TEACHING SCHEME AND COMPLETE SYLLABUS

POSTGRADUATE PROGRAMMES

[M.Tech. in Environmental Engineering]

Session: 2015 (Onward)

Centre for Energy and Environmental Engineering

National Institute of Technology

Hamirpur, Himachal Pradesh, India– 177 005

Web Site: http://www.nith.ac.in

CENTRE FOR ENERGY AND ENVIRONMENTAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR

HIMACHAL PRADESH, INDIA-177005

Post Graduate Programmes

[M.Tech. in Environmental Engineering]

The Centre for Energy and Environmental Engineering established at the National Institute of Technology, Hamirpur, in the year 2009 started Post Graduate programmes in M.Tech w.e.f. July 2010.

Objectives:

1. The course on environmental Engineering will be helpful to gene4rate human resource in this important area. The course will be helpful for the students to be competent in the area of pollution control, environmental monitoring, and design of household sanitation and water supply systems. Development of this course on will improve overall national development. Due to the tremendous increase in population, the requirement of housing, transport, power, telecommunication, drinking water and energy is increasing rapidly and wastes are produced in vast amount. This course will be able to fulfil the current needs and future demand of water supply and monitoring, control, management and treatment of waste and pollution.

The Centre offered Post Graduate Programme, M.Tech. in Environmental Engineering w.e.f July 2015

M.Tech [Environmental Engineering]

Eligibility: the Applicant must have a Bachelor's degree in the following Engineering/Technology discipline:

- Civil Engineering
- Chemical Engineering
- Environmental Engineering

Type of Academic Programme and Annual Intake:

Post Graduate programme M.Tech in Environmental Engineering, with Annual intake of 25 students: General: 10, SC: 3 ST: 02, OBC: 05, Sponsored: 05.

Learning Methodology

The learning methodology will consist of class room teaching through lectures, tutorials, seminars and group discussions. In order to give practical insight, experiments will be conducted in the laboratories of the Centre.

Fee Structure: The fee structure for the programme will be in accordance with regular PG Programme norms of NIT, Hamirpur.

Courses of Study

The Courses are designed for awarding M.Tech [Environmental Engineering] degree after two year duration of study. The Core Courses and Elective Courses have been structured in such a manner that the students with different backgrounds will have the option to choose the elective courses so as to become specialized in a specific field.

Centre for Energy and Environmental Engineering, NIT –Hamirpur (HP)

M. Tech (Environmental Engineering)

Teaching Scheme

(i)Year I - Semester I

S. No.	Subject Code	Title	L	T	P	Credit	Hours /Week
1.	EN-620	Environmental Chemistry	3	0	0	3	3
2.	EN-621	Microbiology and Ecology	3	0	0	3	3
3.	EN-622	Advanced Water Treatment	3	0	0	3	3
4.	EN-___	**Elective-I**	3	0	0	3	3
5.	EN-___	**Elective-II**	3	0	0	3	3
6.	EN-623	Environmental Engg. Lab-I	0	0	3	2	3
Total			**15**	**0**	**3**	**17**	**18**

(ii)Year I - Semester II

S. No.	Subject Code	Course Title	L	T	P	Credit	Hours /Week
1.	EN-624	Statistical Methods and Modelling	3	0	0	3	3
2.	EN-625	Advanced Waste water Treatment	3	0	0	3	3
3.	EN-626	Design of Treatment Plants and Equipments	3	0	0	3	3
4.	EN-___	**Elective-III**	3	0	0	3	3
5.	------	***Open Elective-I (From Other Departments)**	3	0	0	3	3
6.	EN-627	Environmental Engg. Lab-II	0	0	3	2	3
Total			**15**	**0**	**3**	**17**	**18**

***The student will have to take an Open Elective offered by other Departments during Semester**

(iii)Year II – Semester III

S. No.	Subject Code	Course Title	L	T	P	Credit	Hours /Week
1.	EN-799	Self study Course	0	0	0	2	3
2.	EN-800	Seminar	0	0	3	2	3
3.	EN-801	**Dissertation –1[to continue in the IVth semester]**	0	0	0	12	24
Total			**0**	**0**	**3**	**16**	**30**

