Pollution -Health, Vegetation and Materials Damage in India, Air Pollution Laws and Standards, Meteorological Aspects of Air Pollution Dispersions, Temperature Lapse Rates and Stability, Wind Velocity and Turbulence, Plume Behavior, Dispersion of Air Pollutants, Solutions to the Atmospheric Dispersion Equation -the Gaussian Plume Model.

UNIT-II: Air Pollution Sampling and Measurement: Types of Pollutant Sampling and Measurement, Ambient Air Sampling, Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Stock Sampling, Analysis of Air Pollutants, Sulfur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Oxidants and Ozone, Hydrocarbons, Particulate Matter.

UNIT-III: Air Pollution Control Methods: Sources, Correction Methods, Cleaning of Gaseous Effluents, Particulate Emission Control - Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Control of Gaseous Emissions- Adsorption by Solids, Absorption by Liquids, Combustion.

UNIT-IV: Control of Hazardous Emissions: Control of Sulphur Dioxide Emission, De Sulphurization of Flue Gases, Dry Methods, Wet Scrubbing Methods, Control of Nitrogen Oxides.

UNIT-V: Air Pollution from Automobiles: Classification of Vehicles, Genesis of Vehicular Emissions – Exhaust, Crank Case, Evaporative Emissions, Mechanisms of Origin of Air Pollution from Automobiles, Automobile Air Pollution- Indian Scenario, Automobiles Pollution Control at Sources, Exhaust Gas Treatment Devices, Alternate Fuels Comparison, Thermal Reactor, Catalytic Converter, Legal Measures.

COURSE OUTCOMES

The student is expected to

CO1: The student is expected to understand the effects of air pollutants, the metrological aspects, plume behavior and atmospheric dispersion equation.

CO2: Acquire knowledge on sampling techniques and analyze air quality.

CO3: Understand and analyze the basic mechanisms involved, working principle and design aspects of various air pollution controlling equipments.

CO4: Identify the methods to control sulphurdioxide and nitrogen oxide emissions.

CO5: Gain knowledge on vehicular emissions and auto mobiles pollution control at sources along with legal measures.

TEXT BOOKS:

1. Air Pollution and Control Technologies by Prof.Y.Anjaneyulu, Allied publishers.
2. Air pollution by H.C.V Rao, McGraw Hill.
3. Air pollution by M.N Rao, McGraw Hill

REFERENCE BOOKS:

1. Fundamentals of Air Pollution by Daniel A. Vallero, 4th Edition, Elsevier Publisers, 2007
2. Air Pollution by S.K.Agarwal, APH Publishers, 2005.

LAB 1/ WET -05

HYDROLOGY LABORATORY

OBJECTIVES:

1. To prepare and analyze ground water contour map.
2. To estimate the resistivity and thickness of various layers by conducting vertical electrical sounding.
3. To know the lateral & vertical homogeneity of earth by conducting seismic refraction & resistivity imaging.
4. To know about lift, drag, pressure distribution and surface profiles.
5. To know about the characteristic curves and frictional losses.

List of Practicals

1. Preparation of Groundwater contour map.
2. To determine the Resistivity and Thickness of various sub-surface layers vertically below the central point using Schlumberger method (One Dimensional)
3. To create Resistivity image by using ABEM SAS 1000 Terrameter (Two Dimensional)
4. To determine the thickness of the sub-surface layers by conducting Seismic Refraction method
5. To determine sub-surface layers resistivity, fluid resistivity and spontaneous potential by using by using ABEM SAS 300 Well Logger (Sub-surface method)
6. To investigate underground shallow and deeper pipelines and to understand the various anomalies in the sub-surface by using Ground Penetrating Radar with 100 MHz and 400 MHz antennas
7. To determine the aquifer characteristics such as Transmissivity (T) and Storage Coefficient (S) by conducting pumping tests
8. To study the pressure distribution on Aerofoil and Cylindrical model.
9. To study the Lift and Drag on Aerofoil.
10. To study the characteristics curves for Wind Tunnel.
11. To compare the theoretical and actual pressures at cavitation condition.
12. To verify Darcy's Law.
13. To find out the coefficient of Permeability of a given medium.
14. To determine the coefficient discharge for Rota meter at different fluorides.
15. To plot the surface profile of a forced vortex and free vortex by measurement of the surface profile coordinates.
16. To find out the depth of flow along the test length of the flume
17. To plot a specific energy curve for a constant discharge.
18. To study and calibrate the Pitot static tube.
19. To determine the frictional head loss between reservoir and surge tower.

COURSE OUTCOMES

Students are expected to

CO1: Explore the groundwater using electrical resistivity and seismic methods.

CO2: Identify civil utility using Ground Penetrating Radar.

CO3: Determine of aquifer characters using pumping tests and well logging techniques.

CO4: Study the characteristics curves and specific energy curves.

CO5: Determine the frictional losses, coefficient of discharge and surface profiles coordinates.

LAB 2/ WET -06

ENVIRONMENTAL LABORATORY

OBJECTIVES:

1. The physical, chemical parameters of the water and wastewater samples are analyzed in the laboratory.
2. The significance of the results is compared with the Bureau of Indian standards.

List of Practicals

1. To determine the presence of Total Suspended solids in the given wastewater sample.
2. To determine the amount of Total dissolved solids present in the given wastewater sample.
3. To estimate the concentration of nitrates present in the Groundwater and Surface water Samples.
4. To estimate the chlorides concentration in the given Groundwater and Surface water Samples.
5. To estimate the concentration of Sulphates present in the given Groundwater and Surface water Samples.
6. To determine the Alkalinity of the given Groundwater and Surface water Samples.
7. To determine the Total Hardness for Groundwater Sample and Surface water Sample.
8. To determine the Calcium and Magnesium Hardness of Groundwater Sample and Surface water Sample.
9. To estimate the Fluorides concentration in the given Groundwater and Surface water Samples.
10. To estimate the dissolved oxygen content present in the given Groundwater and Surface water samples.
11. To estimate the phosphates concentration in the given Groundwater and Surface water Samples.
12. To estimate the biological oxygen demand present in the given Groundwater, Surface water and wastewater samples.
13. To estimate the chemical oxygen demand present in the given Groundwater, Surface water and wastewater samples.
14. To determine the heavy metals present in the given Groundwater, Surface water and wastewater samples.
15. To determine the total organic carbon present in the given wastewater sample.
16. To determine the E coli and fecal coliform bacteria present in the given wastewater sample

COURSE OUTCOMES

Students will be able to

CO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
CO2: Statistically analyze and interpret laboratorial results.
CO3: Understand and use the water and wastewater sampling procedures and sample preservations.
CO4: Demonstrate the ability to write clear technical laboratorial reports.
CO5: Understand the impact of biological parameters on wastewater.

