Group No.	Course Code	Course Title	UNIQUE CODE
1	20CEE01	Applied Environmental Chemistry and Microbiology	201EV001
1	20CEE02	Water Treatment Technology	201EV002
1	20CEE03	Wastewater Treatment Engineering	201EV003
1	20CEE04	Toxicology and Environmental risk assessment	201EV004
2	20CEE05	Solid Waste Management	202EV001
2	20CEE06	Remote Sensing & GIS in Environmental Engineering	202EV002
2	20CEE07	Transport Process and Modeling of Aquatic Systems.	202EV003
2	20CEE08	Water Resources Engineering & Applied Hydraulics	202EV004
3	20CEE09	Energy & Environment.	203EV001
3	20CEE10	Non point sources of pollution & management	203EV002
3	20CEE11	Environmental sanitation Systems	203EV003
3	20CEE12	Environmental Disaster Management & Risk Assessment	203EV004
4	20CEE13	Atmospheric Environmental Pollution and Control	204EV001
4	20CEE23	Industrial Wastewater Treatment	204EV002
4	20CEE15	Ecology and Environmental Impact Assessment	204EV003
4	20CEE16	Operation & Maintenance of Environmental Facilities	204EV004
5	20CEE17	Advanced Atmospheric Environmental Engineering	205EV001
5	20CEE18	Recycle and Reuse Technology	205EV002
5	20CEE19	Hydraulics of Water and Wastewater Systems	205EV003
5	**20CEE242**	**RISK ASSESMENT AND HAZARDOUS WASTES**	205EV004
6	20CEE21	Occupational Safety & Health.	206EV001
6	20CEE243	Environmental Planning and Management	206EV002
6	**20CEE321**	**Climate Change and Globalization**	206EV003
6	20CEE24	Advanced Computational Methods and Optimization	206EV004

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group I

Course	**APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY**	Exam Duration	03 Hours
Course Code	20CEE01	Exam Marks	100

Syllabus

Module-01:
Introduction to Environmental Chemistry, concept and scope of environmental chemistry: environmental segments-Atmosphere, hydrosphere, lithosphere and biosphere. Oxidation and Reduction reactions, and potentials, oxidation-reduction of water bodies,.
Electro chemistry, conductivity, Electronic pH measurement, Calomel, Glass and other electrodes, Basic concepts from Equilibrium Chemistry, Acids and Bases, Buffers index.

Module-02:
TOC determinations, interferences and modifications, Chemistry of aqueous chlorine.
General Considerations, Chemistry of Fluoride and Fluoride Compounds, Determination methods.
Classification of organic compounds, distinctions of organics and inorganic, major group of organic compounds encountered in industrial waste waters

Module-03:
Basic concepts from Biochemistry Introduction, enzymes, cofactors, temperature relationships, effect of pH, major and trace elements, Biochemistry of carbohydrates, proteins, fats and oils, general Biochemical pathways, energetic and bacterial growth, Biochemistry of man (carbohydrates, fats, proteins and vitamins)
Colorimetric, Beer's and Lambert's Law, Photoelectric colorimeters, spectrophotometers, Nephelometry, Absorption methods, ultra violet spectrophotometry, infrared spectrophotometry, flame photometry, Atomic Absorption spectrophotometry, Emission spectrophotometry, Fluorimetry, Gas chromatography and mass spectrometry, X-ray analysis.

Module-04:
Study of Microbiology in Environmental Protection, Classifications of living organisms with special emphasis on microorganisms Micro-organisms of importance in Air, water and soil environment.Fundamental and applied Microbiology
Types of microscopes, Resolving power and their application, Microscopic flora and fauna of importance in Environmental studies. Culture of microorganisms, stains and staining Techniques, estimation of bacterial numbers.
Algae-occurrence, biological economic importance, morphology, classification and metabolism with special reference to those forms that influence the environment.Culture media.

Module-05:
Fungi– morphology, characteristics, classification, detection, metabolism, Species of importance in Biodegradation of organic matter.
Bacteria – Structure, Composition, classification, size, morphology, spore formation,

Reproduction, Metabolism, Nutritional types, growth kinetics, detoxifying bacteria with special reference to phenols and heavy metals. Role of bacteria in bio-concentration of trace contaminants in food chain.

Rotifers and higher animals**:**Study of protozoa, rotifers, crustaceans, worms and larvae

Viruses - Structure, Composition, types of viruses, growth, diseases

Textbook(s) and/or Reference Books:

1. Sawyer C.N. and McCarty P L ,G F Parkin , Chemistry for Environmental Engineers - New York. Mc Graw-**Hill** Book , 1978.
2. W **Stumm**, J J **Morgan** , "Aquatic Chemistry"New York,. Wiley-Interscience. 1970
3. McKinney R.E. "Microbiology for Sanitary Engineers", McGraw Hill., New York
4. Plichael J. Pellzar, J R et al. "Microbiology" Tata McGraw Hill.
5. **APHA**, **AWWA**, **WPCF**; **Standard Methods** for the **Examination of Water** and **Wastewater** (21st edition)American Public Health Association, American **Water**works Associations, Water Pollution Control Federatio

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group I

Course	**WATER TREATMENT TECHNOLOGY**	Exam Duration	03 Hours
Course Code	20CEE02	Exam Marks	100

Syllabus

Module-01:

Wholesomeness of water, hygiene, aesthetic, and economic requirements, physical, chemical and bacteriological standards for raw and treated water, limnology, thermal stratification, lake over turns. Objectives of various water uses.

Location of intake, site selection, types of intakes, Design of Intake and Raising main, and water treatment units and pipeline friction, Hazen – William equation, Manning equation, network study, Hardy Cross, Newton – Raphson methods, computer method.

Principles of aeration, solubility of gases, Henry's Law, Vapor pressure, gas transfer coefficient, Methods of aeration.

Module-02:

Principles of sedimentation, General equation for settling or rising of discrete particles. Hindered settling, Effect of temperature, viscosity, efficiency of an ideal settling basin. Reduction in efficiency by currents and other factors. Short circuiting, design of inlets and outlets, sludge and sedimentation zones. Tube settlers. Design of settling tank.

Common coagulants used in water, Effects of pH, alkalinity etc. Determination of optimum coagulant dose, Theory and use of coagulant aids. Bentonites, clays, lime soda, silicates, Organic polyelectrolytes, dosing, hydraulic mixing and mixing devices. Design of coagulation and flocculation tanks. Design of mechanical flocculators. Mean velocity gradient 'G', power consumption

Module-03:

Types of Filters, Multimedia filters, micro strainers, Theory of Filtration: Size and shape and characteristics of filtering material. Preparation of filter material. Hydraulics of filteration, hydraulics of back washing. Estimation of loss of head through sand, gravel, under drains. Filtrability index, Design of filters. Filter backwash, design of wash water troughs, rate of flow controllers, loss of head gauges. Filter problems, Operation and maintenance of filters. Pressure filters and diatomaceous earth filter.

Theory of adsorption, Adsorption processes for control of taste and odour, removal of colour. Equilibria and isotherms, kinetic factors affecting and mode of operation.

Module-04:

Softening of water – various methods. Langelier and Ryzner indices, split treatment, recarbonation, use of poly phosphate, disposal of sludge, recalcination, water treatment for boilers and process water, sequestering agents.

