BHARTI UNIVERSITY DURG (C.G.)

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SCHEMEOF EXAMINATION

&

SYLLABUS

Of

M.Tech in Environmental & Water Resources Engg.

UNDER

FACULTY OF CIVIL ENGG.

Session 2021-22

(Approved by Board of Studies)

Effective from NOV. 2021

BHARTI UNIVERSITY,CHANDKHURI,DURG (C.G.)

M.Tech. in Civil Engg. with Specialization in Environmental & Water Resources Engineering

Course of Study — **M. Tech. First Semester**

S. No.	Board of Study	Subject Code	Subject Name	Periods per week			Scheme of Examination			Total Marks
							Theory/Practical			
				L	T	P	ESE	CT	TA	
1	Civil Engg.	MT04211	Advanced Hydrology	3	1	-	70	10	20	100
2	Civil Engg.	MT04212	Advanced Hydraulics	3	1	-	70	10	20	100
3	Civil Engg.	MT04213	Water Pollution Mitigation & Management	3	1	-	70	10	20	100
4	Civil Engg.	MT04214	Computational & Soft Computing Techniques	3	1	-	70	10	20	100
5	**Refer Table-I**		**Elective-I(MT04215)**	3	1	-	70	10	20	100
6	Civil Engg.	MT04216	Water Resources Engg. Lab.	-	-	3	70	-	30	100
7	Civil Engg.	MT04217	Environmental Engg. Lab.	-	-	3	70	-	30	100
Total				**15**	**5**	**6**	**490**	**50**	**160**	**700**

L: Lecture T: Tutorial

P: Practical ESE: End Semester Exam TA: Teacher's Assessment

CT: Class Test

Table – I

List of Elective – I Subjects		
S.No.	**Subject Code**	**Subject Name**
1	MT04215(1)	Hydropower Engineering
2	MT04215(2)	Basics of Microbiology & Biotechnology
3	MT04215(3)	Integrated Water Resources Management & Water Harvesting

Semester: M.Tech -1

Subject: Advanced Hydrology

Branch: Civil Engg.

Total Theory Period: 40

Code: MT04211

Total Marks in End Semester Exam: 70

Total Tutorial Period:1

Minimum of class test to be conducted: 02

Pre-requisite: Basic knowledge of hydrology, open channel flow and river engineering.

Objectives: To understand hydrological processes and apply knowledge for analysis.

Unit I

The hydrologic processes: Precipitation, evaporation, ET, Infiltration, groundwater, and stream flow. Hydrologic measurements and networks

Unit II

Analysis of discrete and continuous hydrologic data: statistical including frequency analysis, correlation,and regression analysis and multivariate analysis, time series analysis and its applications.

Unit III

Hydrograph analysis: Unit hydrograph, Synthetic Unit Hydrograph and IUH.

Unit IV

Flood forecasting methods, flood protection and flood plain zoning. Real Time flood forecasting & warning system

Atmosphere Phenomenon, WMO standard , Introduction to climate change.

Unit V

Flood routing methods, Reservoir routing and Channel routing, Hydrologic routing and Hydraulic routing (Muskingum method).

Expected outcome: To apply the knowledge in the real field situations related to hydrological analysis and modelling

RECOMMENDED BOOKS:

1. Chow V T, Maidment David R. and Mays Larry W. “Applied Hydrology”, McGraw Hill International editions, New Delhi, 1988.
2. Mutreja K.N. “Applied Hydrology” Tata McGraw-Hill Publishing company Ltd., New Delhi,1990.
3. Subramanya K, Engineering Hydrology, Third Edition - Tata McGraw-Hill Publishing company Ltd., New Delhi, 2015.
4. Singh Vijay. P, Elementary Hydrology Prentice Hall, INDIA,1992.
5. Ojha C S P, Bhunya P and Berndtsson P, “Engineering Hydrology” Oxford University Press, Canada, 2008.

Semester: M.Tech - 1

Branch: Civil Engg.

Subject: Advanced Hydraulics

Code: MT04212

Total Theory Period: 40

Total Tutorial Period: 12

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Pre-requisite: Basic knowledge of fluid mechanics and open channel flow

Objective: Analysis of different types of flow in open channel and Numerical analysis of open channel.

Unit I

Laminar and Turbulent boundary layers, BL on a flat plate, Karman's momentum integral equation, Karman - Pohlhausen's approximate equation, Flow under adverse pressure gradient, turbulent BL over smooth and rough surfaces, Analysis of BL control.

Unit II

Turbulent Flow: Reynolds Equations, Semi empirical theories of turbulence, Mixing length, vorticity transport, Karman's similarity theory flow in diverging channels.

Unit III

Gradually varied flow; Classifications and Computations of Free surface profiles, Hydraulics of Confluence of channels

Unit IV

Spatially varied flow; Supercritical flows and Oblique flows, Rapidly varied flow; Hydraulic jump;

Unit V

Continuity and Dynamic equations of Unsteady flow; Wave propagation and Surge; Method of Characteristics, Finite Difference Method

Expected outcome:

To apply knowledge in analysis of boundary layer flow, open channel flow and unsteady flow.