(iv)Year II - Semester IV

S. No.	Subject Code	Course Title	L	T	P	Credit	Hours /Week
1.	EN-801	**Dissertation – [Continued from IIIrd semester]**	-	-	-	20	40
		Total				**20**	**40**

(v) List of Electives for M.Tech [Environmental Engineering]

S.No.	Subject Code	Course Title	L	T	P	Credit	Hours /Week
1.	EN-720	Solid & Hazardous Waste Management	3	0	0	3	3
2.	EN-721	Air Pollution and Control	3	0	0	3	3
3.	EN-722	Industrial Waste Management	3	0	0	3	3
4.	EN-723	Environmental Impact Assessment	3	0	0	3	3
5.	EN-724	Environmental Toxicology and Health	3	0	0	3	3
6.	EN-725	GIS and its Application in Environmental Engineering	3	0	0	3	3

M.TECH (ENVIRONMENTAL ENGINEERING) DETAILED SYLLABUS

(i) M.TECH CORE COURSE DETAILS: SEMESTER-I

Course Code	Course Name	L	T	P	C
EN 620	**Environmental Chemistry**	**3**	**0**	**0**	**3**

Types of chemical reactions, stoichiometric calculations, solutions, chemical thermodynamics, fundamentals of process kinetics, gas laws, ways of shifting chemical equilibria. Equilibrium calculation, alkalinity, acidity, buffers, buffer index. Solubility equilibrium for slightly soluble salts, effect of other solutes on salt solubility, competing acid-base equilibria, effect of complexions, hydrolysis, computing total soluble species concentration Oxidation-reduction processes, stability diagrams, redox potential. Fundamental of Process kinetics: Reaction rate, order and stoichiometery. Fundamental of surface and colloidal chemistry: surface charge on colloidal particles, electric double layer, adsorption isotherm. Basic concepts of quantitative analytical chemistry. Instrumental methods of analysis.

References

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. *Chemistry for Environmental Engineers* , 4th Edn. McGraw Hill, New Delhi, 1994.

2. Benefield, Judkins and Weand – *Process Chemistry for Water and Wastewater Treatment*, Prentice Hall

Course Code	Course Name	L	T	P	C
EN 621	**Microbiology and Ecology**	3	0	0	3

Introduction : Microorganisms - classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication. Recombinant DNA. Viruses, their detection and quantification. Microsopcy, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism.

Microbial Metabolism and Growth : Enzyme and enzyme kinetics, Metabolism, respiration, fermentation, Glycolysis, Kreb's cycle, carbohydrate, protein, lipids, significance of energetics. Chemical composition of cell and nature of organic matter used by microorganisms. Metabolic classification of microorganisms : phototrops, chemotrops, applications in environmental engineering

Microbiology of Water and Wastewater : Distribution of microorganisms, indicator organisms, coliforms - fecal coliforms - E.coli, Streptococcus fecalis differentiation of coliforms - significance - MPN index, M.F. technique, standards. Microbiology of wastewater treatment processes such as activated sludge process, trickling filter, anaerobic processes.

Introduction to Microbiology of Soil and Air and Industrial Microbiology, Microbiology of bioremediation and solid waste treatment

Physical and Biological process on earth: Bio-sphere, earth energy budget, Ecosystem, Uniformitarianism, the ecology of population, Ecosystem and communities: Physical and biological properties

References

1. Maier R M, Pepper I L and Gerba C P. *Environmental Microbiology*, Second Edition, Elsevier- AP, 2009.
2. Pelczar, Jr, M.J., Chan, E.C.S., Krieg, R.N., and Pelczar M. F, *Microbiology*, 5th Edn., Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Rittman B, McCarty P L McCarty P, *Environmental Biotechnology: Principles and Applications*, 2nd edition, McGraw-Hill, 2000

Course Code	Course Name	L	T	P	C
EN 622	Advanced Water Treatment	**3**	**0**	**0**	**3**

Sedimentation and coagulation : Types, settling tests, scale up, Batch flow and continuous flow operations. Coagulation, mechanisms of coagulation, effect of turbidity and alkalinity, chemistry of coagulants.