Minor methods of disinfection Principles of disinfection, Theory of disinfection, disinfection with Halogens (Chlorine, Iodine, Bromine), Chicks Law, Factors affecting disinfection-concentration,

time, temperature, Effects of pH, different methods of disinfections. Free and combined available chlorine, residual chlorine, Breakpoint chlorination, Superchlorination, Chlorine dioxide**,** distruction of virus, dosage control, safety measures, emergency chlorination, disinfection of new mains,

Effects of Fluoride, Fluoridation and defluoridation, Methods of defluoridation.

Theory of corrosion, Principle of galvanic, electrolytic, stress and biochemical corrosions, Factors influencing corrosion such as oxygen concentration, over voltage, pH, temperature. Corrosion inhibition- use of non metallic pipes, lining, coatings, protective films, cathodic protection

Module-05:

Special problems of industrial water supply like sugar, paper and pulp, Textile, Breweries, Petrochemical industries, etc.

Trace organic contaminants in water supplies and their removal.

Distribution system, Water quality in distribution system. Design of distribution system,

Operation and maintenance of distribution system. Operation and maintenance of treatment systems.Scale-up Aspects

Rural Water Supply Systems. Borwell Water supply system(BWSS), Municipal Water supply system(MWSS) and Piped water supply system(PWSS)

Textbook(s) and/or Reference Books:

1. AWWA,Water quality and treatment; a handbook of public water supplies
2. American Water Works Association - 1971.
3. Fair, G.M. Geyer J.C. and Okum – 'Water and Wastewater Engineering', Vol. II- John Wiley, 1969.
4. Weber, Walter J., Physicochemical processes for water quality control., New York; Wiley Interscience; 1972.
5. Water and Wastewater Technology, Mark J Hammer, Prentice Hall of India; 6th edition, June 15, 2007.
6. Basic Water Treatment, C. Binnie, M. Kimber, G. Smethurst, Royal Society of Chemistry; 3rd edition, March 15, 2002.
7. Water Suopply, A. C. Twort, F. M. Law, F. W. Crowley, D. D. Ratnayaka, Wiley, 1994.
8. Environmental Engineering, Howard S. Peavy (Author), Donald R. Rowe (Author), George Tchobanoglous, McGraw Hill Education; First edition, 1 July 2017.
9. New Concepts in Water Purificattion (Von Nostrand Reinhold environmental engineering series), Culp, Gordon L., Culp, Russell L, Van Nostrand Reinhold Company, 1974.
10. Manual on Water Supply and Treatment by Ministry of Works and Housing.

Water Supply Engineering, S.K. Garg, Khanna Publishers, New Delhi 110002, 2016

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group I

Course	**WASTEWATER TREATMENT ENGINEERING**	Exam Duration	03 Hours
Course Code	20CEE03	Exam Marks	100

Syllabus

Module-01:
Objectives of wastewater treatment. Composition, Properties and analysis of wastewater.
Microbiology of waste treatment – Growth and inhibition of bacteria. Kinetics of Biological growth, Batch culture, substrate limited growth, Cell growth and substrate utilization, effects of endogenous metabolism. Monod's and Michaclismenton kinetics and their applications. Determination of kinetic coefficients.

Module-02:
Fundamentals of process analysis, reaction kinetics, mass balance analysis, reactors and their hydraulic characteristics, reaction kinetics and reactor selection. Batch, plug flow, completely stirred tank reactor and packed and fluidized bed reactor.

Module-03:
Design of sanitary sewers and storm water sewers. Physical treatment: reverse osmosis, Dialysis, Electro dialysis, Evaporation, multiple evaporation, Adsorption, sedimentation flocculation, Steam stripping, Screens, comminuters, Grit Chambers, Chemical Treatment : Ion exchange, Neutralization.

Module-04:
Biological treatment process. Activated sludge process-Standard type and modifications. Aerators. Trickling filter, aerated lagoon, and stabilization ponds. Well injection, Brush aeration, subsurface disposal, biodisc system, Treatment disposal of sludge – Sludge characteristics, concentration. Anaerobic sludge digestion. Aerobic sludge digestion, sludge conditioning, Dewatering and drying. Incineration and wet oxidation, Anaerobic filters, UASB

Module-05:
Nitrogen conversion and removal. Forms, sources and operations and process for the control of nitrogen. Nitrification-process, process analysis and their applications. Nitrogen removal by physical and chemical process – Air stripping of ammonia and ion exchange.
Phosphorous removal – Operations and process for phosphorous removal.Nitrogen sulfur and phosphorous cycles.
Waste treatability studies – Bench scale and pilot scale, Effluent standards for discharge to water bodies and land applications – state and central norms & standards.

Textbook(s) and/or Reference Books:

1. Metcalf and Eddy – Wastewater Engineering.
2. Webber W.J. Physico-chemical processes for water quality.
3. Fasir G.M., Geyer J.G. and Okun – Water Wastewater Engineering.
4. Eckenfelder and O'Connor – Biological Waste Treatment.
5. Gaudy and Gaudy – Microbiology for Environmental Scientist and Engineers. McGraw Hill – 1980.
6. Gaudy – Advanced Wastewater treatment.
7. Ramalho – Advanced Wastewater treatments.

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Name of the Programme (Branch/Stream)	Environmental Engineering		
Ph.D. Coursework Group Number: Group I			
Course	**TOXICOLOGY & ENVIRONMENTAL RISK ASSESSMENT**	Exam Duration	03 Hours
Course Code	20CEE04	Exam Marks	100

Syllabus

Module-01:
Introduction to toxicology: Significance, Applications & Importance. Introduction to risk assessment toxicology- Exposure, toxic effects, dose response relationships.

Module-02:
Carcinogens and non –Carcinogens, Toxicology & Epidemiology, public health & risk assessment

Module-03:
Human exposure assessment, characterization of health risks.

Module-04:
Hazard identification exposure and toxicity assessment risk characterization.

Module-05:
Risk communication ecological risk assessment – Monte Carlo methods case studies.

Textbook(s) and/or Reference Books:

1. LaGrefa M.D., Buckingham P.L.and Evans J.C.(1994) " hazardous Waste Management'- McGraw hill ,New york
2. David G.M. and Haner N.B., " An Applied Approach to Epidemiology and Toxicology for Engineers" –Instructors Resource Guide, US Department of Health Education And welfare
3. World Health Organization Report., " Recommended Health Based Limits in Occupational Exposure to Heavy Metals".
4. Kamrin S.E., "a Text Book on Primer on toxicology principles & applications" Lewis

Publishers.
5. Kalos M.H. and WhitlocP.A ., Monte carlo Methods Vol.1 Basica Wiley Publications.
6. Fan A.M & Chang L.W, (1996) " Toxilogy& Risk Assessment – Principles ., Methods & applications " Informa Health care Pubs.
7. Price F.T., Nancy Lane BriqK.V.(200) " Environeamental Toxicology & risks assessment –Recent advancement in Environmental Fate & transport " ASTM INTERNATIONAL .
8. Landis W.G., Ming-Ho Yu (2004) "Introduction to environmental toxicology- Impacts of Chemicals upon Ecological systems." CRC Press.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group 02

Course	**SOLID WASTE MANAGEMENT**	Exam Duration	03 Hours
Course Code	20CEE05	Exam Marks	100

Syllabus

Module-01:
Definition and composition of MSW, Data Collection, collection and Reduction at source.
Collection equipments, systems of collection, garbage, chutes, transfer stations, bailing and compacting, route optimization.
Disposal methods- selection of site, open dumping, ocean disposal, feeding to hogs – merits and demerits.