CORE/ WET-07

RESEARCH METHODOLOGY AND IPR

UNIT 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:

Students will be able to

CO1: Understand research problem formulation.
CO2: Analyze research related information
CO3: Follow research ethics
CO4: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO5: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO6: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students
2. Wayne Goddar and Stuart Melville, "Research Methodology:An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

AUDIT COURSE -1/ WET -08

ENGLISH FOR RESEARCH PAPER WRITING

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

UNIT-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT-III: Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT-IV: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT-V: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT-VI: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

COURSE OUTCOMES:

Students will be able to:

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Ensure the good quality of paper at very first-time submission

SUGGESTED STUDIES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

AUDIT COURSE -1/ WET -08

DISASTER MANAGEMENT

UNIT-1: Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT-IV: Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V: Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

UNIT-VI: Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

COURSE OUTCOMES:

Students will be able to:

CO1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO4: Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AUDIT COURSE -1/ WET -08

SANSKRIT FOR TECHNICAL KNOWLEDGE

OBJECTIVES:

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

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

COURSE OUTCOMES:

Students will be able to

CO1: Understand basic Sanskrit language.
CO2: Understand Ancient Sanskrit literature about science & technology.
CO3: Develop logic in students being a logical language.

SUGGESTED READING

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

AUDIT COURSE -1/ WET -08

VALUE EDUCATION

OBJECTIVES:

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

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

COURSE OUTCOMES:

Students will be able to

CO1: Gain knowledge of self-development
CO2: Learn the importance of Human values
CO3: Develope the overall personality

PROGRAMME CORE-III/WET-09

GEOSPATIAL APPLICATIONS IN WATER RESOURCES

OBJECTIVES:

1. To understand basic concepts of remote sensing for its applications in the area of water resources
2. To acquire knowledge on geographical information systems
3. To get the concepts and applications of data acquisition and data input for water resources project
4. To get the basic and applied knowledge on how to use global positioning systems
5. To understand the applications of remote sensing and geographical information systems in the field of water and environmental technology

UNIT-I: Basic Concepts and Foundation of Remote Sensing: Elements involved in Remote Sensing, Electromagnetic spectrum, Remote Sensing Terminology, Energy Sources, Energy Interactions with Earth Surface Features and Atmosphere, Resolution, Sensors and Satellites, Visual Interpretation Techniques-Basic Elements, Interpretation for Terrain Evaluation, Spectral Properties of Water Bodies

UNIT-II: Geographical Information Systems(GIS): Introduction, GIS Definition and Terminology, GIS Categories, Components of GIS, Fundamental Operations of GIS, A theoretical Framework for GIS, GIS Types of Data Representation, Raster Data Structures, Vector Data Structures, Comparisons between Data Structures.

UNIT-III: Data Acquisition and Data Input: Introduction, Existing Data Sets, Developing Own Data, Digitization and Scanning, Preprocessing- Format Conversion, Data Reduction and Generalization, Error Detection and Editing, Merging, Edge Matching, Rectification and Registration, Interpolation.

UNIT-IV: Global Positioning System (GPS): Introduction, background, the space segment, the control segment, and the user segment, the performance of GPS- factors influencing GPS accuracy, GPS positioning. Base line data computation, Coordinate change and satellite positions, GPS receivers, Fundamentals of GPS application for various results, broad view of GPS applications.

UNIT V: Remote Sensing & GIS Applications: Land Use/Land Cover in Water Resources, Rainfall-Runoff Modeling, Flood Plain Zoning, Drought Assessment and Monitoring, Cropping Patterns, Condition of Crops, Estimation of Sediment Load, Application to groundwater.

COURSE OUTCOMES

The Student is expected to

CO1: Develop the knowledge on basic concepts of remote sensing, elements involved in remote sensing, its energy sources and interaction with earth's surface features and foundations of remote sensing.

CO2: Comprehend the concepts of Geographical Information System (GIS), components of GIS, types and data structures.

CO3: Understand how the data sets are acquired and developed, and can carry out the preprocessing of data inputs.

CO4: Improve the learning on global positioning system (GPS), factors influencing GPS, GPS signal characteristics, mathematical model and GPS applications.

CO5: Identify the importance of Remote sensing and GIS in various applications like water resources, drought assessment, flood plain zoning etc.

TEXT BOOKS:

1. Remote Sensing and Image Interpretation by T.M. Lillesand & R.W. Kifer.
2. GIS by Michel Dimmar.
3. A text Book of RS &GIS by M.Anji Reddy, BS Publishers.

REFERENCE BOOKS:

1. Introduction to Remote Sensing, 5th edition, by Campbell Guilford press, 2011
2. Remote Sensing by Kevin, ELBS Publishers, 1990.
3. Fundamentals of Remote Sensing by Joseph, 2nd Universities Press, 2005.
4. GIS an Introduction by Nadine schuwrman, Blackwell publishers, 2004.
5. Use of GIS in practical Hydrology by Mcijroff *et al*, ITC Netherlands, 1995.
6. Application of remote sensing to hydrology including groundwater by Farsworth, R.K., Bawetl, E.C. & Dhanju, M.S., IHP, UNESCO, 1984.

PROGRAMME CORE-IV/WET-10

WATER AND WASTEWATER TREATMENT TECHNOLOGIES

OBJECTIVES:

1. The students understand transmission and distribution of treated water. Also, they study water and waste water audit.
2. It enables the students to acquire knowledge about different stages of water and wastewater treatment.
3. The students learn biological and low cost treatment of waste water
4. The students understand the tertiary treatment of waste waters along with few case studies
5. It enables the students to know about wetlands and its role in the treatment of waste waters

UNIT-I: Water Transmission and Distribution: Water Pipe Materials, Economics, Water Distribution, Pipe Networks, Methods for Analysis and Optimization, Laying and Maintenance, In Situ Lining, Appurtenances, their Design, Corrosion Prevention, Preventive Maintenance and Leak Detection, Non-Revenue Water, Water and Wastewater Audit.

UNIT-II: Water Treatment Processes: Pumping, Grit Removal, Flow Measurement, Screening, Primary and Secondary Sedimentation, Tube Settlers, Rapid Sand Filtration, Its Operation, Slow Sand Filtration, Its Operation, Pressure Filtration, Water Softening, Disinfection

UNIT-III: Biological Treatment Processes: Domestic and Industrial, primary and secondary treatment systems, pumps and pumping, degree of treatment and design periods, screening, types of screens, bar screens, fine screens, grit chambers and oil and grease removal devices, Trickling filters, low and high rate activated sludge process, design of surface aerators, mechanical diffused aeration, modifications, extended aeration systems, oxidation ditch, rotating biological contractor, sludge treatment and disposal, low cost waste treatment systems.