Flow through beds of solids : Slows sand filters, rapid sand filters, ion exchange units, adsorption towers, contacting towers, flow through expanded beds, flow through porous plates and membranes.

Gas transfer and Disinfection Mechanism of transfer, film coefficients and equilibrium relationship, gas disperses, packed columns, tray columns, spray units. Disinfection, mechanism, different agents.

Advanced treatment operations: Adsorption, isotherms, reverses osmosis, electrodialysis, ultrafiltration, etc.

Applications of Unit Operations in Water Treatment and Design of Physical Facilities

References

1. Metcalf and Eddy Inc, *Wastewater Engineering: Treatment, and Reuse*, 4th edition, Tata McGraw Hill, 2007.
2. Weber W. Physicochemical Processes for Water Quality Control, Wiley-Interscience, New York, 1972.
3. Schroeder E D. Water and Wastewater Treatment, McGraw-Hill, 1997
4. Ministry of Urban development, Govt of India – Manual for Water Treatment.

Course Code	Course Name	L	T	P	C
EN 623	**Environmental Engineering Laboratory-I**	0	3	3	2

Analysis of water/wastewater for physicochemical parameters
Turbidity, Alkalinity, pH, hardness, chlorides, sulphates, nitrates, oil and grease, available chlorine, Dissolve Oxygen , Biochemical oxygen demand, chemical oxygen demand.

Microbiological techniques
Microscopy, staining techniques, isolation and growth of bacteria, microbiological quality of water – MPN, Plate count and membrane filtration techniques, effect of environmental factors on microbial growth.

Ambient air quality monitoring for sulphur dioxide, nitrogen oxides, carbon monoxide, particulates using high volume sampler

Stack monitoring

(ii).M.TECH CORE COURSE DETAILS: SEMESTER -II

Course Code	Course Name	L	T	P	C
EN 624	**Statistical Methods and Modelling**	3	0	0	3

Introduction : Measures of Central tendency, dispersion, skewness and kurtosis - Principle of least squares - Correlation and regression - rank correlation.

Sampling Distributions and Estimation

Sampling distributions - Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method - Method of moments.

Testing of Hypothesis

Sampling distributions - Tests based on Normal, t, Chi-square and F distributions
Analysis of variance – one-way and two-way classifications.
Mathematical modelling and simulation, Defining systems and its components, Types of models and their applications.

Introduction to Soft Computing Techniques

Fuzzy set theory and logic, Fuzzy MCDM and FRBS, simple applications in environmental engineering. Neural networks and Genetic Algorithsms

Models for Fate and Transport of Contaminants

Modelling of volatilization, chemical transformations, sorption/desorption, photochemical transformations, biological transformations. Brief review of mass, momentum and energy balance, advection, molecular diffusion, dispersion, their application in modelling of rivers, lakes, sediments, wetlands, subsurface flow and transport, air pollution modelling

References

1. Box G E P, Hunter J S and Hunter W G *Statistics for Experimenters*, 2nd Edition,, John Wiley and Sons, 2005
2. Berthouex P M and Brown L C. *Statistics for Environmental Engineers*, 2nd Edition, CRC Press, 2002.
3. Freund, J.E. and Miller, I.R., *Probability and Statistics for Engineers*, Prentice–Hall of India, 5th Edition, New Delhi, 1994
4. Ramaswami, A, Milford, J B, Small, M. J. *Integrated Environmental Modeling - Pollutant Transport, Fate, and Risk in the Environment* John Wiley & Sons, 2005.
5. Burrough, P.A. and McDonnell, R.A., *Principles of Geographical Information Systems*, Oxford University Press, 1998.
6. Snape, J.B., Dunn, I.J. Ingham J and Prenosil **J** Dynamics of environmental bioprocesses, modelling and simulation Weinheim: VCH, 1995.
7. International Water Association - Activated sludge modelling ASM1 and ASM2
8. Chapra S C, *Surface Water Quality Modeling*, McGraw-Hil, Inc., New York, 1997.

