SYLLABUS

OF

M. TECH

(Hydraulics and Water Resources Engineering)

I YEAR

(CBCS)

DEPARTMENT OF CIVIL ENGINEERING

INTEGRAL UNIVERSITY LUCKNOW

SYLLABI AND EVALUATION SCHEME

M. Tech. (Hydraulics and Water Resources Engineering)

(w.e.f. Batch 2020-21)

Semester – I

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			Exam ESE	
								UE	TA	Total		
1	DC	CE566	Open Channel Hydraulics	3	1	-	4	40	20	60	40	100
2	DC	CE556	Water Resources Systems Planning and Management	3	1	-	4	40	20	60	40	100
3	DC	CE557	Advanced Hydraulic Engineering	3	1	-	4	40	20	60	40	100
4	DE		Elective - I	3	1	-	4	40	20	60	40	100
5	DC	CE563	Experimental Method in Water Resources Engineering	-	-	3	2	-	-	60	40	100
Total							**18**					**500**

Semester – II

S. No.	Course Category	Code No	Name of Subject	Periods			Credits	Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			EXAM ESE	
								UE	TA	Total		
1	DC	CE565	Applied Hydrology	3	1	-	4	40	20	60	40	100
2	DC	CE552	Research Methodology	3	1	-	4	40	20	60	40	100
3	DC	CE568	Climate Change Impacts in Water Resources Engineering	3	1	-	4	40	20	60	40	100
4	DC	CE572	Research Paper Presentation and Discussion/Seminar	-	-	-	4	-	-	60	40	100
5	DC	CE567	Computer Methods in Hydraulics and Hydrology	-	-	3	2	-	-	60	40	100
Total							**18**					**500**

TA- Teacher Assessment; **ESE –** End Semester Examination; **CT-** Cumulative Test.
Note: Duration of ESE shall be 03 (Three) hours per subject

M. Tech (Hydraulics and Water Resources Engineering)

List of the Elective Paper:

Elective – I

CE555	Mathematics and Statistics for Hydraulic Engineering
CE558	Modeling Simulation and Optimization
CE560	Advanced Numerical Analysis
CE561	Flood and Drought

Elective – II

CE660	Remote Sensing and GIS in Water Resources Engineering
CE661	Hydro Power Engineering
CE662	Advanced Irrigation Engineering

Elective – III

CE664	Fluvial Hydraulics
CE665	Application of Soft Computing Technique in Hydrology
CE666	River Engineering

Elective – IV

CE668	Hydraulic Structures
CE669	Watershed Management
CE670	Earth and rock fill Dams

TA- Teacher Assessment; ESE- End Semester Examination; CT- Cumulative Test

Note: Duration of ESE shall be 03 (Three) hours per subject.

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE566	**Title of the Course**	Open Channel Hydraulics	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To calculate the flow depth and discharge for use in canal design and other hydraulic structures.						

Course Outcomes	
CO1	Students will learn the type of flow, Different types of equation, Types of Channels and Discharge Calculation.
CO2	Students will learn about the gradually varied flow function and GVF profiles and GVF computations.
CO3	Students will learn about the various type of jump in sloping and rectangular channels and effect on hydraulic structures
CO4	The learner will learn about SPH simulations, unsteady flow, surges, surge tank, water hammer, St. Venant equations, Hydraulic flood routing
CO5	To learn the Design of canals, Theories of design, apron design, design of spillway, design of labyrinth spillway

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Uniform Flow	Uniform flow, Manning's equation, Chezy;s method ,most efficient sections ,non rectangular channels, flow depth and discharge calculation.	08hrs	CO1
2	Gradually Varied Flow	Gradually varied flow functions, standard tables, governing differential equations, Bressi's method, GVF profiles, GVF computations	08hrs	CO2
3	Rapidly Varied Flow	Hydraulic jump in sloping and rectangular channels, non-rectangular channels, overflow spillway, eddi formation, effect on hydraulic structures	08hrs	CO3
4	Unsteady Flow	SPH simulations, unsteady flow, surges, surge tank, water hammer, St. Venant equations, Hydraulic flood routing.	08hrs	CO4
5	Ground Water Hydrology	Design of canals, Theories of design, apron design, design of spillway, design of labyrinth spillway.	08hrs	CO5