Module-02:
Treatment Methods: Various methods of refuse processing, fertilizer, fuel and food values.
Sanitary Land Filling: Definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate treatment, gas collection and recirculation. Control of land fill gases, design problems

Module-03: Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes of composting. And Design Problems
Human exposure assessment, characterization of health risks.

Module-04: Incineration Processes 3Ts to control high temperature incinerators, design approach, prevention of air pollution, gasification systems, combustion systems., closure of landfills,

Module-05:
Pyrolysis: Process, basic steps involved, end product, pyrolysis of specific solid waste.
Recycle and Reuse: Material and energy recovery operation, reuse in other industries. Recovery of biological conversion products, recovery of thermal conversion products
Managementof toxic solid waste, recent innovations.

Textbook(s) and/or Reference Books:

1. **JL Pavoni**, JE Heer Jr, DJ Hagerty , **Handbook** of **solid waste disposal** - 1975 - osti.gov,U.S.A
2. Solid waste Management, Van Nostrand Reinhold co., 1975.
3. G.Tchobanoglous, H. Theisen and R.Liliaissen, Solid Waste Engineering, Principles and Management Issues, McGraw Hill, New York, 1977.
4. CL Mantell Solid wastes: origin, collection, processing, and disposal , John Wiley and Sons, Inc.,New York, NY 1975
5. Powers,p.W. How to dispose of toxic substances and industrial waste, Noyes data corp,ParkRidge,NJ ,U.S.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group 02

Course	**REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN ENVIRONMENTAL ENGINEERING**	Exam Duration	03 Hours
Course Code	20CEE06	Exam Marks	100

Syllabus

Module-01:
Definition, remote Sensing in Environmental Engineering.
Basics of Remote Sensing Techniques – Radiation Sources, Physics of Remote Sensing – Transmission Paths – Target and Sensors.

Module-02:
Sensors– Types and Classification – Spectral Bands of Sensors. Sensors for UV, IR and visible ranges.
Multi spectral scanners.
Platforms – Aircrafts, Satellites

Module-03: Data Acquisition and Interpretation – Visual and digital Interpretation – Brief Discussion Only.
Application of remote sensing techniques to management of Water Resources.
Monitoring of Quality of Environment, Land Use Pattern Studies.
GIS – Concepts and spatial methods – introduction spatial information, temporal information.GIS – Functionality – introduction, data acquisition, data processing, storage and retrieval.

Module-04: Computer Fundamentals of GIS and data storage character files and binary files, file origination liked list, chains, trees.
GIS and remote sensing data integration techniques in spatial decision support system,
land suitability, New work analysis virtual GIS.

Module-05:
Hardware and software requirements for GIS.
GIS in solid waste transport, remodeling of distribution systems and ground water vulnerability.

Textbook(s) and/or Reference Books:

1. Pater A burraugh Rachal AMcDonnas “Principle of GIS” (Oxford)
2. Christopher Jones “GIS and Computer Cartography”
3. Life Sand, “Remote Sensing and Image Interpretation, John Wiley and Sobns.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group 02

Course	**TRANSPORT PROCESSES AND MODELING OF AQUATIC SYSTEMS**	Exam Duration	03 Hours
Course Code	20CEE07	Exam Marks	100

Syllabus

Module-01:
Models as Comprehensive tools in Environmental Management Diffusion and dispersion – Definition, Molecular turbulent and shear diffusion, derivation of Fick's laws of diffusion and convective – diffusion equations for turbulent and shear flow regimes.

Module-02:
Steady state water quality modeling. Models for decaying pollutants (bacteria, phenol, ammonia) in rivers. 1-D oxygen balance models – Streeter – Phelps equation, critical point method. Data collection – specialized water quality surveys based on statistical average concepts. Estimation of parameters – decay and reareation rates. Calibration and verification of 1-D oxygen model. Error measures.

Module-03: Mixing zones in rivers – definition, steady state 2-D analysis with pipe and diffuser outfalls using solutions based on method of images for conservative and decaying pollutants field study methodology. Parameter estimation – Lateral Mixing coefficient – critical point method – derivation and examples.

Module-04: Dissolved oxygen models for lakes under completely mixed and stratified conditions, Ocean disposal of wastewater – Silting and design of outfalls. Near field and far field mixing with simple examples. **5Hrs**
Eutrophication models – simplified nutrient loading models for rivers and lakes.

Module-05:
Ground water quality modeling concepts – formulation of 1-D and 2-d models with decay and retardation for instantaneous sources, Non-point sources of pollution, Analytical modeling for plume delineation studies from point sources. Field data gathering and parameter estimation.
Ecosystem model – Description, Schematization and formulation.

Textbook(s) and/or Reference Books:

1. Rich L.G. Environmental Systems Engineering. McGraw Hill – 1972.
2. Thomas R.V. – Systems Approach to Water Quality Management. McGraw Hill – 1980.
3. Biswas A.K. – Models for water quality management – McGraw Hill, 1980.
4. Rinaldi S.D. and Soncini R., - Modeling and Control of River Water Quality. McGraw Hill – 1979.
5. Gower A.M. – Water quality in catchment ecosystems. John Wiley – 1980.
6. Thomann and Mueller 1986. Principles of water quality management and control – Harper and Two Pubs.
7. Hazen and Cherry, Ground Water Quality.
8. Velz L.Z. Applied Stream Sanitation.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group 02

Course	**WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS**	Exam Duration	03 Hours
Course Code	20CEE08	Exam Marks	100

Syllabus

Module-01:
Water resources of the world**.** Surface and ground water resources of India and Karnataka National Water Policy Act. Multiple uses of water resources.
Hydrology Introduction, Hydrologic Cycle including quantity and quality, estimation of precipitation and rain gauge density.

Module-02:
Hydrograph theory – Unit hydrograph, assumptions, derivation of unit hydrographs,
S-hydrograph and synthetic hydrograph, flow routing – Muskingam method, Low flow analysis.
Urban Hydrology – Run-off estimation, design of storm water drains.
Basics and applications of Remote Sensing in Water Resources.

Module-03: Distribution Network – Hardy Cross Method and Newton Raphson method, Raising Main Design.Unsteady flow through conduits: Water hammer analysis – Analytical and graphical methods, Water hammer protection methods.

Module-04: Flow measurements: Stream gauging, weir method, end-depth method, chemical method, tracer method, ultrasonic method, flumes, etc.

Module-05:
Groundwater Basic equations of flow. Flow into wells in unconfined and confined aquifers for steady and unsteady conditions, Sea water intrusion. Artificial recharge, groundwater pollution. Bore wells– Types and design principles.

Textbook(s) and/or Reference Books:

9. Rich L.G. Environmental Systems Engineering. McGraw Hill – 1972.
10. Thomas R.V. – Systems Approach to Water Quality Management. McGraw Hill – 1980.
11. Biswas A.K. – Models for water quality management – McGraw Hill, 1980.
12. Rinaldi S.D. and Soncini R., - Modeling and Control of River Water Quality. McGraw Hill – 1979.
13. Gower A.M. – Water quality in catchment ecosystems. John Wiley – 1980.
14. Thomann and Mueller 1986. Principles of water quality management and control – Harper and Two Pubs.
15. Hazen and Cherry, Ground Water Quality.
16. Velz L.Z. Applied Stream Sanitation.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group 02

Course	**WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS**	Exam Duration	03 Hours
Course Code	20CEE08	Exam Marks	100

Syllabus

Module-01:
Water resources of the world**.** Surface and ground water resources of India and Karnataka National Water Policy Act. Multiple uses of water resources.
Hydrology Introduction, Hydrologic Cycle including quantity and quality, estimation of precipitation and rain gauge density.