Texts/References Books:

1. Garde R. J, Turbulent flows, Wiley, 1994
2. Rouse H., Fluid Mechanics for Hydraulic Engineers , Dover Pub., New york, 1961
3. Schlisting H, Gersten K., Boundary layer theory,8th edition, Springer Publication,2000
4. Fox &Mc Donald, Introduction to Fluid Mechanics, , John Wiley 2013.
5. ChaudharyHanif M., Open Channel flow, Prantice-Hall of India Pvt. Ltd. New Delhi, 1993.
6. Chow V T, Open Channel Hydraulics, McGraw-Hill Book company, International editions,New Delhi,1973.
7. Subrmanya K, Flow in open channels, Second edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001
8. Srivastava Rajesh, Flow through open channels, Oxford University press, New Delhi, 2008.

Semester: M.Tech - 1
Subject: Water Pollution Mitigation & Management
Total Theory Period: 40
Total Marks in End Semester Exam: 70
Minimum of class test to be conducted: 02

Branch: Civil Engg.
Code: MT04213
Total Tutorial Period: 12

Unit-I Sources & Characteristics of Water Pollution

Water pollution-Sources & types of water pollution–Physical, chemical & biological–Effect of water pollution. Drinking water quality standards waste Water treatment–Primary, secondary, tertiary-

Unit-II Water Quality & Standards

Quality of surface waters, Water quality in flowing waters, Water quality in Impounded waters, Groundwater quality, Water quality standard Microbiological quality of drinking water, and d Chemical quality of drinking water

Unit-III Industrial Activity & Mitigation Measures

Role of water in different industries-Effluent discharge characteristics- Discharge Standards for Rivers and Streams-Role of stakeholders, Public NGOS, Government in Protection of Water bodies-Control Measures-Mitigation Measures for Industrial, Water Contamination due to industries.

Unit -IV Water Pollution Regulations

Administrative regulation under recent legislations in water pollution control. Water (Prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (Prevention & control of pollution) Rules 1975 Water (Prevention & control of pollution) Cess Act. 1977 as amended by Amendment Act 1991.

Unit-V Role of Regulatory Boards

Sustainable Development, Rain Water Harvesting-Methods-Water Pollution- Causes and Effects-Role of Regulatory bodies and Local bodies-CPCB-TWAD Board–CMWSSB etc-Case Studies related to Effective Water Management.

TEXT BOOK

1.Fair.G.M, “Water and Waste water engineering Vol.I&II”.John Wiley and sons, Newyork. 2010.

REFERENCES

1. Metcalf & Eddy, “Wastewater engineering, Treatment and Reuse”, Tata McGrawhill publications, 2008.
2. Eckenfelder, W.W., ""Industrial Water Pollution Control", McGraw-Hill, 2009.
3. Arceivala.S.J, "Wastewater Treatment for Pollution Control", Tata McGraw-Hill, 2008.
4. “ArunaVenkat Environmental Law and Policy”,PHI learning private limited New Delhi, 2011.
5. Water Management In India, “Concept Publishing Company”, New Delhi.

Semester: M.Tech - 1

Subject: Computational & Soft Computing Techniques

Total Theory Period: 40

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Branch: Civil Engg.

Code: MT04214

Total Tutorial Period: 12

OBJECTIVES:

- To educate the students to know about computing techniques
- Develop the different numerical technique and logic like ANN, Fuzzy
- To educate the students on aspects data management
- Develop the model Applications for monitoring and management of Environment

Unit I Computing Principles

Introduction to Computing techniques –Algorithms and Flowcharts, Numerical methods -Solution to ordinary and partial differential equation using Finite difference and Finite element method , Numerical integration and differentiation, Design of digital models for Environmental applications.

Unit II Artificial Intelligence

Knowledge based Expert system concepts -Principle of Artificial Neural Network (ANN) –Neural Network Structure –Neural Network Operations –ANN Algorithm -Application of ANN Model to Environmental field –Genetic Algorithms

Unit III Fuzzy Logic

Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models.

Unit IV Data Management

Data base structure -Data acquisition -Data warehouse -Data retrieval-Data format Attribute -RDBMS – Data analysis -Network data sharing -Statistical Analysis (SYSTAT) -Regression -factor analysis -

Histogram-scatter diagram - Goodness of fit.

Unit V Environmental Modeling Using MATLAB

Introduction to MATLAB Software –Environmental modeling principles and MATLAB Applications –Pollutants transport, decay and degradation modeling using MATLAB. Case studies.

EXPECTED OUTCOMES:

- Ability to understand the computing techniques.
- Ability to apply the principle of soft computing for solving Environmental problems
- Ability to assess the Environmental Impacts using ANN and Fuzzy logic.
- Ability to employ modern advanced computing tools in environmental studies

REFERENCES:

1. Aliev R. A, and AlievRashad, "Soft Computing and its Applications", World Scientific Publications Co. Pte.Ltd. Singapore, 2014.

2. Chepra S. C. and Canele R. P., "Numerical Methods forEngineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2014.

3. Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.

4. Kotteguda, N.T., and Renzo Resso, Statistics, "Probability and Reliability for Civil and Environmental Engineers", McGraw Hill Companies Inc., New York, 2008.

5. Mathews J. H. and FinkK.D. , "Numerical methods using MATLAB", Pearson Education 2010.

Semester: M.Tech - 1

Subject: Hydro Power Engineering

Total Theory Period: 40

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Branch: Civil Engg.

Code: MT04215(1)

Total Tutorial Period: 12

Pre-requisite: Basic knowledge of hydrology, fluid mechanics, and open channel hydraulics.

Objectives: To gain the knowledge of hydropower, thermal power and to analyse its potential at different sites.