Course Code	Course Name	L	T	P	C
EN 625	**Advance Wastewater Treatment**	3	0	0	3

Kinetics of Biological Growth: Nutrition and growth conditions, Effect of environmental conditions, bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogenous metabolism, inhibition, effect of temperature, application of growth and substrate removal kinetics to biological treatment.

Reactors and Reactor nalysis. Types of reactors and their analysis

Biological Processes: Fundamentals and design concepts of aerobic treatment processes. Anaerobic treatment processes

Nutrient removal and Pond treatment processes: Biological processes for nitrogen and phosphorus removal. Different pond treatment systems

Biological processes for sludge processing

References

1. Metcalf and Eddy Inc, *Wastewater Engineering: Treatment, and Reuse*, 4th edition, Tata McGraw Hill, 2007.
2. Benefield L D, and Randall, C W. *Biological Process Design for Wastewater Treatment* Prentice Hall, 1980.
3. Schroeder E D. Water and Wastewater Treatment, McGraw-Hill, 1997
4. Karia G L and Christian R A. Wastewater Treatment : Concepts and Design Approach, Prentice Hall, 2006.
5. Soli J Arceivala, Wastewater treatment for pollution control

Course Code	Course Name	L	T	P	C
EN 626	**Design of Treatment Plants and Equipment**	3	0	0	3

Design of screens, grit chamber, skimming tank, and flotation tank. Design of equalization tank, Design of plug flow and complete mix activated sludge process, secondary settling tank, trickling filter, bio tower, rotating biological contactors, sequencing batch reactor, oxidation ditch, and aerated lagoon.

Design of oxidation ponds, Inhoff tank, septic tank, design of sludge digestion, sludge thickening unit, sludge trying bed, incinerators, Design of anaerobic reactors, Design of anaerobic filter, UASB reactor. Design of disposal system

References

(1) Ministry of Urban development, Govt of India – Manual for Sewage Treatment.

(2) Qasim S R, Motley E M and Zhu G, Water Works Engineering, Prentice-Hall India, 2006.

(3) Montgomery – *Water Treatment Principles and Design*, John Wiley and Sons.

(4) Metcalf and Eddy Inc – *Wastewater Engineering: Treatment, and Reuse*, 4th edition, Tata McGraw Hill, 2007.

Course Code	Course Name	L	T	P	C
EN 623	**Environmental Engineering Laboratory-II**	**0**	**3**	**3**	**2**

Analysis of solid wastes
Characterisation of wastes from different industries
Coagulation and flocculation/optimum dosage of coagulants
Filtration Performance Studies
Kinetics of chlorination
Water softening by chemical precipitation
Adsorption kinetics
Sludge Volume Index
Settling characteristics of discrete settling solids
Removal of heavy metals by precipitation

(iii).M.TECH CORE COURSE DETAILS: SEMESTER -III

Year II – Semester III

S. No.	Subject Code	Course Title	L	T	P	C	Hours/ Week
1.	EN-799	Self Study Course	0	0	0	3	3
2.	EN-800	Seminar	0	0	3	2	3
3.	EN-801	**Dissertation Phase –1 [to continue in the IVth semester]**	0	0	0	12	24
Total			**0**	**0**	**3**	**17**	**30**

EN-799: Self Study: - The faculty adviser will decide a specific problem and the students are required to study the subject. They are required to submit a syllabus in consultation with faculty adviser at the end of the second semester. Syllabus will be internally assessed by the faculty adviser and course coordinator and same will be approved in the department post-graduate committee.

EN-800: SEMINAR: - Each Student is required to present a seminar on a scheduled date and a typed copy of the seminar report is to be submitted. Assessment is based on the presentation and contents of seminar report

(iv). M.TECH CORE COURSE DETAILS: SEMESTER –IV

Year II - Semester IV

S. No.	Subject Code	Course Title	L	T	P	C	Hours/ Week
1.	EN-801	**Dissertation -Phase-II** [Analysis, Presentation ,Viva]	-	-	-	20	40
		Total				**20**	**40**

EN-801: DISSERTATION PRELIMINARY/ FINAL DISSERTATION

Each student is to carry out the dissertation work for which topic will be assigned at the end of the second semester.