Reference Books:

K Subramanya "open channel flow ", McGraw Hill.; 7th Edition 2012

V T Chow , "*open channel hydraulics ",* McGraw Hill Education; 3rd Edition 1981

F.M.White "*Fluid Mechanics ",* Mc-Graw Hill Publications,1st Edition Reprint 2007

e-Learning Source:

https://nptel.ac.in/courses/105105105/

https://nptel.ac.in/downloads/105105104/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	2	2	1	1	1	2	1	1	1
CO2	2	1	2	2	1	1	2	1	1	2	2	1	1	1
CO3	1	1	1	2	2	2	1	1	2	2	1	1	1	1
CO4	1	2	2	1	1	1	2	1	1	1	2	1	1	1
CO5	1	1	1	1	2	2	1	1	2	1	2	2	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE556	**Title of the Course**	Water Resources Systems Planning and Management	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To understand Principles of Systems Analysis in Water Resources Engineering, Resources Planning and Development, Nature of Water Resources Systems and Socio Economic Characteristics • To understand the Principles of Engineering Economy, Capital, Economic and Financial Evaluation and Socio-Economic Analysis • To understand Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Optimization Techniques, Simulation and Multi Objective Optimization. • To understand the Surface Water Storage Requirements, Storage Capacity, Hydropower and Flood Control, Reservoir Operations, Irrigation and Planning of an Irrigation System. • To understand concept of Groundwater management, Conjunctive Use of Water Resources and Design of Water Conveyance and Distribution Systems.					

Course Outcomes	
CO1	Students will be able to explain the principles of system analysis and nature of water resources system
CO2	Students will be able to understand the engineering economy and able to understand the financial evaluation
CO3	Students will be able to understand Linear Programming Models and methods of analysis
CO4	Students will be able to understand the Requirements of Surface Water Storage ,Hydropower and flood control
CO5	Students will be able to understand Groundwater management, Conjunctive Use of Water Resources and design of water conveyance and distribution systems.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Planning and Development, Nature of Water Resources Systems, Socio Economic Characteristics.	08hrs	CO1
2	Economic Analysis of Water Resources System	Principles of Engineering Economy, Capital, Interest and Interest Rates. Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Economic and Financial Evaluation, Socio-Economic Analysis.	08hrs	CO2
3	Methods of Systems Analysis	Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models, Classical Optimization Techniques, Gradient Techniques, Stochastic Programming, Simulation, Search Techniques, Multi Objective Optimization.	08hrs	CO3
4	Water Quantity Management	Surface Water Storage Requirements, Storage Capacity and Yield, , Water Allocations for Water Supply, Hydropower and Flood Control, Reservoir Operations, Irrigation , Planning of an Irrigation System, Irrigation Scheduling.	08hrs	CO4
5	Design of Systems	Groundwater management, Conjunctive Use of Surface and Subsurface Water Resources, Reservoir Design, Design of Water Conveyance and Distribution Systems.	08hrs	CO5

Reference Books:

Chaturvedi, M.C. “Water Resources Systems Planning and Management”, Tata McGraw Hill Pub. Co., N Delhi.

Hall. W.A. and Dracup, J.A. “Water Resources Systems”, Tata McGraw Hill Pub. N Delhi.

James, L.D. and Lee “Economics of Water Resources Planning”, McGraw Hill Inc. N York.

Kuiper, E. “Water Resources Development, Planning, Engineering and Economics”, Buttersworth, London.