Unit I

Planning of hydropower development, Hydropower potential. Operation of power plants for peak and base load, Characteristics of power market, Integration of various types of plants, Augmentation of power plants, Pump storage plants, Small hydro power.

Unit II

Design of hydropower installation components – intake structures, water conductor systems, tunnels, surge-tanks, penstocks, valves and anchor-blocks hydro mechanical parts.

Unit III

Turbines and their foundations, Turbines and their performances Introduction to structural and geotechnical aspects of powerhouse design, Types of powerhouse – Underground, Semi-Underground.

Unit IV

Gates, stilling basins, spillways., hydropower plants efficiencies, power distribution.

Unit V

Reservoir operation for hydropower generation in a multipurpose projects, Basin scale hydropower generation in a multipurpose projects, Basin scale hydropower development, Mathematical models for reservoir sizing and opera

outcome: To apply the knowledge in the area of hydropower and thermal engineering.

Texts/Reference Books:

1. M.M. Dandekar and K.N. Sharma, Water Power Engg.,Vikas Publishing House, New Delhi.
2. R.S. Varshney, Hydropower Structures, Nem Chand and Bros., Roorkee.
3. A.K.Keshari,Water power Engineering,new age publishers,New Delhi.

Semester: M.Tech - 1
Subject: Basics of Microbiology & Biotechnology
Total Theory Period: 40
Total Marks in End Semester Exam: 70 Minimum of class test to be conducted: 02

Branch: Civil Engg.
Code: MT04215(2)
Total Tutorial Period: 12

UNIT I

Basic concepts– Spontaneous generation, Germ theory of diseases, Cell theory. Contributions of Antonie van leuwenhoek, Joseph Lister, Robert Koch, Louis Pasteur, Edward Jenner, John Tyndall, Sergei N. Winogradsky, Selman A waksman, Alexander Flemming, Paul Erlich, Fannie Hesse, Elie Metchnikoff, Kary Mullis.

UNIT II

Sterilisation and disinfection- Definitions, Principles.Methods of sterilization- Physical methods (Heat, Filteration), Radiation and Chemical methods.Control of sterilization and Testing of sterility.

UNIT III

Microscopy – Principles, Light microscope, Phase Contrast, Dark field, Bright field, Fluorescent, Interference microscope (Stereo microscope), Confocal, Inverted microscope, and Electron microscope (TEM and SEM). Measurement of Microorganisms- Micrometry. Staining- Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining, Nuclear staining and Acid fast staining.

UNIT IV

Microbiological media, composition and types: selective and differential media Growth curve and growth kinetics. Influence of environemental factors for microbial growth. Nutritional groups of bacteria: overview Estimation of Microbes- Direct Microscopic count, Turbidometric assay, TVC- Indirect Method- CO_2 liberation- Protein estimation- Development of pure culture methods. Cellultra structure: Peptidoglycan structure and synthesis. Cytoplasmic matrix and components: Inclusion bodies. Maintenance and Preservation of cultures

UNIT V

Taxonomy– Principle and its types (Classical approach– Numerical, Chemical, Serological and Genetic). Bacterial taxonomy – Bergey's manual of Systematic Bacteriology (Eubacteria and Archaebacterium).

REFERENCES

- Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
- Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology McGraw Hill Book R. Krieg, 1986 Company
- Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.

Semester: M.Tech - 1

Branch: Civil Engg.

Subject: Integrated Water Resources Management & Water Harvesting

Code: MT04215(3)

Total Tutorial Period: 12

Total Theory Period: 40

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

OBJECTIVES:

Students will be introduced to the role of disciplines of ecology and socio-economic play in Management of water resources.

Unit-I Context for Iwrm

Water as a global issue: key challenges and needs –Definition of IWRM within the broader context of development –Complexity of the IWRM process –Examining the key elements of IWRM process.

Unit-II 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 –Case studies. Pricing: distinction between values and charges –Private sector involvement in water resources management: PPP objectives, PPP options, PPP processes, PPP

experiences through case studies –Links between PPP and IWRM.

Unit III Water Supply & Health within the Iwrm Consideration

Links between water and human health: options to include water management interventions for health – Health protection and promotion in the context of IWRM –Health impact assessment of water resources development.

Unit IV Agriculture in the Concept of Iwrm

Water for food production: „blue" versus „green" water debate –Virtual water trade for achieving global water security –Irrigation efficiencies, irrigation methods and current water pricing.

Unit V Water Legal and Regulatory Settings

Basic notion of law and governance: principles of international and national law in the area of water management. Understanding UN law on non-navigable uses of international water courses –Development of IWRM in line with legal and regulatory framework.

OUTCOMES:

The students will gain knowledge about economic aspects of water and also broad understanding of the complexities of dealing with water resources problems.

REFERENCES:

1. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2. Technical Advisory Committee, Poverty Reduction and IWRM, Technical Advisory Committee Background paper no: 8. Global water partnership, Stockholm, Sweden, 2003.
3. Technical Advisory Committee, Regulation and Private Participation in Water and Sanitation section, Technical Advisory Committee Background paper No:1. Global water partnership, Stockholm, Sweden, 1998.
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.

Semester: M.Tech - 1

Branch: Civil Engg.

Subject: Water Resources Engg. Lab.