Module-02:
Hydrograph theory – Unit hydrograph, assumptions, derivation of unit hydrographs,
S-hydrograph and synthetic hydrograph, flow routing – Muskingam method, Low flow analysis.
Urban Hydrology – Run-off estimation, design of storm water drains.
Basics and applications of Remote Sensing in Water Resources.

Module-03:
Distribution Network – Hardy Cross Method and Newton Raphson method, Raising Main Design.
Unsteady flow through conduits: Water hammer analysis – Analytical and graphical methods, Water hammer protection methods.

Module-04:
Flow measurements: Stream gauging, weir method, end-depth method, chemical method, tracer method, ultrasonic method, flumes, etc.

Module-05:
Groundwater Basic equations of flow. Flow into wells in unconfined and confined aquifers for steady and unsteady conditions, Sea water intrusion. Artificial recharge, groundwater pollution. Bore wells– Types and design principles.

Textbook(s) and/or Reference Books:

1. Ven T. Chow – Handbook of Applied Hydrology.
2. Todd – Ground water hydrology
3. Ranganath H.M. – Advanced hydrology
4. Subramanya K.S. – Advanced hydrology
5. Ven T. Chow – Open Channel Hydraulics
6. Hammer M.J. and Mackichan K.A. – Hydrology and Quality of Water Resources.
7. Sabins – Remote Sensing.
8. Thomann and Muller – Principles of Water Quality Modeling, Estuary Section 3.1.
9. Ram S.Gupta – Hydrology and Hydraulic System, S.
10. John Permankian, Water Hammer Analysis.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group III

Course	**ENERGY & ENVIRONMENT**	Exam Duration	03 Hours
Course Code	20CEE09	Exam Marks	100

Syllabus

Module-01:
Introduction: Global energy, Environmental resources, Energy needs, Energy crisis.
Indian Scenario: Energy consumption, needs & crisis.

Module-02:
Energy Production, utilization, laws and principles.
Renewable sources of energy and environmental aspects-Biogas, Biomass.

Module-03:
Hydropower, Ocean energy, solar energy, agricultural waste derived energy.
Urban water derived energy, wind energy.

Module-04:
Non-Renewable sources of energy an environmental aspects-Energy from coal .oil, natural gas. Nuclear energy, geothermal energy.
Global temperature, Green house effects, Global warming.

Module-05:
Acid rain-Causes, effects and control methods
Regional impacts of temperature change

Textbook(s) and/or Reference Books:

'ilber L.C " hand book of Energy systems". Engg. Wiley & Sons,1989.
asten G.M. " Introduction to Environmental Engg.And Science".
ncero and Sincero, Environmental Engineering- A design approach, Prentice hall of India(1999).
ao and Parulekar B.B energy Technology –Non-Conventional renewable and Conventional, second lition Khanna Publication, 1997.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group III

Course	**NON-POINT SOURCES OF POLLUTIONS AND MANAGEMENT**	Exam Duration	03 Hours
Course Code	20CEE10	Exam Marks	100

Syllabus

Module-01:
Introduction: Global energy, Environmental resources, Energy needs, Energy crisis.
Indian Scenario: Energy consumption, needs & crisis.

Module-02:
Energy Production, utilization, laws and principles.
Renewable sources of energy and environmental aspects-Biogas, Biomass.

Module-03:
Hydropower, Ocean energy, solar energy, agricultural waste derived energy.
Urban water derived energy, wind energy.

Module-04:
Non-Renewable sources of energy an environmental aspects-Energy from coal .oil, natural gas. Nuclear energy, geothermal energy.
Global temperature, Green house effects, Global warming.

Module-05:
Acid rain-Causes, effects and control methods
Regional impacts of temperature change

Textbook(s) and/or Reference Books:

1. Wilber L.C " hand book of Energy systems". Engg. Wiley & Sons,1989.
2. Masten G.M. " Introduction to Environmental Engg.And Science".
3. Sincero and Sincero, Environmental Engineering- A design approach, Prentice hall of India(1999).
4. Rao and Parulekar B.B energy Technology –Non-Conventional renewable and Conventional, second edition Khanna Publication, 1997.

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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group III

Course	**ENVIRONMENTAL SANITATION SYSTMES**	Exam Duration	03 Hours
Course Code	20CEE11	Exam Marks	100

Syllabus

Module-01:
COMMUNICABLE DISEASES: -
Definitions, Microorganisms, disease communicated, General methods of communicable disease control, control of epidemics.

Module-02:
FOOD SANITAION:-
Food born disease, food and drug laws, food and bacteria, legal control of food safety, dried foods, frozen foods. Sanitation of eating and drinking establishment.
MILK SANITATION: -
Essentials of Milk Sanitation, Milk and Bacteria, Milk borne diseases, sanitation, pasteurization, bacteriological standards.

Module-03:
SWIMMING POOLS & BATHING BEACHES- Introduction, Pool Operation, Pool Maintenance, Wading Pools, Bathing Beaches.
INSECTS, RODENTS, NOXIOUS WEEDS- The Housefly, Mosquito Control, Bed Bug, Rat and Mice, Ragweed & Noxious Weed Control.

Module-04:
RURAL SANITATION:
Rural water supplies and different methods of sewage disposal in rural areas.
Cleaning and Disinfection, Emergency Water Supply and Treatment
INDUSTRIAL HYGIENE:
Occupational hazards sources, effects and control measures, sanitation programmes.

Module-05:
INSTITUTIONAL SANITATION:
Schools, Hospitals-Location planning- Lighting and ventilation, disposal of wastes.
Radioactive wastes – Sources – effects – disposal methods.

Textbook(s) and/or Reference Books:

1). Environmental engineering & Sanitation – Joseph A Salvato, Willey – Interscience.

2). Municipal and Rural Sanitation – Ehlers and steel, McGraw – Hill.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group III

Course	**ENVIRONMENTAL DISASTER MANAGEMENT AND RISK ASSESSMENT**	Exam Duration	03 Hours
Course Code	20CEE12	Exam Marks	100

Syllabus

Module-01:
Natural disasters – Floods, landslides, earthquakes, volcanism, avalanche, cyclones, drought and fire. Prediction, perception and adjustment to hazards.

Module-02:
Disaster Management – Environment risk due to project activities. Preparation of on-site and off site disaster management plans. Predisaster actual disaster-post disaster relief camp organization. Role of voluntary organization and armed forces.

Module-03:
Risk analysis and assessment: Basic concept, purpose of risk analysis; analytical techniques; tools of risk assessment-toxicology, epidemiology exposure modeling, and significance of risk, risk characterization, communication and management.

Module-04:
Evaluation of the likelihood of major accidents in industrial processes, assessing risk to ecosystems and human health from genetically modified organizations, waste water treatment and disposal, epidemiology exposure modeling, assessing risk to human health from chemicals.
Psychology of risk, the economic and evaluation of risks.

Module-05:
Risk assessment in developing programs. Experience of world Bank-risk communication framework for sustainable development.