UNIT-IV: Tertiary Treatment Processes: Removal of final suspended solids, micro straining, coagulation and filtration, removal of Dissolved solids, adsorption, solvent extraction, ion exchange, Introduction to Osmosis, reverse osmosis, Reverse osmosis technique for Sea water desalination, electro dialysis, Specific Industrial Wastewater Treatment – Case studies on pharmaceutical and chemical industries.

UNIT-V: Ecological Sanitation and Wetlands: Sanitation of human excreta, dry sanitation, separation of urine and faeces, dehydration and decomposition, house hold management, communal management, recycling the nutrient, grey water management in ecological sanitation. Wetlands - Introduction, Definition, Classification, Delineation, Identification Methods, Importance, Human Impacts, Wetland Protection, Mitigation, Wetland Management, Designed Ecosystem, Water and Treated Wastewater Recycling and Reuse, Soil Filters, Constructed Wetlands.

COURSE OUTCOMES:

The student is expected to

CO1: Learn about water transmission pipe networks, non-revenue water and wastewater treatment as a part of water conservation.

CO2: Understand different water wastewater treatment units and its stages and design of water treatment plant.

CO3: Know about sewerage systems, design and appurtenances.

CO4: Gain knowledge about secondary or biological treatment of waste water sludge treatment and disposal, low cost waste treatment systems like oxidation pond and oxidation ditch.

CO5: Know about ecological sanitation and wetlands and its role in the treatment of wastewater, constructed wetlands, recycle and reuse of treated wastewater.

TEXT BOOKS:

1. Analysis of flow in water distribution Networks by P.R. Bhave, Technomic Publishing Co., USA, 1991.
2. Water Supply Engineering by S.K.Garg, Khanna Publishers, 2008.
3. Ecological Sanitation by Uno Winblad Published by Stockholm Environment Institution.
4. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata Mc Graw Hill Book Company, 2003.
5. Waste Water Treatment by Kaira & Christian, Prentice Hall International, 2006.
6. Sewage disposal and Air pollution engineering by S.K.Garg, Khanna Publishers, 2008

REFERENCE BOOKS:

1. Environmental Engineering by Peavy and Row, Mc Graw Hill, 1998.
2. Environmental Engineering by G. Kiely, Mc Graw Hill, 2007.

PROGRAMME ELECTIVE-III/WET-11

IRRIGATION MANAGEMENT

OBJECTIVES:

1. To know the fundamentals of soils physical & chemical properties with respect to soil water plant relationship.
2. To learn to estimate water requirement of various principal crops.
3. To learn the design and development of various irrigation methods.
4. To know survey and design of land grading, conveyance of water through field channels and through underground pipe lines.
5. To learn salt problems in irrigated areas and design of drainage systems.

UNIT-1: Introduction: Irrigation Development in India, Necessity, Scope, and Benefits of Irrigation, Types of Irrigation, Physical and Chemical properties of soils, Texture and structure of Soils, Soil groups of India, Soil Water plant Relations in Irrigation, Measurement of Soil Moisture, Field Capacity, Temporary and Permanent Wilting Points, Hydraulic Conductivity, Water movement through soils.

UNIT-II: Water Requirement of Crops: Meteorological Parameters needed in estimating water requirement of crops, Their measurements, Methods for estimating evapotranspiration of crops, Consumptive Use, Irrigation Requirement of Principal Crops, Duty, Delta and Base Period and Inter-relationships, Factors Affecting the Duty, Cropping Patterns, Irrigation Efficiencies.

UNIT-III: Methods of Irrigation: Surface Irrigation Methods, Border, Check, Furrow, Sub-irrigation Methods and their Relative Merits, Principles of Design of Surface Irrigation Methods, Micro- Irrigation, Sprinkler and Drip Irrigation Methods and their advantages and disadvantages, Design principles and Methods for Evaluation, Concepts of Hydroponics, Aeroponics and precision farming.

UNIT-IV: Land Grading and Field Layout: Criteria for Land Leveling, Land Grading Survey and Design, Equipment of Land Grading, Field Layout suiting different crops. Conveyance of Irrigation Water, Field Channels, Different lining materials, Design of field channels, Drop structures, Conveyance of water through underground pipe lines.

UNIT-V: Drainage of Irrigated Lands: Salt problems in Soil and Water, Water logging in irrigated areas, Causes, Methods for Controlling water logging, Drainage, Surface and Subsurface Drainage Systems, Suitability of these methods, Design of Drainage Systems, Reclamation and Management of Salt Affected Soils.

TEXT BOOKS:

1. Irrigation: Theory and Practice by Michael. A.M 2nd Edition, Vikas Publishing House,
2. Land and Water Management Engineering by V.V.N. Murthy, Kalyani Publishers, 2008.
3. Irrigation –Theory and Practice" by Withers and Vipond, S, Cornell University Press, 1980.

REFERENCE BOOKS:

1. Soil and Water Management Systems by Scwabe G.O., Fangmeir, D.D. and Elliot W.J, John Wiley & Sons, 1996.
2. Irrigation, Drainage and Salinity by Hutchinson.
3. Irrigation and Water Resources Engineering by Asawa,G.L ,New age Publishers,2005.
4. Irrigation Principles and Practice by Hansen, V.E., Israelson O.S. and Stringham G.C. John Wiley & Sons, N York.

PROGRAMME ELECTIVE-III/WET-11

FLUVIAL HYDRAULICS

OBJECTIVES:

1. To acquire basic concepts of free surface flow and its distribution along with applications of various basic equations.
2. To understand the concepts of gradually varied flow for steady state condition.
3. To understand the concepts of gradually rapid flow for steady state condition.
4. To get the knowledge on non-dimensional members and applications to hydraulic models.
5. To acquire the concepts and basic design rules for design of stable channels.

UNIT-I: Basic Concepts of Free Surface Flow: Basic Principles of Free Surface Flow, Types of Channels, Flow Regimes, Velocity Equations, Most Economic sections, Uniform Flow Computations, Velocity and Pressure Distribution, Energy Principles and its Applications, Specific Energy, Critical Depth, Critical Flow Computations, Momentum Equation and its Applications, Specific force Diagram.

UNIT-II: Steady Gradually Varied Flow: Dynamic Equation, Characteristics of Flow Profiles, Practical Problems, Gradually Varied Flow Analysis and Computation.

UNIT-III: Steady Rapidly Varied Flow: Hydraulic Jump, Types of hydraulic jump, Hydraulic jump Analysis, Length of the jump, Expression for energy loss during the jump, Jump in Sloping Channels. Unsteady Rapidly Varied Flow- Dam Break Problem, Moving Hydraulic Jump, Positive and Negative Surges.