Code: MT04216

Total Marks in End Semester Exam: 70

Course Objective:

1. To compare the result of analytical models introduced in lecture to the actual behavior of real fluid flows
2. To discuss and practice standard measurement techniques of fluid mechanics and their applications
3. To work on small design projects

List of Experiment:

1. To determine the hydrostatic forces on immersed body.
2. To determine the energy losses in pipes.
3. To calculate the cavitation Number.
4. To determine the coefficient of discharge of Orifice meter &Venturimeter
5. Determination of minor losses due to sudden expansion and contraction in a pipe flow
6. To determine the surface profile and total distribution of a forced & free vortex.
7. To study laminar to turbulent flow and determine lower critical Reynolds number.
8. To estimate the discharge of an ogee spillway.
9. To determine the co-efficient of discharge of a weir.
10. To study centrifugal pump in series and parallel.
11. To study velocity distribution in pipe and to compute the discharge by integrating velocity profile.
12. To find out the co-efficient of evaporation using pan-evaporimeter.
13. To determine the depth of rainfall using rain-gauge.
14. To study the characteristics of Reciprocating Pump for variable speeds.
15. Study the characteristics of Francis turbine.

Course Outcome:

Students who successfully complete this course will have demonstrated, the ability to:

1. Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.
2. Produce a working model through hands-on experience in fluid mechanics design and explain its operation in terms of what was learned in the course.

Manuals/Text Book/Reference Book:

1. Fluid Mechanics and Machinery Laboratory-Student reference manual (online) by P.SundaraKumar,M.Tech (PhD)

2.Experiments in Fluid Mechanics: by Singh Sarbjit , PHI Learning Pvt.Ltd.- 2012

3.Fluid mechanics with engineering applications by E.JohnFinnemore and Joseph B.Franzini (10^{th}Edition) textbook of fluid mechanics and Hydraulic machines by Dr.R.K. Bansal-Laxmi Publications

Semester: M.Tech - 1

Branch: Civil Engg.

Subject: Environmental Engg. Lab.

Code: MT04217

Total Marks in End Semester Exam: 70

OBJECTIVES:

To familiarise with the physico chemical characterisation of water and wastewater.

LIST OF EXPERIMENTS:

1. Measurement of pH, Electrical conductivity and Turbidity of water samples
2. Determination of Chlorides in water.
3. Determination of Iron and Fluoride in water
4. Determination of Acidity and Alkalinity of water.
5. Determination of Sulphate in water.
6. Determination of hardness of water
7. Determination of nitrate & TKN in water (demo)
8. Determination of residual chlorine of water
9. Determination of total dissolved solids
10. Determination of optimum coagulant dosage
11. Determination of Ammonia Nitrogen in wastewater.
12. Coagulation and Precipitation process for treating waste water
13. Determination of suspended, volatile, fixed and settle able solids in wastewater.
14. B.O.D. test
15. C.O.D. test
16. Determination of Calcium, Potassium and Sodium.
17. Heavy metals determination -Chromium, Lead and Zinc. (Demonstration only)

OUTCOMES:

The students completing the course will have the ability to use the techniques, skills and modern instruments to determine the quality of water and wastewater.

REFERENCE:

1. Standards Methods for the Examination of Water and Wastewater, 17th Edition, WPCF,APHA and AWWA, USA, 1989.

BHARTI UNIVERSITY, CHANDKHURI, DURG (C.G.)

M.Tech. in Civil Engg. with Specialization in Environmental & Water Resources Engineering

Course of Study — **M. Tech. Second Semester**

S. No.	Board of Study	Subject Code	Subject Name	Periods per week			Scheme of Examination Theory/Practical			Total Marks
				L	T	P	ESE	CT	TA	
1	Civil Engg.	MT04221	Remote Sensing (RS) & Geographical Information System (GIS) in Water Resources	3	1	-	70	10	20	100
2	Civil Engg.	MT04222	Environmental Impact Assessment	3	1	-	70	10	20	100
3	Civil Engg.	MT04223	Advanced Groundwater Hydrology	3	1	-	70	10	20	100
4	Civil Engg.	MT04224	Design of Hydraulic Structures	3	1	-	70	10	20	100
5	**Refer Table-II**		**Elective-II**	3	1	-	70	10	20	100
6	Civil Engg.	MT04226	RS & GIS Lab.	-	-	3	70	-	30	100
7	Civil Engg.	MT04227	Computational Lab.	-	-	3	70	-	30	100
Total				**15**	**5**	**6**	**490**	**50**	**160**	**700**

L: Lecture T: Tutorial

P: Practical ESE: End Semester Exam TA: Teacher's Assessment

CT: Class Test

Table–II

List of Elective–II Subjects (MT04225)		
S.No.	**Subject Code**	**Subject Name**
1	MT04225(1)	Reservoir Operation & System Analysis in Water Resources
2	MT04225(2)	Flood & Drought Management
3	MT04225(3)	Wastewater Management

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Remote Sensing (RS) and GIS in Water Resources **Code: MT04221**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisite: Basic knowledge of hydrology, physics and mathematics.

Objective: To study reflectance of different natural substances and do the interpretation.

Unit – I

Principal of Remote Sensing System: Fundamental laws, atmospheric Windows. EMR, Resolutions.

Unit – II

Spectral Response of Common earth Surface Features, Platform and Sensors, Orbits, Polar Orbiting and geostationary satellites, Multispectral Imaging, Visual interpretation elements, false colour concepts.

Unit – III

Fundamentals of Digital Image processing, image rectification, restoration and registration,

Unit – IV

GIS Fundamentals, vector and raster based GIS, Spatial data sources, Geo-referencing, digitization,GPS (Global Positioning System).