Textbook(s) and/or Reference Books:

1. John G Rau and David C Woosten (1980) Environmental Impact analysis Hand book, McGraw-Hill.
2. John Glasson, RikiTherivel, Andrew Chadwick (1994). Introduction to Environmental Impact Assessement, Research Press.
3. Girish K Mishra and G C Mathew (eds) (1993) Natural Disaster Reduction Reliance Publishing House, 302/74, Rangit Nagar, New Delhi

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group IV

Course	**ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL**	Exam Duration	03 Hours
Course Code	20CEE13	Exam Marks	100

Syllabus

Module-01:

Introduction – Definitions, Sources and Classifications of air pollutants, Primary and Secondary air pollutants, Stationary and mobile sources.

Meteorology– Composition and structure of the atmosphere, Meteorological factors influencing air pollution, wind circulation, solar radiation, adiabatic lapse rate, ELR, Atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature inversions, Measurements of meteorological variables, wind rose diagram, General characteristics of stack effluent, plume behavior, Stack effluent dispersion theories, dispersion equations.

Module-02:

dispersion models, fixed box model, Gaussian dispersion model, stack design, maximum ground level pollutants concentration, Concentrations along plume line, Calculation of effective stack height, downwind pollutant concentrations under temperature inversion. Heat island effect, Effect of terrain on plume behaviors.

Effects of air pollution on human health, plants, animals, and building materials, air pollution episodes national ambient air quality standards, criteria and indices.

Module-03:

Sampling procedures: Classification of sampling methods, difficulties encountered in sampling, instruments for sampling waste gases and for atmospheric sampling (sampling train), sampling sites, sampling methods, sampling suspended particulates by high volume filtration, stack sampling techniques

Laboratory analytical methods used for analysis of atmospheric samples (chemical, instrumental and biological methods)

Photochemical air pollution: Theory of formation of PAN, factors effecting, measurement and effects of photochemical smog

Particulates**:** Collection mechanism and efficiency, Deposition of particulates from stacks, Hood and Duct design.

Module-04:

Particulate Pollution Control Equipment – Design considerations of setting chambers, Cyclone separators, Wet collectors, Fabric filters and Electrostatic precipitators.

General Control of gases and vapours**:** Combustion, Adsorption and Absorption (and their kinetics), closed collection and recovery systems, masking and counter action, Basic design of packed bed absorption water.

Module-05:

General control methods to reduce sulphur dioxide emissions from fossil fuel.

Noise:Definition, Measuremetns, Sources, Effects, Occupational hazards. Addition of noise levels, CPCB standards, LeqLd, Ln, Ldn, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, noise control at source, along its path and at receiver, Legal aspects of noise.

Textbook(s) and/or Reference Books:

1. Perkins – Air Pollution.
2. Stern – Air Pollution Vol. I, II, III
3. Kenneth Work and Cecil F Warner – Air Pollution, its origin and control, Harper and Row, Publishers, New York. 1982
4. Environmental Engineer's Handbook, 2, Chilton Book Co., Radnor, PA (1974),U.S.A
5. PL Magill, FR Holden, AC Ackley(Eds.), Air Pollution Handbook McGraw-Hill, New York (1956).
6. Sterm A.C. (ed.) Vol. V – Air Quality Management.
7. RC Flagan, JH Seinfeld ,Fundamentalsof airpollutionengineering,2012

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PhD Coursework Courses-2020
As per the Ph.D. regulations - 2020

Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group IV

Course	**INDUSTRIAL WASTEWATER TREATMENT**	Exam Duration	03 Hours
Course Code	20CEE23	Exam Marks	100

Syllabus

Module-01:

Effects of Industrial wastes on sewage, sewage treatment plants and receiving water bodies. Effluent standards and receiving water quality standards. Different aspects and choices of various alternatives.

- Joint treatment of raw industrial waste with domestic sewage.
- Joint treatment of partially treated industrial waste and domestic wastes.
- Ill effects of discharge of raw waste on soil, environmental auditing.

Module-02:

Industrial Waste Survey – Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, conductivity, biomonitoring, computation of organic waste loads on streams,steeter-Phelps formulations,Thimas method for determingpollutiom-loads on capacity of streams, Churchill method of multiple linear correlations.

Module-03:

Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and Inorganic dissolved solids.

Module-04:

Wastewater Treatment in Specific Industries**:** Distillery, Dairy, Sugar, Cannery, Pulp and Paper, Cement, Textile, Dairy, Fertilizer, oil refinery, Pesticides, Pharmaceutical, tannery. Radio Active Wastes Treatment – Low Activity and high activity wastewaters Ultimate disposal of Industrial Wastewater Sugar, Refinery and Diary Industries.

Module-05:

Effects of Waste additions on physical and chemical properties of soil, Bio-Remediation ,Design of Complete treatment system disposal for industries: Distillery, Diary, Sugar, Refinery, Textile, Paper and Pulp mill to meet P.C.B. norms. **8Hrs**

Environmental auditing- introduction, Cost of pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities, site selection-Evaluation of cost of product basis, Tangible and Intangible factors,Importance of long term planning,Waste disposal and water supply as a critical factor,.

Textbook(s) and/or Reference Books:

1. Nelson N Nemerow – Liquid waste of Industry theories, Practices and Treatment, Addison Willey New York.
2. Nardam S Azad – Industrial Wastewater Management Handbook, McGraw Hill Book Col., New York.
3. Ross R.D. – Industrial Waste Disposal, Reinhold Environmental Series – New York.
4. Dickinson – Practical Waste Treatment and Disposal Applied Science Publication, London.
5. Mahajan – Pollution Control in Process Industries, TMH, New Delhi.
6. Self N.J. – Industrial Pollution Control.
7. Eckenfelder – Industrial Water Pollution Control, McGraw Hill Company, New Delhi by American Chemical Society, Washington D.C. USA.
8. Gaynor W Dawson et al – Hazardous Waste Management, A Wiley-Interscience Publication, New York.
9. James f Parr et al – Land Treatment of Hazardous Wastes, Noyes Data Corporation, Parkridge, New Jersey, USA.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group IV

Course	**ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT**	Exam Duration	03 Hours
Course Code	20CEE15	Exam Marks	100

Syllabus

Module-01:

Classification of Ecosystem, Terminology, Concepts of Ecology, Sub-divisions in Ecology. Biotic and Abiotic components, Structure and functions of ecosystems.

Module-02:

Energy flow in Ecosystems. Measurement of Primary productivity. Ecological Niche and Succession. Population Ecology, Community Ecology, Habitat Ecology. Biogeochemical cycles, Ecological pyramids.

Module-03:

Aquatic and Terrestrial Ecosystems, Dominance and Diversity Indices(problems) Adaptations, Biogeography, Systems Ecology and Ecosystem Modeling. **6Hrs**

Oligotrophy, Eutrophic status, Nutrient Enrichment – Analysis of Eutrophication – Vollenweider and Dillon Models of Phosphorous loading on lakes. Control of Eutrophication

Module-04:

Developmental Activity and Ecological Factors. EIA, EIS, FONSI, Need for EIA Studies, Baseline information, Step-by-step procedure for conducting EIA, Limitations of EIA. **6Hrs**

Framework of Impact Assessment, Developmental projects in environmental setting. Objectives and scope of EIA. Contents of EIA, Methodologies, Techniques of EIA. Assessment and Prediction of impacts on Attributes: air, water, noise, land, ecology soil, cultural and socio-economic environment, EIA guidelines for development projects, REIA-CEIA.