UNIT-IV: Hydraulic similitude: Dimensions and dimensional homogeneity, Rayleigh's method, Buckingham's pi- theorem method, Froude's, Reynolds, Mach's and Weber's laws of similitude, simple applications to hydraulic models, Distorted models, Scale effect.

UNIT-V: Design of stable Channels: Design of Unlined channels in alluvial transporting canals by Kennedy's and Lacey's theories.

COURSE OUTCOMES

The student is expected to

CO1: To learn about types of flows and flow profiles, varied flow analysis and computation.
CO2: Understand dam break analysis, formation of jump on sloping channels, surges and its types.
CO3: Know about different methods of dimensional analysis and its applications.
CO4: Gain knowledge about different dimensionless members and their model laws and flow fields in which they are applicable, kinds of similarity and types of models and scale effect.
CO5: Be thorough with design of alluvial channels, different theories and their relative merits and demerits.

TEXT BOOKS:

1. Open Channel Hydraulics by Chow,. V.T., Mc Graw Hill Inc. N York, 2009.
2. Open Channel Flow by Henderson, Mc Millan Pub. London, 1996.
3. Flow in Open Channels by Subramanya, K, Tata Mc Graw Hill Pub., 2009.

REFERENCE BOOKS:

1. Mechanics of Sediment Transportation and Alluvial Stream Problems by Garde and Ranga Raju, K.G. Wiley Eastern, N Delhi, 1980.
2. Open –Channel Flow by Chaudhry M.H, Prentice Hall of India, N Delhi, 1994.
3. Open Channel Hydraulics by French, R.H. Mc Graw Hill Pub Co., N York, 1986.
4. Open Channel Flow by M.Hanif Chaudhry, Elsevier Publishers, 2006.

PROGRAMME ELECTIVE-III/WET-11

URBAN HYDROLOGY

OBJECTIVES:

1. The students understand urban hydrological cycle, impact of urbanization on quality of water and erosion due to urban runoff.
2. It gives an idea about probabilistic and statistical approaches, data collection and analysis of storm water.
3. The students learn urban drainage systems and design considerations for sewers.
4. The students understand the storm water management and mitigation of urban storm runoff.
5. The students are expected to learn maintenance of urban drainage systems and regulations.

UNIT- I: Urban Hydrologic Process: Process of urbanization, Water in Urban ecosystem, Urban water subsystems, Urban hydrologic cycle, Impact of urbanization on urban runoff and stream flow quantity, Impact of urbanization on quality of runoff and stream flow, Erosion due to urban runoff.

UNIT- II: Storm water Modelling: Analysis of hydrologic changes due to urbanization, Approaches to study, Data collection and analysis, Probabilistic and statistical approaches, Principles of storm water modelling.

UNIT- III: Urban Drainage Systems: Sanitary and combined sewer systems, components, Design considerations for fixing sewer capacity, Infiltration into and ex-filtration from sewers, causes, Infiltration inflow analysis, Field investigations, Control measures.

UNIT- IV: **Storm Water Management**: Urban storm runoff quantity and quality management, Mitigation of damaging effects of urban storm runoff

UNIT-V: Urban Drainage Systems Maintenance: Maintenance management of UDS and its subsystems, Drainage system, Storm drain conveyance system, Pump stations, Open channel illicit connections and discharges, Spill response, Other considerations, limitations and regulations.

COURSE OUTCOMES

The student is expected to

CO1: To know about impact of urbanization on urban runoff urban water sub systems, urban hydrologic cycle.

CO2: Learn modeling of storm water, probabilistic and statistical approaches of analysis of storm water data.

CO3: Understand urban drainage systems, sewers, components, design considerations, infiltration and exfiltration in sewers, field investigations and control measures.

CO4: Be well acquainted with storm water management, monitoring run off, quantity and quality, measures to mitigate damaging effects of urban storm runoff.

CO5: Be familiar with maintenance of urban drainage systems, pump stations, illicit connections, limitations and regulations.

TEXT BOOKS:

1. Stephenson. D, “Storm Water Hydrology and Drainage”, Elsevier Publications, 2nd Edition, 1981.
2. Hall.J.M, “Urban Hydrology”, Elsevier Applied Science Publishing Company, 1st Edition, 1984.

REFERENCE BOOKS

1. Overtens D.E., and Medows M.E., “Storm water Modeling” Academic Press, 2nd Edition. 1976.
2. Grigg, N.S, “Urban Water Infrastructure Planning, Management, and Operations”, John Wiley & Sons, 2nd Edition, 1986.
3. Viessman W.I., Knapp J.W., Lewis G.L., and Henbrough, T.E., “Introduction to Hydrology”.

PROGRAMME ELECTIVE-IV/WET-12

SUSTAINABLE WATER RESOURCES DEVELOPMENT

OBJECTIVES:

1. It is intended to create awareness among students about sustainability of water resources goals and policy approaches.
2. Students understand national water policy, challenges, global issues and concerns as a part of sustainable water resources development.
3. Students are exposed to local, regional and global perspective of sustainable water resources management.
4. Students learn about various economic water issues and water conservation.
5. The students are taught about water act and measures for sustainable water resources development.

UNIT-I: Introduction: Concept Of Sustainable Development, Sustainability Principles For Water Management, Goals For Guiding Sustainable Water Resource Management, Important Preconditioning In Water Policy Approaches, Framework For Planning A Sustainable Water Future.

UNIT-II: Sustainable Water Resources Development: Sustainability, Sustainability in Water Resources, National Water policy, National Water Mission, Challenges to sustainable development of water resources, framework for sustainable development of water resources, The global water crisis, Global initiatives, Water and ethics, Global water tele-connections and virtual water.

UNIT–III: Sustainable Water Resources Management: Sustainable Water Resources Management In A Local, Regional And Global Perspective, Water Resources-Their Use And Management, And Challenges To Achieve Sustainable Use And Management.

UNIT IV: Water Economics: Economic view of water issues, economic characteristics of water good and services, Non-market monetary valuation methods, Water economic instruments, policy options for water conservation and sustainable use, Pricing, distinction between values and charges, Private sector involvement in water resources management.

UNIT-V: Measures for sustainable development: Water act, sustainable water resource management, government water conservation policies, general measures for sustainable development in water resources, sustainable water resources in India.

COURSE OUTCOMES

The student is expected to

CO1: To know about frame work for sustainable development of water Resources keeping global water crises in view.

CO2: To learn virtual water, national water policy, national water mission along with the challenges in the development of sustainable development of water resources.

CO3: To be thorough sustainable water resources management in local, regional and global perspective including the challenges to achieve sustainable water use and management.