Unit – V

Application: Land cover mapping, reservoir sedimentation studies, Generation of thematic maps,ground water potential zonation map.

Expected Outcome: To apply knowledge of remote sensing for different hydrological, disaster management and hydrological predictions.

Text/Reference Books

1. Remote sensing and GIS. B. Bhatta. Oxford Publications
2. Lillessand and Keifer, Remote Sensing and Image Interpretation, Jhonwiley and Sons.
3. Sabinne, Remote Sensing principles and Interpretations, W. H. Freeman and Company, New York.
4. Burrough and McDonnell, Principles of Geographical Information Systems, Oxford University Press Satellite remote sensing. Wiley, Prof. A. K. Keshari, IIT Delhi 2016

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Environmental Impact Assessment **Code: MT04222**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisite: Not Required.

Objective: To introduce applications of environmental engineering in highways projects.

Unit – I

Introduction: What are EIA, Purpose, and Project types, Inputs and how do environmental impactsarise.

Unit – II

EIA: Process-stages, Project cycle.

Unit – III

Environmental impact assessment (EIA): Environmental statement and target areas fixation, Scooping, Objectives, Air pollution transport models, Noise propagation model.

Unit – IV

Methods for carrying out EIA starting from feasibility studies, Case studies of EIA with specialemphasis on development projects like highways.

Unit – V

Preparation of environmental management plan (EMP) procedure for obtaining environmental c learance, sitting guidelines for industries, public participation in carrying out EIA and EMP.

Expected Outcome: The Student would be able to understand about EIA, Methods for carrying outEIA starting from feasibility studies and Preparation of environmental management plan.

Text Books:

1. Canter, Environmental Impact Assessment, McGraw Hill Inc.

Reference Books:

1. Kadiyali, L. R., Traffic Engineering and Transportation Planning. Khanna Publishers, NewDelhi.
2. Environmental consideration in planning and design of highways in India, IRC, New Delhi

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Advanced Ground Water Hydrology **Code: MT04223**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Pre-requisite: Basic knowledge of hydrology, soil mechanics and fluid mechanics.

Objectives: To gain knowledge in groundwater hydrology and its analysis.

Unit – I

Introduction - Ground water development in India, Soil moisture, Classification of subsurface water, Characteristics of fluid and the Medium, Specific yield, Porosity, Storage co-efficient, Permeability, Compressibility. Aquifers Classification of aquifers.

Unit – II

Darcy‘s law, Range of validity of Darcy‘s law. Co-efficient of permeability. General Hydro-dynamical Equations for the flow of Fluids through Porous media, The Equation of continuity, Equations of motion, Dupuit‘s equations for unconfined seepage flow, Plane free surfaceflow with horizontal impervious base without and infiltration and evaporation, Confined and semi- confined flow.

Unit – III

Unconfined flow towards well with uniform infiltration from the ground surface, Confined radial flow towards the well, Discharge as a function of drawdown, well efficiency, Radius of influence, Lowering of ground water table, Unsteady confined flow, Well losses.

Unit – IV

Ground Water Quality: Water sampling, potable water standards of WHO and BIS. Conjunctive Use ofSurface and Ground Water, Economics of CU, Design of irrigation system &water supply based on CU.

Unit – V

Geophysical Investigations: Surface geophysical techniques, Electrical resistivity, Seismic refraction and reflection, sub surface method, well logging. Making up and production wells, construction and maintenance of tube wells, filter materials and education wells**.**

Expecte outcome: To develop understanding of groundwater mechanism, and apply for **d**

conjunctive use and artificial recharge.

Texts/Reference Books:

1. Ground water Hydrology, Todd D K, John Wiley
2. Ground water H M Raghunath, Wiley
3. Groundwater Science, C R Fitts, Elsevier
4. Hydraulics of groundwater, Bear J, MGH
5. Hydrogeology, Davis and Deweist, John Wiley,
6. Ground water Resources Evaluation, Walton MGH

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Design of Hydraulic Structures **Code: MT04224**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisite: Basic knowledge of hydrology, open channel flow, soil mechanics, and irrigation.

Objective To impart knowledge and skills in design of Hydraulic Structures.

:Unit – I

Geology of Dam sites, reservoirs and tunnels, site investigations and interpretation, treatment of bed foundation.

Unit – II

Gravity dam- forces acting on a dam uplift forces, earthquake effects stability requirements, design criteria and factor of safety, two dimensional analysis, distribution of shear and normal stresses, principle stresses and analysis of gravity dams.

Unit – III

Control of cracking, transverse and longitudinal joints. Galleries in dams. Earth and Rock fill dam: Type, analysis and design.

Unit – IV

Arch dams and Buttress Dams – Characteristics, forces and criteria for safe design, simple trial loadanalysis for arch dams, use of models and recent trends in design.

Unit – V

Design of spillways and outlet works.

Expected Outcome: To design and analyse the Hydraulic Structures.

Texts/Reference Books:

1. Irrigation and Hydraulics Structure, S K Garg, Khanna Publishers
2. Irrigation and Hydraulics Structures, B C Punmia, Laxmi Publishers
3. Irrigation, Hydraulic Structures and Water Power Engineering – K. R. Arora, Standard Publishers and Distributers, Delhi-6

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Reservoir Operations and System Analysis in Water Resources **Code: MT04225(1)**

Total Tutorial Period: 12

Total Theory Period: 40

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Pre-requisite: Basic knowledge of hydrology, fluid mechanics and numerical techniques

Objectives: To understand the operation and planning of reservoir.