Module-05:

Public participation in environmental decision making. Practical considerations in preparing Environmental Impact Assessment and Statements. **6Hrs**

Salient features of the project activity – Environmental parameters – Activity relationships – matrices.

EIA for water resource development projects, Nuclear power plant project, mining project (coal, aluminum, iron ore, bauxite), Thermal Power Plant (coal based) project, pharmaceutical industries, etc

Textbook(s) and/or Reference Books:

1. Odum – Fundamentals of Ecology – Addition Co.
2. Kormondy – Concepts of Ecology – Prentice Hall Publicaton.
3. Anantakrishnaan T.N. – Bio-resources Ecology – Oxford and IBM.
4. Krebs J – Ecology – The experimental analysis of distribution and abundance-II Edition Harper International.
5. **Mommy REEd** Environmental Impact Assessment John wiley.
6. Canter L – Environmental Impact Assessment McGraw Hill, 1977.
7. Clark B.C., Bisett and Tomlinsan P – Perspective on environmental impact assessment – Allied Publishers – 1985.

8. Mall C.A.S. and Day J.W. – Ecosystem Modeling in Theory and Practice: An Introduction with Case NI Stories – John Wiley.
9. Heer and Hagerty, Environmental Impact Assessment and Statements. Van Nostrand and Reinhold Co. 1977.
10. Jain et al – Environmental Impact Assessment, Van Nostrand.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group IV

Course	**OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES**	Exam Duration	03 Hours
Course Code	20CEE16	Exam Marks	100

Syllabus

Module-01:

Importance of Operation and Maintenance, Basic Principles of Operation and Maintenance – corrective and Preventive Maintenance, Database of Facilities for O and M – Detailed Plans, Drawings, Operation Manuals, Computer Applications in O and M.

Module-02:

O and M of Water Supply Facilities**:** Intakes, pumps, rising mains, water treatment process control, water quality and water quality monitoring, loss o carrying capacity of pipes. Causes, Leak – Detection, Projection of pipe break rates, record keeping, appurtenances – valves, hydrants and fittings. Use of Network Models in O and M. Safety aspects..

Module-03:

O and M of Wastewater Facilities**:**

Sewer Network: Inspection Methods for Sewers and Appurtenances – Manual and Television, Cleaning Rehabilitation – Sealing, Repair and Replacement – Safety in Sewer Inspection. O and M of Wastewater Treatment Plant. Monitoring, Operational Problems and Corrective Measures in Different units of Treatment.

Module-04:

O and M of Air Pollution Control Facilities:

Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone separators, Bag filters, scrubbers, electrostatic precipitators, gaseous emission control devices – Absorption beds and adsorption columns, thermal oxidizers, incinerators and their trouble shooting, safety measures during O and M

Module-05:

Operation and Maintenance Planning:

Organizational Structure, Work Planning, Preparation and Scheduling Cost Estimates.

Textbook(s) and/or Reference Books:

1. Water and Wastewater Technology, Hammer MJ – 1985.
2. Water Treatment Plants, Syed R. Quasim, Holt Rinchart and Winston – 1985.
3. Neumann W.L. Industrial Air Pollution Control Systems, 1997, McGraw Hill.
4. CPHEEO Manual on Water Supply and Treatment, GOI Publication, 1991.
5. CPHEEO Manual on Sewerage and Sewerage Treatment, GOI Publication. 1995.
6. Training Manual on O and M for Municipal Staff, Asian Development Bank Project, Government of Karnataka.
7. Walski T.M. Analysis of Water Distribution Systems, CBS, Publications, New Delhi, 1987.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group V

Course	**ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING**	Exam Duration	03 Hours
Course Code	20CEE17	Exam Marks	100

Syllabus

Module-01:

Atmospheric Processes and Chemical Reactions; Definition of Terms –
Aerosols, particle, photolysis, gas to particle conversion, condensation, evaporation, dissolution, sublimation, specific heat, conduction, radiation. Mechanical turbulence, forced convection, advection, equation of state, first law of thermodynamics. Reaction Rates (Gas Phase Species) Atmospheric gases and their molecular structures, chemical reactions and photo processes, reaction rates, reaction rate coefficients, sets of reactions, stiff systems.
Atmospheric Boundary Layer: Characteristics of atmospheric boundary layer-boundary layer depth, mean velocity power-law profile, Log-Log velocity profile, spectral description of turbulence, turbulence intensity. Reynolds streets parameter, spectral density function, integral length scale, inertial sub range and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapor, friction velocity, surface roughness lengths, bulk aerodynamic equations for eddy diffusion, monin-obukhov similarity theory, eddy diffusion above the surface layer, ground surface temperature and moisture.

Module-02:

Urban Air Quality Simulation Modeling: General need, alternative approaches, basic model applications, general composition of models,. Numerical modeling approaches-Guassian diffusion models, physical basis of the mass conservation approach, mathematical foundation of the mass conservation approach.
Inherent problem in air quality simulation modeling: Boundary conditions, spatial resolution and compatibility with available data. Transportation related modeling-street canyon models, highway models, airport models. Air quality simulation models for Quasi-Inert pollutants –sulfur dioxide and particulate models, carbon monoxide models. Air quality simulation models for photochemical pollutants-background, features of photochemical air quality simulation models, model evaluation, model validation.

Module-03:

Dispersion of Heavy Gases: Introduction, characteristics of heavy gas flow, introduction to numerical modeling of heavy gas dispersion, requirements for physical models (non-dimensional parameters, choice of scaling variables).
Mobile Sources of Pollution: Introduction, emission standards for automobiles, Gasoline, origin exhaust emissions from gasoline engines, crankcase and evaporative emissions, alternative fuels and their utilization.

Module-04:

Indoor Air Pollution: Introduction, the IAQ problem, diagnosis and remediation of IAQ problems,

the interdisciplinary approaches. Industrial hygiene and its application to IAQ, industrial hygiene methodology. Indoor air quality and industrial hygiene, sampling, analysis and interpretation. Industrial hygiene methodology, architectural and construction aspects.

Module-05:

Design of Industrial Ventilation Systems: Introduction, ventilation by dilution, hood specification, hoods of simple geometry, experimental velocity contours, complex hood design, duct design, fan selection and performance.

Textbook(s) and/or Reference Books:

1. Jacobson. Z A., Fundamental of Atmospheric modeling, Cambridge University press, Cambridge, 1999.
2. Warren B Johnson et. Al. Air Pollution, Arthur C Stern, third edition, Volume I, Academic Press, New York, 1976.
3. Krogstad and Jacobsen. Dispersion of heavy gases, in encyclopedia of environmental control technologies, edited by Cheremioinoff , Volume 2, Rulf publishing company, Houston.
4. Crawford Martin, “Air pollution control theory” – Tata McGraw. Hill publishing company Ltd. New Delhi, 1980.
5. Stull B Roland, Boundary Layer Meteorology, Kluwer Academic Publishers, 1988.
6. Snyder H William, “Guideline for fluid modeling of atmospheric diffusion”, U S Environmental Protection Agency research Triangle Park, NC 2711.
7. Wark K Warner C F and Davis. W T., Air Pollution, “its origion and control” third edition, Harper and Row Publication, 1998.
8. Steve M Hays, Ronald V Gobbell 7 Nicholas R Ganick, “Indoor Air Quality” – Tata McGraw-hill, 1995.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group V

Course	**RECYCLE AND REUSE TECHNOLOGY**	Exam Duration	03 Hours
Course Code	20CEE18	Exam Marks	100

Syllabus

Module-01:
Waste as a Resource**:** Resource economics, Disposable materials, Recycling Collection, Processing, Governmental Role in Waste Management, and Potential for Reuse.
Waste Analysis: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fines Analysis, Energy Content.