CO4: To gain knowledge regarding water economics, options for water conservation and private sector involvement in water resources management.

CO5: To be well versed with water act, government policies on water conservation and the measures for sustainable water resources.

TEXT BOOKS:

1. S.K.Gupta “Modern Hydrology and Sustainable Water Development” November 2010, Wiley-Blackwell.
2. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
3. Mollinga .P. Etal “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.

PROGRAMME ELECTIVE-IV/WET-12

ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:

1. To understand the concept, historical context and wider importance of EIA as a planning tool.
2. Students learn about EIA methodologies.
3. Students will be able to assess the impact on soil and groundwater.
4. To construct and assess the methodology for assessment of impacts on surface water environment.
5. Students Illustrate and evaluate the stages of environmental audit.

UNIT-I: Introduction: Basic Concept of EIA, Initial Environmental Examination (IEE) and Environmental Impact Assessment, Initial Environmental examination (IEE), Important Steps in EIA, Systematic Approach for using EIA as a Planning Tool for Major Project Activities, concepts of water and carbon footprints.

UNIT-II:EIA Methodologies: Introduction, Criteria for the Selection of EIA Methodology, EIA Methods – Ad-hoc Methods, Matrix Methods, Network Methods, Overlay Methods, Cost / Benefit Analysis, environmental protection laws.

UNIT-III: Assessment of Impact of Developmental Activities and Land use: Methodology for the Assessment of Soil and Groundwater, Delineation of Study Area, Identification of Activities, Description of Existing Soil/Groundwater Resources Soil Characteristics, Procurement of Relevant Soil Quantity, Assessment of Impact Significance on landfills and human habitation.

UNIT-IV: Environmental Impact Assessment on Water: Introduction, Projects which Crate Impact Concerns for the Surface Water Environment, Systematic Methods for Evaluation of Impact of Various Developmental Activities on surface water Environment, Identification of Surface Water Quality or Quality Impacts, Description of Existing Surface Water Resources Conditions, Procurement of Relevant Surface Water Quality, Impact Prediction, Interpretation of Impact Significance on Water Resources Projects.

UNIT-V: Environmental Audit: Objectives of Environmental Audit, Advantages of Environmental Audit, Waste Audit, Energy Audit, Compliance Audit, Management Audit, Audit Protocol, Audit Procedure, Stages of Environmental Audit, Program Planning, On Site Activities, Evaluation of Audit Data and Preparation of Audit Report, EIA case studies.

COURSE OUTCOMES

The Student is expected to

CO1: Understand the basic concept of EIA, important steps in EIA and systematic approach for using EIA as a planning Tool for Major project activities.

CO2: Identify the EIA methodologies and criteria for selection of EIA methodology.

CO3: Recognize the impact of development activities and landuse on soil and groundwater resources and assess the impact significance on landfills and human habitation.

CO4: Identify and interpret the projects which create impacts on surface water environment, surface water quality, Impact significance on water resources project.

CO5: Understand the concept of environment audit, its objective, different types of audit and experience on site activities and gain technical knowledge during the field visit to industries.

TEXT BOOKS:

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.
2. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.

REFERENCE BOOKS:

1. Environmental Science and Engineering, by Suresh K. Dhaneja – S.K.,Katania &. Sons Publication, New Delhi.
2. Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd, Delhi.

PROGRAMME ELECTIVE-IV/WET-12

CLIMATE CHANGE ADAPTATION AND MITIGATION

OBJECTIVES:

1. To understand the concept, historical context and wider importance of Climate change and its impacts.
2. To understand the framework of climate risk assessment.
3. To develop solutions for climate change adaptation and mitigation for different sectors.
4. To understand the Indian and international climate change policy and finances.

UNIT-I: Introduction: Weather and Climate, Variability, Basic Concept of Climate Change, Sources of Green House Gases (GHGs), natural and anthropogenic contribution towards climate change, different climatic models, GCM, RCM and projections, impact of climate change on different sectors, impact of CC globally, impact of CC in India, Climate change education and awareness.

UNIT-II: Climate Risk Assessment (CRA): Definitions, Climate hazards, Floods, droughts, heat waves, cyclones, storm surge, climate impacts, susceptibility, climate risk, vulnerability, social vulnerability, adaptive capacity, Gender aspects, Participatory rural appraisal (PRA), focused group discussions, CRA for different sectors like Urban, Agriculture, Forest, Industry, Tools for carrying out CRA and ranking methods.

UNIT-III: Climate Change Adaptation: Definitions, Adaptation and Disaster Risk Reduction, losses and opportunities, Soft and Hard measures, different types of adaptation, adaptation for different sectors community, urban, agriculture, forest, industry, cost-benefit analysis of adaptation measures, prioritization, water audits and water footprints estimation and associated measures. Concepts of smart cities, sustainable cities, integrated water management,

UNIT-IV: Climate Change Mitigation: Definitions, Technological options to reduce emissions, fossil fuel, successful case studies, energy efficiency, renewable energy, solar, wind, bio-gas, low carbon development, sustainable transportation, clean development mechanism, carbon sequestration, carbon footprints and emissions estimation, Cost of mitigation, cost-benefit analysis, Business models to promote energy efficiency ESCO, venture capital, prioritization of mitigation measures, Life Cycle Assessments and Extended Producer Responsibilities, Circular Economy, analysis of co-benefits of adaptation and mitigation, Food-water-energy nexus.

UNIT-V: Climate Change Finance and Policy: Sources of climate change finance, national and international funding agencies, UN, WB, ADB, Green Climate Fund, International treaties on climate change, UN framework for climate change, Montreal and Kyoto Protocol, United Nations Sustainable Development Goals, Indian Policies on Climate Change, Paris Agreement, India's Intended Nationally Determined Contributions (INDC), National Action Plan for Climate Change, State Action Plan for Climate Change

COURSE OUTCOMES

The Student is expected to

CO1: Understand the basic concept of climate change and its impacts on earth and India.
CO2: Evaluate the climate risk for different sectors.
CO3: Develop an adaptation plan for various sectors and prioritize the measures based on impact and cost-benefit analysis.
CO4: Propose mitigation measures, carry out carbon emission reduction and cost benefit analysis.
CO5: Understand the international and national policies on climate change along with sources of finance for implementing CCA and CCM measures.