Unit – I

Purpose and types of reservoir, principle of reservoir planning, investigations required.

Unit – II

Physical characteristics of reservoir, reservoir yield, fixations of storage capacity of reservoir, floodrouting.

Unit – III

Operation of single and multi-purpose reservoirs, life of reservoir.

Unit – IV

Reservoir sedimentation, reservoir losses, evaporation, allocation of cost of multi-purpose reservoirs.

Unit – V

Introduction to mathematical models for reservoir models.

Expected Outcome: To apply the knowledge in planning and operation of reservoir.

Texts/Reference Books:

1. Irrigation and Hydraulics Structure, S K Garge, Khanna Publishers
2. Irrigation and Hydraulics Structures, B C Punamia, Laxmi Publishers
3. Irrigation, Hydraulic Structures and Water Power Engineering – K. R. Arora, Standard Publishersand Distributers, Delhi-6

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Flood & Drought Management **Code: MT04225(2)**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Pre-requisite: Basin knowledge of hydrology, open channel flow, and soil mechanics.

Objectives: To understand floods, drought and its management.

Unit – I

Floods: Introduction, Rational method, Empirical formulae, Unit hydrograph method, Flood frequency studies Gumbel's method, Log Pearson type III distribution, Partial duration series, Regional flood frequency analysis, Limitations of frequency studies

Unit – II

Flood Routing: Introduction, Basic equations, Hydrologic storage routing, Attenuation, Hydrologicchannel routing Hydraulic method of flood routing, Routing in conceptual hydrograph development,

Unit – III

Flood Management Techniques: Introduction Flood Control and Management, Catchment Area treatment, Structural Measures Non-structural Measures.

Unit – IV

Droughts: Climatic Regions, Arid region, Semi-arid region, humid regions. Drought, Drought and rainfall, Drought classification, Drought, rainfall and temperature. Effects of drought, Effects on ground water, Effects on water quality, Effects on socio economic status.

Unit – V

Flood forecasting, Design flood, Design storm, Flood control in India.

Expected outcome: To apply different flood and drought management techniques in real field Conditions.

Text Books/Reference Books

1. Watershed Hydrology by R. Suresh, Standard Publishers and Distributors, Delhi.
2. Chow V T, Maidment David R. and Mays Larry W. "Applied Hydrology", McGraw Hill International editions, New Delhi, 1988.
3. Mutreja K.N. "Applied Hydrology" Tata McGraw-Hill Publishing company Ltd., New Delhi,1990.
4. Subramanya K, Engineering Hydrology, Third Edition - Tata McGraw-Hill Publishing company Ltd., New Delhi, 2015.

Semester: M.Tech - II **Branch: Civil Engg.**

Subject: Wastewater Management **Code: MT04225(3)**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Unit I Introduction

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial wastesurvey – Industrial wastewater generation rates, characterization and variables – Populationequivalent – Toxicity of industrial effluents and Bioassay tests.

Unit II Industrial Pollution Prevention

Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Source reduction techniques – Waste Audit – Evaluation of pollution prevention options – Environmental statement as a tool for pollution prevention – Waste minimization Circles.

Unit III Industrial Wastewater Treatment

Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal – Refractory organics separation by adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photo catalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.

Unit IV Wastewater Reuse and Residual Management

Individual and common effluent treatment plants – Joint treatment of industrial wastewater – Zero effluent discharge systems – Quality requirements for wastewater reuse – Industrial reuse – Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewateringand disposal of sludge – Management of RO rejects.

Unit V Case Studies

Industrial manufacturing process description – Wastewater characteristics – Source reductionoptions and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing –

Petroleum Refining – Pharmaceuticals – Sugar and Distilleries – Food Processing – fertilizers – Thermal Power Plants and Industrial Estates.

REFERENCES:

1. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill, 1999.
2. Arceivala, S.J., "Wastewater Treatment for Pollution Control", Tata McGraw-Hill, 1998.
3. Frank Woodard, "Industrial Waste treatment Handbook", Butterworth Heinemann,2001.
4. World Bank Group , "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP,1998.
5. Paul L. Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw-Hill International,2000.

Subject: RS & GIS Lab. **Code: MT04226**

Total Marks in End Semester Exam: 70

OBJECTIVE:

- The hands on experiments in the image processing, GIS platforms and GPS will make the students to appreciate their importance in hydrology and water resource.

LIST OF EXPERIMENTS

1. Georefferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
2. Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
3. Creation of Digital Elevation Model using Vertical Mapper.
4. GPS Survey and its data transformation into GIS environment.
5. Converting *.tab file to *.shp& vice versa using Universal Translator.
6. Transformation of Google files to GIS environment.
7. Creation of Vorronoi / Theissen diagram for points using MapInfo/ArcGIS.
8. Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed
9. Delineation.
10. Interpolation of point data to create Spatial Maps.
11. Overlay Analysis using ArcGIS.

OUTCOMES:

- Expertise in digital image processing
- Good exposure to the Global positioning system in real time data processing
- Potential of Geographical Information System
- Data integration between Satellite data, GPS and GIS in Decision Making

Subject: Computational Lab **Code: MT04227**

Total Marks in End Semester Exam:70

Course Objective:

- To provide the keen knowledge to students about all computer applications using in water resourcesengineering
- To make the student strong enough to deal all type of water resources problems

LIST OF EXPERIMENT:

1. To study various application of GIS in water resources.
2. To identify the locations for formulating the reservoirs within watershed.
3. To determine the availability of water in watershed.
4. To determine the peak discharge and plotting of Hydrograph.
5. To analyze the flow in river system.
6. To study the various parameters of sub-surface flow.
7. To study the Ground water flow modeling.
8. To determine the maximum floodplain encroachments.
9. To design the hydraulic structure using MATLAB approach.
10. To identify the artificial ground water recharge sites for confined and unconfined aquifers.
11. To forecast the climate data through statistical approach.