Module-02:
System Design: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems.

Module-03:
Water Reuse**:** Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Examples of Water Reuse, Close Cycle and Open Cycle Reuse Recreational Reuse.
Energy Recovery: Combustion, Energy Losses, Energy Recovery Analysis Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel.

Module-04:
Metals Recovery**:** Ferrous metals, Properties, Principles of Magnetic Field – Ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous metal separation, Eddy-Current Separation – Theory and Types, Extraction of Material from a bed

Module-05:
Reuse of Industrial Effluent, Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones, Uses of Sewage in Pisciculture, Groundwater Recharge of Sewage Effluents, Reuse for Amenity.
Health Aspects of Water Reuse, Guidelines for Evaluating Recreational Water Reuse, Resource Conservation and Recovery Act.

Textbook(s) and/or Reference Books:

1. Springer, Recycling and Resource Recovery Engineering, Springer-Verlag Berlin Heidelberg (1996).
2. ICE: Reuse of Sewage Effluent, Proceedings of the International Symposium, Thomas Felford London (1985).
3. Dean R.B. and E., Water Reuse Problems and Solutions, Academic Press (1981).
4. Kut D., and Hase G., Waste Recycling for Energy Conservation, John Wiley & Sons Incedition, Harper and Row Publication, 1998.
5. Steve M Hays, Ronald V Gobbell 7 Nicholas R Ganick, “Indoor Air Quality” – Tata McGraw-hill, 1995.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group V

Course	**HYDRAULICS OF WATER AND WASTEWATER SYSTMES**	Exam Duration	03 Hours
Course Code	20CEE19	Exam Marks	100

Syllabus

Module-01:
Water Supply System – Introduction – types of systems, population forecasting methods, water demand, pressure, design period, pipe materials and roughness coefficient.
Storage Reservoirs – Need, different types, capacity determination and evaluation of pumping systems.

Module-02:
Pipe Networks – Peak Factors for intermittent and continuous distribution system. Branch and Grid Iron systems. Nodal demand, Design Layouts of distribution systems,
Evaluation of distribution system – Computer Analysis of Pipe Networks for different options, Economic Analysis of Pipelines and Networks

Module-03:
Leak Detection – Prediction, Prevention and Control.
Water Quality in Distribution System – factors affecting water quality predictive tools and intermediate disinfections.

Module-04:
Wastewater Collection System – Separate and combined sewer Systems, relevant equations for flow condition, pipe materials and roughness coefficient, design guidelines and examples. Sewer Appurtenances.

Module-05:
Sewer Network – Estimation of Nodal Flows,, Pumping Stations, Evaluation of Different Network Options.
Storm Sewers – flooding and water quality problems, run-off calculations, storm water inlets, open drains and sewer pipes and design for different layouts.

Textbook(s) and/or Reference Books:

1. Sincero A P., and Sincero G A., “Environmental Engineering – A Design Approach”, Prentice Hall of India Pvt, Ltd, New Delhi. (1999)
2. Hammer M J Jr. M J.“Water and Wastewater Technology”, Prentice Hall of India Pvt. Ltd., New Delhi. (2008)
3. Walski T M, “Analysis of Water Distribution Systems”, CBS Publications, New Delhi. (1987),
4. CPHEEO Manual on Water Supply and Treatment, (1991), GOI Publications.
5. CPHEEO Manual on Sewerage and Sewage Treatment, (19950, GOI Publications.

RISK ASSESMENT AND HAZARDOUS WASTES MANAGEMENT			GROUP- V
Course Code	20CEE242	Exam Hours	03

Module-1

Risk – Importance, Identification, characterization, communication – Internal & External, Risk - Management Structure, management Cycle, Participation and Consultation

Ecological Health impact assessment. Exposure assessment. risk factors. Sorption/ partitioning of organics, volatilization and structural / property activity relation.

Module-2

Risk factor calculation, impact identification – Risk Area, impact, Likelihood, consequences, Controls, Severity, risk score calculation; Toxicology and Risk Assessment: Toxic effects, Dose response assessment, Risk exposure assessment, Carcinogenesis, ecotoxicology, risk characterization.

Module-3

Hazard identification and Risk Assessment – HAZOP, HAZID, Risk Ranking Matrix, Process and Instrumentation Diagram, and importance of Standard operating procedures, Material safety and Data Sheets, Guidelines, case study

Emergency Preparedness, Incident Investigation, Non Conformity, action and Preventive and Corrective Actions, Auditing.

Module-4

Hazardous Waste Management

Sources, Classification, Impacts of Mismanagement, Problems in Developing Counties,and Regulations for Hazardous Waste Management

Hazardous Waste Characterization, Designated Hazardous Wastes, Waste Minimization and Resource Recovery – Approaches, Development of a Waste Tracking System, Selection of waste Minimization Process, Case Studies.

Module-5

Biomedical Waste management: Biomedical (Handling and Management) Rules 2008 ,sources, treatment and disposal **Transportation of Hazardous Waste** – requirements, regulations, containers and Labelling, bulk and non-bulk transport, Emergency Response, personal protective equipment.

Treatment & Disposal: Physico-chemical, Chemical and Biological

Treatment of hazardous waste, Thermal treatment - Incineration and pyrolysis

Course outcomes:

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

(1) Understand and apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges

(2) Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste

(3) Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

(1) Lagrega M.D., Buckingham P.L., and Evans J.C., (1994),
"Hazardous waste Management", McGraw Hill International Edition

(2) Wentz C.A.,(1995),"Hazardous Waste Management", McGraw

Reference Books

(1) Hazardous waste (management and handling) Rules, 2001

(2) Biomedical (Handling and Management) Rules 2008

(3) Charles A. Wentz; "Hazardous Waste Management", McGraw Hill
Publication, 1995.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group VI

Course	**OCCUPATIONAL SAFETY AND HEALTH**	Exam Duration	03 Hours
Course Code	20CEE21	Exam Marks	100

Syllabus

Module-01:
Introduction: History and Development, Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws.
Accident Causation: Need for Accident Investigation, Accident Investigation Plan, Methods of Acquiring Accident Facts, Correcting Missing Skills, Investigator Tendencies and Characteristics, Supervisory Role in Accident Investigation. Human Error Model, Petersen's Model, Epidemiological Models.

Module-02:
Ergonomics**:** Ergonomics at work place, Ergonomic Task Analysis, Preventing Ergonomic Hazards, Setting up of Ergonomics Program.
Occupational Hazard and Control**:** Hazard Analysis, Human Error Analysis in Causation with Hazard Analysis, Fault Free Analysis, Emergency Response, Decision for Action, Purpose and Considerations, Right Decision, Wrong Remedy, Hazard Control Measures, Hazards and their Control in Pharmaceutical, Construction, Textiles, Petroleum Refineries and LPG Bottling, Iron and Steel Industries.

Module-03:
Fire Prevention and Protection**:** Fire Development and its Severity Effects. Enclosure, need for early Detection of Fire, Extinguishing Fire Electrical Safety Product Safety, Technical Requirements of Product Safety Programme.