TEXT BOOKS:

1. Climate Change Modeling, Mitigation, and Adaptation. American Society of Civil Engineers. Zhang, T. C., Ojha, C. S. P., & Kao, C. M. (2013, March).
2. Handbook of climate change mitigation and adaptation Chen, W. Y., Suzuki, T., & Lackner, M. (Eds.). (2016) New York: Springer.
3. Climate Change by Joseph Romm

REFERENCE BOOKS:

1. IPCC fifth assessment report: Technical Summaries for Working Group I-III (freely available online athttp://www.ipcc.ch/report/ar5/)

LAB 3/WET-13

GIS AND IMAGE PROCESSING LABORATORY

OBJECTIVES:

1. To delineate the watershed area.
2. To prepare various thematic maps.
3. To carry out geometric correction of satellite data using ground control points (GCPs) and preparing mosaics of satellite images.
4. To generate Digital Elevation Models (DEM) and NDVI of AOI.
5. To prepare Land use/land cover maps using unsupervised and supervised classification algorithms.

List of Practicals

1. Geo Referencing of the Scanned Toposheet/maps using ground control points.
2. To delineate the Boundary for the Watershed/ Catchment Area.
3. To prepare the Base map for the given study Area.
4. To prepare the Drainage map for the Delineated Catchment Area
5. To prepare the Contour map for the Delineated Catchment Area
6. To Generate the Slope map for the given study Area.
7. To prepare the Land Use Land Cover map for the given study Area.
8. To Import the raw Satellite data into Raster Image.
9. To Execute Geometric Correction for the Raw Satellite data
10. To rectify the image with ground control points
11. To create a Subset for the Satellite Image
12. To Mosaic the satellite Images
13. Preparation of DEM map of the study area
14. Preparation of drainage maps of area of interest.
15. To Execute Unsupervised Classification for the Delineated Study Area
16. To generate the Land Use/Land Cover for the area of interest using Supervised Classification
17. To generate NDVI (Normalized Differential Vegetative Index) map.

COURSE OUTCOMES

The Student is expected to

CO1: Identify and generate different types of maps using GIS software.

CO2: Prepare the maps for the delineated catchment area using GIS.

CO3: Carry out geometric correction of satellite data using ground control points (GCPs), and preparing mosaics of satellite images.

CO4: Generate Digital Elevation Models (DEM) and NDVI from satellite image of AOI.

CO5: Prepare Land use/land cover maps using unsupervised and supervised classification algorithms.

LAB 4/WET-14

WATER RESOURCES MODELLING LABORATORY

OBJECTIVES:

1. To apply SWAT and CROPWAT softwares in watershed analysis.
2. To identify rainwater harvesting structures.
3. To prepare Priority watershed maps, flood maps showing inundated areas, Surface water body inventory maps and drought maps.
4. To apply EPANET for designing pipe network distribution.
5. To model the aquifer parameters.

List of Practicals

1. To introduce SWAT modeling software.
2. Application of Geomatics for watershed analysis using SWAT.
3. Application of Geomatics for rainfall-runoff modeling using freeware.
4. Evapotranspiration modeling using CROPWAT.
5. Preparation of groundwater table of area of interest using Geomatics
6. Identification of harvesting structures in the given area.
7. Preparation of prioritization of watershed maps.
8. Preparation of flood maps and flood inundated areas.
9. Preparation of drought maps and drought analysis.
10. Preparation of surface water body inventory of the given study area.
11. To design the pipe distribution by EPANET.
12. To model groundwater resources using MODFLOW.

COURSE OUTCOMES:

The Student is expected to

CO1: Apply the concept of geomatics for watershed analysis and rainfall-runoff modelling using SWAT.

CO2: Execute evapotranspiration modeling using CROPWAT.

CO3: Identify harvesting structures in given area.

CO4: Priority watershed maps, flood maps including inundated areas, Surface water body maps, drought maps and their analysis.

CO5: Design the pipe distribution network and model the groundwater resources.

CORE/WET-15

MINI PROJECT

The mini project will be based on the work done during the industrial training/internship of two months provided during semester break.

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

End semester presentation should be done

(a) Along with the report on identification of topic for the work and

(b) The methodology adopted involving scientific research, collection and analysis of data,

(c) Determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

COURSE OUTCOMES:

CO1: Students will get an opportunity to work in actual industrial environment if they opt for internship.

CO2: In case of mini project, they will solve a live problem using software/analytical/computational tools.

CO3: Study different techniques used to analyze complex systems

CO4: Students will learn to write technical reports.

CO5: Students will develop skills to present and defend their work in front of technically qualified audience.

AUDIT COURSE-2/WET-16

CONSTITUTION OF INDIA

OBJECTIVES:

1. To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working).

UNIT-II: Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-III: Contours of Constitutional Rights & Duties:

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

UNIT-IV: Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT-V: Local Administration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Panchayati raj: Introduction, PRI: Zilla Panchayat.
- Elected officials and their roles, CEO Zilla Panchayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-VI: Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

COURSE OUTCOMES:

Students will be able to:

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

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

AUDIT COURSE-2/WET-16

PEDAGOGY STUDIES

OBJECTIVES:

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

UNIT-I: Introduction and Methodology:

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

UNIT-II: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

- Curriculum, Teacher education.

UNIT-III: Evidence on the effectiveness of pedagogical practices

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

UNIT-IV: Professional development: alignment with classroom practices and follow- up support

- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

UNIT-V: **Research gaps and future directions**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

COURSE OUTCOMES:

Students will be able to understand:

CO1: What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING:

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

AUDIT COURSE-2/WET-16

STRESS MANAGEMENT BY YOGA

OBJECTIVES:

1. To achieve overall health of body and mind.
2. To overcome stress.

UNIT-I: Definitions of Eight parts of yog. (Ashtanga)

UNIT-II: Yam and Niyam.
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT-III: Asan and Pranayam
i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

COURSE OUTCOMES:

Students will be able to:
CO1: Develop healthy mind in a healthy body thus improving social health also
CO2: Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

AUDIT COURSE-2/WET-16

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES:

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students.

UNIT-I: Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-II: Approach to day to day work and duties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-III: Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

COURSE OUTCOMES:

Students will be able to

CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

CO2: The person who has studied Geeta will lead the nation and mankind to peace and prosperity

CO3: Study of Neetishatakam will help in developing versatile personality of students.

SUGGESTED READING

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

PROGRAMME ELECTIVE –V/WET-17

SOLID AND HAZARDOUS WASTE MANAGEMENT

OBJECTIVES:

1. The students are expected to learn about solid waste, characteristics and its disposal methods
2. It creates awareness regarding hazardous waste, characterization and control.
3. The students learn about management, minimization and audit of hazardous waste
4. The students understand bio and electronic waste, it's safe disposal and 3R concept.
5. The students acquire knowledge about methods of remediation of waste land followed by reclamation

UNIT-I: Introduction: Definition of Solid Wastes, Domestic Solid Wastes, Types of Domestic Solid Wastes, Collection, Transportation, Characteristics of Solid Waste, Segregation, Principles of waste disposal, site selection, Types of Disposal Methods, Sanitary Land Fill, Incineration, Composting, Vermi Compost, Recovery of Energy from Solid Wastes.