Course Outcome:

- Student will be able to get full knowledge on various computer applications and their usage in waterresources engineering
- Student will be able to do research in various area of water resource engineering through soft computingtechniques.

- **Manuals/Text Book/Reference Book:**

1. “Getting Started with ArcGIS by ESRI”-Bob Booth and Andy Mitchell-2001

2. “US Army Corps, HEC-HMS, River Analysis-Applications Guide”-version 4.1 January 2010

3. Visual MODFLOW-Student version tutorial Guide-Online version

BHARTI UNIVERSITY, CHANDKHURI, DURG (C.G.)

M.Tech. in Civil Engg. with Specialization in Environmental & Water Resources Engineering

Course of Study — **M.Tech. Third Semester**

S. No.	Board of Study	Subject Code	Subject Name	Periods per week			Scheme of Examination Theory/Practical			Total Marks
				L	T	P	ESE	CT	TA	
1	Civil Engg.	MT04231	Eco-Hydrology & Eco-Technology	3	1	-	70	10	20	100
2	**Refer Table-III**		**Elective-III**	3	1	-	70	10	20	100
3	Civil Engg.	MT04233	Preliminary work on Dissertation	-	-	28	140	-	60	200
4	Civil Engg.	MT04234	Seminar Based on Dissertation	-	-	3	-	-	100	100
Total				**6**	**2**	**31**	**280**	**20**	**200**	**500**

L: Lecture T: Tutorial

P: Practical ESE: End Semester Exam TA: Teacher's Assessment

CT: Class Test

Table–III

List of Elective–III Subjects		
S.No.	**Subject Code**	**Subject Name**
1	MT04232(1)	Solid Waste Management
2	MT04232(2)	Climate Change Implication & Remedial Measures
3	MT04232(3)	Irrigation Water Management

Semester: M.Tech - III **Branch: Civil Engg.**

Subject: Eco-Hydrology & Eco-Technology **Code: MT04231**

Total Theory Period: 40 **Total Tutorial Period:12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisites: Basic knowledge of environment and ecology, engineering hydrology is helpful.

Objectives: Gain insight into the balance between ecology and technology. Understand an eco-technological approach for design and operation.

Unit I

Aim, scope and applications of ecology - Development and evolution of ecosystems - Principles and concepts pertaining to communities in ecosystem - Energy flow and material cycling in ecosystems – productivity in ecosystems - Rationale of ecological engineering and eco technology - Classification of Eco-technology

Unit II

Uniform and Non-uniform flow in channels and sewers, Hydrologic cycle and its interaction with human activity, Atmospheric and subsurface water, Surface water, Hydrologic analysis, Hydrologic statistics.

Unit III

Basic concepts of ecosystem dynamics, eco designing, ecotechnological approaches, applicationsof eco technology for societal welfare and sustainable development

Unit IV

Wetland ecosystems ecological significance, natural purifying potential, Constructed Wetlandstheir design, structure, functioning, and applications.

Unit V

Restoration of degraded ecosystems using ecological approach: mined areas and wastelands Building resilience of ecosystems soil fertility management.

Expected **Outcome:** The Student will be able to know the principles, its type and different methods of Eco-Hydrology & Eco-Technology.

Text Books:

1. Mitsch, W.J. and Jorgensen, S.E. 1989. Ecological Engineering: An Introduction to Ecotechnology John Wiley & Sons, New York.
2. Kadlec, R.H., Knight, R.L. 1986. Treatment Wetlands Lewis Publishers, Boca Raton,FL.
3. Environmental Hydraulics of Open Channel Flows, Chanson H., Butterworth – Heinemann
4. Applied Hydrology, Chow, V.T., Maidment, D.R. and Mays, L.W., McGraw Hill Inc.
5. Open Channel Hydraulics, Chow, V.T., McGraw Hill Inc.

Semester: M.Tech - III **Branch: Civil Engg.**

Subject: Solid Waste Management **Code: MT04232(1)**

Total Theory Period: 40 **Total Tutorial Period:12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisites: Basic knowledge of chemistry is helpful.

Objectives: Gain insight into the collection, transfer, and transport of municipal solid waste. Understand the design and operation of a municipal solid waste landfill, resource recovery facility and waste to energy facility.

Unit I

Municipal Solid Waste Management:

Legal and Organizational foundation: Definition of solid waste, waste generation, major legislation, monitoring responsibilities, sources and types of solid waste, sampling and characterization, Determination of composition of MSW, storage and handling of solid waste,Future changes in waste composition.

Unit II

Collection and Transport of Solid Waste:

Waste collection systems, analysis of collection system, alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit III

Process of Solid Waste and Energy recovery:

Unit operations for separation and processing,Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment Energy recovery, Incinerators

Unit IV

Disposal of Solid wastes-Land farming, deep well injections.Landfills: Design and operation including: site selection, Geo environmental investigations , engineered sites, liners and covers, leachate control and treatment, gas recovery and control, including utilization of recovered gas (energy), and

landfill monitoring and reclamation, , Requirements and technical solution

Unit V

Designated waste landfill remediation. Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s off site waste management options. Natural attenuation process and its mechanisms.