Module-04:
Environmental Safety and ISO 14000 ISO series of Standards, ISO 14001 Standards, Environmental Management Systems (EMS), Total Quality Management (TQM) and Total Safety Management (TSM).

Module-05:
Occupational Health**:** Health and Safety Considerations, Personal Protective Equipments, Effects of Exposure and Treatment for Metal Working Trades, Municipal Solid Waste, Epoxy Resins, Foundries, Occupational Health and Safety Considerations in Wastewater Treatment Plants.

Textbook(s) and/or Reference Books:

1. David L. Goetsch, "Occupational Safety and Health" for Technologists, Engineers and Manaers, 3rd Edition, Prentice Hall.
2. David A Calling – Industrial Safety Management and Technology, Prentice Hall, New Delhi.
3. Della D.E. and Giustina, Safety and Environmental Management. Van Nostrand Reinhold International Thomson Publishing Inc., 1996.
4. Trevethick R.A. Environmental and Industrial Health Hazards, William Heinemann Medical Books Ltd., London (1973).

ENVIRONMENTAL PLANNING AND MANAGEMENT			
GROUP VI	20CEE243	Exam Hours	03

Module-1

Environment and Sustainable Development: Carrying capacity, relationship with quality of life, carrying capacity and resource utilization. Engineering Methodology in Planning and its Limitations: Carrying capacity based short and long term regional planning.

Module-2

Environmental Protection: Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental Protection cost. Case studies on Regional carrying capacity

Module-3

Engineering Economics: Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting

Module-4

Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Module-5

Total Quality Management in environmental management and protection – ISO 9000, 14000 and 18000 series of standards. Environmental Audit – methods, procedure, reporting and case studies.

Course outcomes:

At the end of the course the student will have :

. Sound understanding of the principal environmental policy issues confronting managers in diverse geographical and culture situations.

2. An awareness of the ethical and moral issues involved in seeking the wise and sustainable use of resources

3. A range of relevant practical skills, particularly in the fields of impact assessment, audit and law.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

(1) Lohani B.N , “Environmental Quality Management”,South Asian Publishers, New Delhi

(2) Chanlett, “Environmental Protection”, McGraw Hill Publication, Newyork.

3. Danoy G.E., and Warner R.F., “Planning and Design of Engineering Systems”, Unwin Hyman Publications.

Reference Books

(1) MOEF, Government of India, “Carrying Capacity Based
Developmental Planning Studies for the National Capital Region”, 1995-96.

(2) NEERI, Nagpur, Annual Reports 1995 & 1996.

(3) UNEP / UNDP – “Environmental Sustainable Development”.

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PhD Coursework Courses-2020
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Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group VI

Course	**Climate Change and Globalization**	Exam Duration	03 Hours
Course Code	20CEE321	Exam Marks	100

Syllabus

Module-01:
Energy Issues and Climate Change**:** Alternate Energy Sources
Green-House Effect:as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources Quantification of CO2 Emission, Global Warming Potential (GWP) of GHGs.

Module-02:
Modeling Climate change, Ozone layer depletion and its control**.**
Impacts of climate change**:** Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands and Estuaries loss.

Module-03:
Kyoto Protocol**:**Importance, Significance and its role in Climate Change.
Carbon Trading**:** Mechanisms , Various Models (European, Indian) Global and Indian Scenario.

Module-04:
leaner Development Mechanisms:Various Projects related to CO2 Emission Reduction**.**

Module-05:
Alternatives of Carbon Sequestration: Conventional and non-conventional techniques , Role ofCountries and Citizens in Containing Global Warming**.**

Textbook(s) and/or Reference Books:

1. Barry R.G., and Chorley R.L., (1992) **"Atmosphere, Weather and Climate"** 4th Edition, ELBS Publication.
2. Bolin B., (Ed.), (1981), **"Carbon Cycle Modelling"** John Wiley and Sons Publications
3. Corell R.W., and Anderson P.A., (Eds.), (1991), **"Global Environmental Change"** SpringlerVerlog Publishers.
4. Francis D., (2000) **"Global Warming: The Science and Climate Change",** Oxford University press.
5. Frame B., Medury Y., and Joshi Y., (Eds.), (1992) **"Global Climate Change: Science, Impact and Responses"**
6. Linden E., (2006), **"The Winds of Change: Climate, Weather and the Destruction of Civilizations",** Simon and Schuster Publications.
7. Mintzer I.M., (Ed.), (1982), **Confronting Climate Change, Risks , Implications and Responses"** Cambridge University Press.
8. Srivatsava A.K., (2007), **"Global Warming"** APH Publications.
9. Wyman R.L., (Ed.), (1991), **Global Climate Change and Life on Earth",** Chapman and HallPublications.
10. Yadav, Chander and Bhan, (2005), **"Global Warming: India's Response and Strategy",** RPH Publications.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI
PhD Coursework Courses-2020
As per the Ph.D. regulations - 2020

Name of the Programme (Branch/Stream)	Environmental Engineering

Ph.D. Coursework Group Number: Group VI

Course	**ADVANCED COMPUTATIONALMETHODS AND OPTIMIZATION**	Exam Duration	03 Hours
Course Code	20CEE24	Exam Marks	100

Syllabus

Module-01:
Newton-Raphson method for solution of simultaneous equations. Numerical solutions of partial differential equations. Finite difference, Finite element method and method of characteristics. Explicit and implicit methods to solve simple parabolic differential equations, convergence, Boundary value problems and successive over relaxation methods. Numerical dispersion errors and their prevention, Comparison of solutions by analytical and finite difference techniques for one dimensional instantaneous discharge simple computer program based examples.

Module-02:
Definition and classification of optimization problems, its importance in environmental studies. Single and multivariable optimization without and with constraints.
Linear Programming: Standard form of problems – pivotal reduction of equations. Single and two phase simplex methods. Piece wise linear approximation of non-linear optimization.

Module-03:
Numerical search methods for 1-D non-linear problems – Dichotomous, Fibonacci and Golden section methods. Quadratic and cubic interpolation methods, Solutions of linear programming problems using computer programming.

Module-04:
Statistics and Probability: Frequency Distribution – Characteristics of Distribution: Central Tendency and Dispersion, Concepts of Probability – Binomial, Poisson and Normal distribution, and their applications.

Module-05:
Methods of Least Square and regression – Multiple Regression – The Chi Squared Test; F-test, t-test. Analysis of problems using computer programming.

Textbook(s) and/or Reference Books:

1. Antony Raiston Philip Rabinowitz – A First Course in Numerical Analysis.
2. Brice, Luther N.A. and James O. Wilkes – Applied Numerical Methods.
3. Stanton R.G. – Numerical Methods for Science and Engineers.
4. Bheveridge – Optimizaton Techniques.
5. Rao S.S. – Optimization
6. Desai C.S. and John F Abel – Introduction to the Finite Element Method
7. Sienkiowics O.C. – The Finite Element Method
8. Statistical Hydrology
9. Ram S. Gupta, Hydrology and Hydraulic Systems.
10. Taha, Optimization.
11. Srivatsava A.K., (2007), **"Global Warming"** APH Publications.

12. Wyman R.L., (Ed.), (1991), **Global Climate Change and Life on Earth",** Chapman and HallPublications.
13. Yadav, Chander and Bhan, (2005), **"Global Warming: India's Response and Strategy",** RPH Publications