UNIT-II: Hazardous Wastes: Introduction, Physical and Biological Routes of Transport of Hazardous Substances, Environmental Laws, Indian Scenario, Special Hazardous Wastes, Hazardous Waste Sources and Characterization Categories and Control, Sampling and Characterization, Analysis of Hazardous Wastes.

UNIT-III: Hazardous Waste Management and waste minimisation Technologies: Waste Recovery Processes, Solidification, Stabilization and Encapsulation, Biological Processes, Thermal Processes. Storage and Transportation Including Optimization, Disposal Facilities, TSDF Cradle to Grave Concept, Land Disposal of Wastes, Land Fills, incineration, Underground Disposal, Sea Disposal, Pollution Prevention and Recycling, Environmental Facility Assessment and Audit Waste Minimization, Hazardous Waste Remediation Technologies.

UNIT-IV: Biomedical & Electronic Waste: Hospital/Biomedical Waste Management Including Collection, Transportation, Treatment and Safe Disposal. Zero Waste Technology, Re-Use and Recycling of Wastes, Recovery of By-Products and Energy Audit

UNIT-V: Waste Land Remediation and Reclamation: Definition of Waste Land, Characteristics of Waste Land, Physical, Chemical and Biological Pollution of Soils, Dumping, land Fills, Leachate Problems, Remediation Methods-Physical, Chemical and Biological Methods.

COURSE OUTCOMES

The student is expected to

CO1: To know about solid and hazardous waste transportation, environmental laws and analysis of hazardous waste.

CO2: Learn waste recovery processes, cradle to grave concept of handling hazardous waste.

CO3: Understand disposal of hazardous waste both on surface and underground and waste minimization and hazardous waste remediation technologies.

CO4: Be familiar with collection transportation treatment and safe disposal of both biological and electronic waste and be conversant with reuse and recycling of wastes, recovery of by products and energy audit.

CO5: Gain knowledge about waste land characteristics and its remediation, different kinds of pollution of soils, remediation methods.

TEXT BOOKS:

1. Solid and Hazardous Waste Management by M.N.Rao & Razia Sultana, B.S.Publishers, 2011.
2. Hazardous Waste Management by Charles A.Wentz, McGraw Hill Publishers.
3. Standard Hand Book of Hazardous Waste Treatment and Disposal by H.M. Free man, McGraw Hill, 1997.

REFERENCE BOOKS:

1. Integrated Solid Waste Management by Goerge Tchobanolous, Hilary Theisen & Samuel A.Vigil.
2. CPCB Manual on Solid Waste Management, 2003.

PROGRAMME ELECTIVE –V/WET-17

HYDRO POWER DEVELOPMENT

OBJECTIVES:

1. It deals with understanding of hydropower schemes and types
2. Intended to create awareness regarding intake structures and penstocks
3. The students learn about water hammer and its analysis
4. The students understand surge tanks, their working and computations
5. The students learn about different types of power houses along with their suitability

UNIT-I: Classification of Hydropower Schemes, Load Studies and factors, Flow duration curve, Firm and secondary power pondage and storage.

UNIT-II: Low and high head intakes, fore bay trash rack, gates and tier operation, air vent, Design of Penstock, Pen stock anchorages.

UNIT-III: Water hammer analysis: Basis equations, solution for linearized equations, arithmetic method and graphical method.

UNIT-IV: Surge tanks: Different types, their working, Computation of Surges in simple surge tank, Surge stability.

UNIT-V: Power Houses: General arrangement of overgrown lower houses component parts and their functions, Criteria for fixing power house dimensions, Selection of type and capacity of turbine. Underground power houses: Types of layout their suitability and merits.

COURSE OUTCOMES

The student is expected to

CO1: To know about hydropower systems, types, different load studies, pondage and storage.

CO2: Understand different intake structures, layout of a hydropower plant, penstock, design and anchorages.

CO3: Learn about water hammer, analysis, solution of linearized equations.

CO4: Be familiar with surge tanks, types, working, computations and stability analysis.

CO5: Be well acquainted with power houses, arrangement, selection of type, criteria for fixing dimensions, layout of underground power houses, stability and merits.

TEXT BOOKS:

1. Hydropower structure by varshney
2. Water Power Engineering by Dandekar and Sharma.
3. Fluid Transients by V.L.Streeter.

PROGRAMME ELECTIVE –V/WET-17

MICRO IRRIGATION TECHNOLOGIES

OBJECTIVES:

1. The students understand the concept of micro irrigation, survey of fields and data to be collected in the design of irrigation system.
2. The students gain knowledge about drip and sprinkler irrigation systems including their design and their suitability to different crops.
3. The students gain knowledge about land scaping for irrigation, poly houses, farm houses.
4. The students became familiar with Automation and Fertigation.
5. The students learn installation, operation and maintenance of piping system.

UNIT I: Field Data Collection: Introduction to Survey of fields, Introduction to survey for Pipelines, Soil and Water Sample collection procedures, Data to be collected from field and their importance in design of an irrigation system.

UNIT II: Drip and Sprinkler Irrigation Systems: Preparation of Drawings, Estimate and Bill of Quantities, Use of item codes. Worked out Examples for Tree Crops, Row Crops & Intercrops, Introduction of sprinkler Irrigation systems, types of sprinklers, Mini and Micro sprinklers, Preparation of designs, drawings, Estimate and Bill of Quantities, Use of item codes.

UNIT III: Landscape Irrigation System: Site specific installation requirement, Understanding the landscape architects plan, Irrigation system for road dividers, poly houses, farm houses, sports ground – GUN sprinkler, Design of Sprinkler Irrigation Systems for Turf and Golf Courses, Use of treated wastewater.

UNIT IV: Automation and Fertigation: Concept, Necessity, Advantages, Types, Components, Design, preparation of Bill of quantities, Preparation of irrigation and fertigation schedule, Fertigation with alkaline water, Fertigation with acid water, Special instruction on use of equipment.

UNIT -V: Installation, Operation and Maintenance of Irrigation Systems: Planning for trenching work, transportation and storage of PVC/HDPE pipes, Lowering, Laying and Jointing of pipes and installation work, Design, Operation & maintenance of lift irrigation piping. Operation and Maintenance of Micro Irrigation Systems: Daily, weekly and monthly maintenance, Chemical Treatments, their importance, procedures, calculations of chemical doses.

COURSE OUTCOMES:

The student is expected to

CO1: The design of an irrigation system.
CO2: Know about design of drip and sprinkler irrigation systems.
CO3: Understand the concepts of land scaping.
CO4: Gain knowledge on automation and fertigation.
CO5: Familiarize with operation and maintenance of irrigation systems.