The main objective of dissertation work is to provide scope for original and independent study/research, to develop a theme and to demonstrate ability of using analytical approach independently. The theme or topic of dissertation should be within the framework of P.G. Programme.

Thesis is prepared by each student under the supervision of the faculty advisor and to be submitted as per the specified time and the student has to defend his/her work at the viva-voce examination fixed by the Institute.

(V). M.TECH. ELECTIVE COURSES DETAILS:

Course Code	Course Name	L	T	P	C
EN 720	**Solid And Hazardous Waste Management**	**3**	**0**	**0**	**3**

Introduction

Solid waste sources - nature and characteristics - Quantities and Qualities - generation rates – Potential of disease - nuisance and other problems.

Collection and Storage

Solid waste management – Functional elements of solid waste-on-site storage, collection and separation. – Containers and its location – collection systems- vehicle routing- route balance- transfer station - Processing- recovery and reuse.

Disposal

Disposal methods – sanitary land filling, planning, site selection, design. Monitoring Closure and post closure monitoring – Other methods like incineration, pyrolysis, composting, biological digestion,

Hazardous Waste Management

Introduction to hazardous waste – Definition, characterization and composition – TCLP test – The magnitude of problem – Risk assessment - – Storage and transportation of hazardous waste – Labeling of hazardous waste – Physical, Chemical and Biological treatment of hazardous waste – Bioremediation of hazardous waste – Treatment of nuclear waste and Radio-active waste.

Legislation

Biomedical waste and BMW-98 Rules - MSW-2000 Rules – Legislation for E-waste and radio active waste.

References

1. David Rimbers, "Municipal Solid Waste Management: Pollution Technologies Review", Noyes Data Corporation, London. (1990)
2. Charles A. Wentz, "Hazardous Waste Management", McGraw Hill International Edition, New York. (1995)
3. Tchobanoglous G, "Solid Wastes: Engineering principles and Management issues", McGraw Hill Book Company, Delhi. (1977)
4. Michael D. Lagrega, Phillip L. Buckingham, Jeffrey C. Evans, "Hazardous Waste Management" McGraw Hill, New York. (1994)
5. Gaynor W. Dawson, Basil W. Mercer, "Hazardous Waste Management" Wiley Interscience, New York. (1986)

Course Code	Course Name	L	T	P	C
EN 721	**Air Pollution and Control**	3	0	0	3

Air Quality and Standards :
Important air pollutants, their sources, characteristics and effects. Sampling and Analysis: Ambient air sampling, stack sampling, Air quality standards.

Air Pollution Meteorology and Dispersion Models.
Atmospheric motion, Lapse rate, atmospheric stability, inversion, atmospheric dispersion, maximum mixing depth, Diffusion models, plume rise.

Control of Particulates
Characteristics of particulates. Filters, gravitational, centrifugal-multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection-ESP design procedure

Control of Gaseous Pollutants
adsorption, absorption. Emission control in coal-fired power plants and other important industries. Condensation and incineration

Automobile Pollution
Legislation for motor vehicle emission control, control of automobile pollution, internal combustion engines, modification of IC engines to reduce emission, air fuel ratio, catalytic converters.
Odour pollution and control, Indoor air pollution, Noise pollution and control

References

1. de Nevers, H *Air Pollution Control Engineering*., McGraw-Hill, New York, 1995.
2. Wark K, Warner C F and Davis W. Air Pollution Its Origin and Control, 3rd edition, Harper and Row, New York, 1997.
3. Rao M N, *Air Pollution*, Tata McGraw Hill, New Delhi, 1989.
4. Griffin R D, *Principles of Air Quality Management*, 2nd Edition, CRC Press, Boca Raton, USA, 2007.