References:

1. Handbook of Solid Waste Management by Frank Kreith, GeorgeTchobanoglous, McGrawHill Publication
2. Bagchi, A., Design, Construction, and Monitoring of Landfills, (2nd Ed). Wiley Interscience,1994. ISBN: 0471306819.
3. Sharma, H.D., and Lewis, S.P., Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation. Wiley Interscience, 1994. ISBN: 0471575364.
4. George Techobanoglous et al, "Integrated Solid Waste Management",McGraw Hill Publication, 1993.
5. Charles A. Wentz; " Hazardous Waste Management ", McGraw Hill Publication, 1995.

Semester: M.Tech - III **Branch: Civil Engg.**

Subject: Climate Change Implication & Remedial Measures **Code: MT04232(2)**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam: 70

Minimum of class test to be conducted: 02

Prerequisite: Basin knowledge of physics, mathematics and open channel flow.

Objective: Understanding of climate change phenomenon, and its modelling.

Unit I

Basics of Climate change study: Climate, weather and Climate Change; Overview of Earth's Atmosphere; Layers of Atmosphere; Temperature, Radiation and Variation; Heat-Balance of Earth Atmosphere System; Temporal Variation of Air temperature; Temperature Change in Soil;Thermal Time and Temperature Extremes, Hydrologic cycle, greenhouse effect.

Unit II

Climate Change: Introduction; Causes of Climate Change; Modelling of Climate Change, Global Climate Models, General Circulation Models, Downscaling; IPCC Scenarios, difference between climate change and climate variability.

Unit III

Statistical Methods in Hydro-climatology: Trend Analysis; Empirical Orthogonal Functions, Principal Component Analysis; Canonical Correlation; Statistical Downscaling with Regression.

Unit IV

Climate Variability: Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes.

Unit V

Effect of Climate change on low and high river flows: Trend analysis, climate change projections and its effect on stream flow generation. Effect of glacial retreat on stream flow.Sealevel rise, salt water intrusion.

Expected outcome: Able to use different Climate models, statistical downscaling and its application on river flows.

Recommended Books:

1. Burde, G. I., A. Zangvil, 2001: The Estimation of Regional Precipitation Recycling. Part I:Review of Recycling Models. *J. Climate*,14, 2497–2508.
2. H.vonstorch, A.Navarra, Analysis of Climate Variability, 2nd Edition Springer-Verlag Berlin Heidelberg New York 1999.
3. Von Storch and Zwiers F W, Statistical Analysis in Climatic Research, Cambridge, 1999.
4. McGuffie, K. and Henderson-Sellers, A Climate Modeling Primer, Wily, 2005.IPCC Assessment Report-2015.

Semester: M.Tech - III **Branch: Civil Engg.**

Subject: Irrigation Water Management **Code: MT04232(3)**

Total Theory Period: 40 **Total Tutorial Period: 12**

Total Marks in End Semester Exam:70

Minimum of class test to be conducted: 02

Prerequisite: Basic knowledge of hydrology, open channel flow, and soil mechanics.

Objective: To impart knowledge and skills in basic principles and design of irrigation system.

Unit I

Soil water plant relationship, Irrigation requirements, Irrigation efficiencies. Design of conventional and modern methods of irrigation, Macro-irrigation systems: design of level border,graded border and furrow irrigation systems.

Unit II

Adaptability, advantages, drawbacks, tank and well irrigation systems. Micro-irrigation systems:planning and design of sprinkler and drip irrigation systems.

Unit III

Irrigation of arid lands, Drainage of irrigated land, Salinity of soil, Salinity control, Quality of irrigation water, Contaminants and their effects on various crop types.

Unit IV

Planning and operation of irrigation systems, Conjunctive use of water, Salinity and alkalinitymanagement. Participatory irrigation management, Water management policy

Unit V

EIA and Socio-economic impacts of irrigation project. Different Water Distribution system.

Expected outcome: The Student will be able to know the principles of irrigation, its type anddifferent methods of irrigation.

Texts/Reference Books:

1. Irrigation and Hydraulics Structure, S K Garge, Khanna Publishers
2. Irrigation and Hydraulics Structures, B C Punamia, Laxmi Publishers
3. Irrigation, Hydraulic Structures and Water Power Engineering – K. R. Arora, Standard Publishers and Distributers, Delhi-6.
4. Handbook of Drainage of irrigated areas in India, LBII/WAPCOS (India) Ltd, TechnicalReportno. 5. New Delhi, March 1988.

5 Handbook of irrigation Technology, Vol. II, HermahFlorida.
J. Finkel, CRC press, Inc. Boca Raton,

BHARTI UNIVERSITY, CHANDKHURI, DURG (C.G.)

Tech. in Civil Engg. with Specialization in Environmental & Water Resources Engineering

Course of Study							M. Tech. Fourth Semester			
S. No.	Board of Study	Subject Code	Subject Name	Periods per week			Scheme of Examination Theory/Practical			Total Marks
				L	T	P	ESE	CT	TA	
1	Civil Engg.	MT04241	Dissertation + Seminar	-	-	46	300	-	200	500
Total				**-**	**-**	**46**	**300**	**-**	**200**	**500**

L: Lecture P: Practical

CT: Class TestT: Tutorial

ESE: End Semester Exam TA: Teacher's Assessment