TEXT BOOKS:

1. Micro Irrigation Scheduling and Practices (Innovations and Challenges in Micro Irrigation) by Megh R. Goyal, Balram Panigrahi, Sudhindra N. Panda, Apple Academic Press, 2017
2. Land and Water Management Engineering by V.V.N. Murthy, Kalyani Publishers, 2008.
3. Irrigation –Theory and Practice" by Withers and Vipond, S, Cornell University Press, 1980.

REFERENCE BOOKS:

1. Irrigation: Theory and Practice by Michael. A.M 2nd Edition, Vikas Publishing House,
2. Irrigation Principles and Practice by Hansen, V.E., Israelson O.S. and Stringham G.C. John Wiley & Sons, N York.

OPEN ELECTIVE/WET-18

BUSINESS ANALYTICS

OBJECTIVES:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT I: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI: Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES:

Students will be able to

CO1: Demonstrate knowledge of data analytics.

CO2: Think critically in making decisions based on data and deep analytics.

CO3: Use technical skills in predicative and prescriptive modeling to support business decision-making.

CO4: Translate data into clear, actionable insights.

REFERENCE BOOKS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVE/WET-18

INDUSTRIAL SAFETY

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

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

UNIT-III: Wear and Corrosion and Their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

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

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

REFERENCE BOOKS:

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

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OPERATIONS RESEARCH

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

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

UNIT III: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

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

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

COURSE OUTCOMES:

The student should be able to

CO1: Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
CO2: Students should able to apply the concept of non-linear programming
CO3: Students should able to carry out sensitivity analysis
CO4: Student should able to model the real world problem and simulate it.

REFERENCES BOOKS:

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

OPEN ELECTIVE/WET-18

COST MANAGEMENT OF ENGINEERING PROJECTS

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

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

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

REFERENCE BOOKS:

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

OPEN ELECTIVE/WET-18

COMPOSITE MATERIALS

UNIT–I: **Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: **Reinforcements:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCE BOOKS:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

OPEN ELECTIVE/WET-18

WASTE TO ENERGY

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

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

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

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

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

REFERENCES BOOKS:

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

OPEN ELECTIVE/WET-18

ENVIRONMENTAL STATISTICS

OBJECTIVES:

1. To understand the concept, historical context and wider importance of Climate change and its impacts.
2. To understand the framework of climate risk assessment
3. To develop solutions for climate change adaptation and mitigation for different sectors
4. To understand the Indian and international climate change policy and finances

UNIT-I: Introduction to Statistics: introduction to data, Types of data, sources of paid and free data, role of environmental statistics, Environmental Sampling, types of sampling, population, descriptive and inferential statistics, mean, standard deviation, standard error, median, mode, quartiles, kurtosis, variance and their significance, Exploratory data analysis and data visualization, hands-on in MS Excel.

UNIT-II: Introduction to R: What is R? R command and Scripts, R packages, R Working directory, R functions, getting data into R, Data cleaning, sub-setting and combining data, data transformation in R, carry out all basic analysis in R in both descriptive and inferential statistics

UNIT-III: Probability and Statistic: Experiments, Counting rules, events and probability, conditional probability and Bayes theorem, Discrete Probability distribution, Binomial and Poison Probability, Continuous probability distribution, Normal Probability distribution, interval estimation, Hypothesis test, Type I and Type II errors, inference of population mean known and unknown, use of environmental data, hands-on in Excel and R.

UNIT-IV: Analysis of Variance, Correlation and Regression: ANOVA, ANCOVA, simple regression model, Non-linear regression, coefficient of determination, t-test, F-Test, point and interval estimation, residual analysis, multiple regression, logistic regression, forecasting methods, Time series, Temporal data, autoregressive modeling, use of environmental data, hands-on excel and R.

UNIT-V: Spatial Statistics: Raster and Vector data reading and analysis in R, spatial point pattern analysis, local and global statistics, complete spatial randomness (chi-square, distance methods, Ripley's K-function), spatial measurements (autocorrelation, Morans I, Geary's c, semi variogram), Spatial correlation, spatial regressions, spatial prediction (simple, ordinary, universal kriging) hands on in R using environmental data,

COURSE OUTCOMES

The Student is expected to

CO1: Understand the data, sampling procedures, descriptive and inferential statistics in environmental data

CO2: Use R and MS Excel for basic statistical analysis for environmental data

CO3: differentiate discrete and continuous probabilities and its application in environmental science, carry out various test and hypothesis

CO4: use correlation, regression and analysis of various in R and Excel for interpreting environental data and use it for decision making

CO5: Understand the concept of spatial statistics and use it for environmental data for decision making

TEXT BOOKS:

1. Piegorsch, W. W., & Bailer, A. J. (2005). *Analyzing environmental data*. John Wiley & Sons.
2. Qian, S. S. (2016). *Environmental and ecological statistics with R*. Chapman and Hall/CRC.

REFERENCE BOOKS:

1. Probability and statistics applications for environmental science by Shaefer, S. J., & Theodore, L. (2007). CRC Press.
2. Statistical geoinformatics for human environment interface by Myers, W. L., & Patil, G. P. (2012). . Chapman and Hall/CRC.
3. Statistics for environmental engineers by Brown, P. M. B. L. C., &Hambley, D. F. (2002).

DISSERTATION PHASE-1

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review.

The preliminary results (if available) of the problem may also be discussed in the report.

The work has to be presented in front of the examiners panel set by Head DRC.

The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

COURSE OUTCOMES:

CO1: Students will be exposed to self-learning various topics.
CO2: Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
CO3: Students will learn to write technical reports.
CO4: Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

DISSERTATION PHASE- II

It is a continuation of Project work started in semester III.

He has to submit the report in prescribed format and also present a seminar.

The dissertation should be presented in standard format as provided by the department.

The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.

The report must bring out the conclusions of the work and future scope for the study.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator.

The candidate has to be in regular contact with his guide.

COURSE OUTCOMES:

CO1: Students will be able to use different experimental techniques.
CO2: Students will be able to use different software/ computational/analytical tools.
CO3: Students will be able to design and develop an experimental set up/ equipment/test rig.
CO4: Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
CO5: Students will be able to either work in a research environment or in an industrial environment.
CO6: Students will be conversant with technical report writing.
CO7: Students will be able to present and convince their topic of study to the engineering community.

Eligibility Criteria:

M.Tech (WATER AND ENVIRONMENTAL TECHNOLOGY)	B.Tech in Civil Engineering/Agriculture Engineering / Environmental Engineering Or M.Sc in Geo-Physics/ Geology/ Hydrology/ Remote Sensing/ Water & Environmental Sciences.