Course Code	Course Name	L	T	P	C
EN 722	**Industrial Waste Management**	3	0	0	3

Introduction to Industrial wastes

Industrial waste source, Nature and characteristics, quantity and quality of industrial wastes and their impact on the environment, waste volume reduction, waste strength reduction, neutralization, removal of suspended and colloidal solids, removal of inorganic and organic dissolved solids, disposal of sludge solid – treatment of cyanide waste – heavy metal and radio activity.

Management

Management of industrial waste for various industries like dairy, sugar, paper, distillery, textile, tannery, food processing, fertilizer, pharmaceutical industrial.

Recent Trends

Development of integrated treatment for waste water – physico chemical treatment tertiary treatment methodologies - recent trends in clean technologies – zero polluting industry concept – Reuse and recycle of waste water.

References

1. Nemerow, N.L. Liquid waste of Industries, Addison Wesely. 1996
2. Rao M N and Datta A K Wastewater Treatment, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Eckenfelder. Industrial Water Pollution Control, McGraw-Hill.
4. Metcalf and Eddy, (1995) Wastewater Engineering-treatment, Disposal, Refuse, T.M.H. Edition, New Delhi.

Course Code	Course Name	L	T	P	C
EN 723	**Environmental Impact Assessment**	3	0	0	3

Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development. Evolution of environmental impact assessment (EIA), Current screening process in India. A step-by-step procedure for developing EIA. Elements of Environmental Analysis. Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Water Quality Impact Analysis and energy impact analysis. Impact Assessment Methodologies-Matrices, overlays, network analysis. Case studies of Industrial EIA and Water resources projects. Brief introduction about Environment legislation and Environmental Audit.

References:

1. Environmental Impact Assessment for Developing Countries: Asit K. Biswas
2. Environmental Impact Analysis Handbook : G.J. Rau and C.D. Wooten
3. Environmental Impact Assessment by C.W. Canter
4. Environmental Impact Assessment Theory and practice Peter Wathern

Course Code	Course Name	L	T	P	C
EN 724	**Environmental Toxicology and Health**	3	0	0	3

Dimensions of environmental health, causative agents of diseases, social factors, urban problems, housing and health, economy and health, climate and other atmospheric elements, violence, crime and mental health, family health practice, health care planning and delivery, chronic and communicable diseases.

Industrial and agricultural pollutants, occupational health, epidemiological data, occupational health hazards, environmental exposure and diseases, industrial toxicants, hazardous wastes, preventing exposure to unhealthy and unsafe working conditions, ergonomics, controlling stress of life.

Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability.

Foodborne and waterborne diseases outbreaks, Nuclear energy and environmental health, concerns and uncertainties about nuclear power, nuclear power plants, safety.

Environmental health planning, need for planning, the planning process. Environmental health services, various agencies, international efforts, role of industry, voluntary health agencies, Law and human welfare, public health and the law, constitutional right to healthy environment, environmental education Health aspects of water supply and sanitation, disposal of wastewater in rural and urban areas, integrated approach to health and sanitation.

Transmission of diseases through air, water and food. Insect vector and rodent control. Excreta treatment and management in rural and urban slums, low cost options. Software related to environmental health and hygiene.

References

1. Cairncross S, Feachem R. Environmental Health Engineering in the Tropics; 2nd edition, John Wiley & Sons 1993.

2. Morgan M T, *Environmental Health,* Wadsworth Publishing Co, 1997

3. The World Bank – Appropriate technology for water supply and sanitation (Series)

Course Code	Course Name	L	T	P	C
EN 725	GIS and its Application in Environmental Engineering	**3**	**0**	**0**	**3**

Essential components of GIS, geographic grid, map projection, coordinate systems. Vector data and its representation, topological and non-topological vector data, TIN, vector analysis. Acquiring and handling of raster data, GIS data analysis. GIS packages and their salient features,

Advantage and disadvantage of GIS application. Selection of software and hardware, Need analysis. Remote sensing Application. GPS application, DEM Application, Mapping, Water and sewer model

1. C.P. Lo Concept and Techniques of Geographical Information systems
2. Kang-tsung Chang Introduction to Geographical Information systems
3. Stan Aromoff Geographical Information systems- A Management Perspective
4. U.M. Shamsi GIS Applications for water, wastewater, and stormwater systems