Biswas, A.K. “Systems Approach to Water Management”, McGraw Hill Inc. N York.

e-Learning Source:

https://nptel.ac.in/courses/105/108/105108081/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	0	0	0	0	1	0	2	1	0	0		
CO2	2	1	0	0	1	0	0	0	0	0	3	1		
CO3	1	1	3	2	0	0	0	0	1	0	2	0		
CO4	2	2	0	0	0	0	2	0	2	0	0	2		
CO5	2	2	3	1	0	0	2	0	1	0	1	2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE557	**Title of the Course**	Advanced Hydraulic Engineering	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite		**Co-requisite**					
Course Objectives	• To understand the hydraulic engineering principle in various problems of practical world						

Course Outcomes	
CO1	Students are able to understand basic concept of properties of fluid and its application
CO2	Students will learn about basic principle of Gradually Varied flow (GVF), Channel Contractions and its applications
CO3	To apply dimensional analysis to predict physical parameters of model and prototype. To learn the Navies Stokes Equation, Bernoulli's and Euler's equation and its applications.
CO4	To understand the Finite element method, application to potential flow problems, and application to transient problems.
CO5	To understand the concept of Stream function, velocity potential, and Flow dynamics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Fluid Flow	Fluid properties, Forces on immersed bodies, buoyancy, meta centre, flow measurement, shear and normal forces, lift and drag force	08hrs	CO1
2	Free Surface Flows	Free surface equation, governing principles, flow over the hump, width contraction, elevation and transition, GVF profiles, hydraulic jump.	08hrs	CO2
3	Dimensional Analysis	Dimensional analysis and similitude, Buckingham pi theorem, similarity laws, laminar and turbulent flows, navier stokes equation, Bernaulli's and eulers equation	08hrs	CO3
4	Finite Element Method	Finite element method theory, derivation, application to potential flow problems, source sink, application to transient problems, shape functions	08hrs	CO4
5	Potential Flow Theory	Stream function, velocity potential, Gama and beta function, application to seepage problems, flow dynamics, Darcy's law. Ground water flow	08hrs	CO5

Reference Books:

A.K..Jain "*Fluid Mechanics* ", Nem Chand & Bros.; 7th Edition 2012

Modi and seth , "Fluid Mechanics", McGraw Hill Education; 3rd Edition 20

F.M.White "Fluid Mechanics ", Mc-Graw Hill Publications,1st Edition Reprint 2007

e-Learning Source:

https://nptel.ac.in/courses/105105105/

https://nptel.ac.in/downloads/105105104/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2	2	1	3	2	3	2	1	2	2
CO2	2	2	2	2	3	2	3	2	2	2	1	1	2	2
CO3	2	3	1	3	2	3	3	2	3	1	2	2	2	2
CO4	3	2	2	2	1	2	3	2	2	2	1	1	2	2
CO5	1	2	2	2	2	2	2	2	1	2	1	1	2	2

1- Low Correlation; 2- Moderate Correlation; 3- 1Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE555	**Title of the Course**	Mathematics and Statistics for Hydraulic Engineering	**L**	**T**	**P**	**C**
Year	1st	**Semester**	1st	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To understand the application of Multiple Integration, Differential Equation and Conformal Mapping in Hydraulic and Water Resources Engineering • To learn about the application of Distributions, Measures of central tendency, Fractals and application to hydraulic engineering. • To learn about the application of Distributions, Measures of central tendency, Fractals and application to hydraulic engineering. • To learn about the applications of Furrier transform and Integrals in hydraulic and water resources engineering • To learn about the Mathematical modeling in hydraulic and water resources engineering.						

Course Outcomes	
CO1	To understand the basic concept of Multiple Integration, Differential Equation and Conformal Mapping
CO2	To understand the application of Eigen Value and Eigen Vectors and Algorithm in Hydraulic and Water Resources Engineering
CO3	To learn about the application of Distributions, CDF and PDF, Measures of central tendency, Fractals and application to hydraulic engineering.
CO4	To learn about the applications of Furrier transform and Integrals in water resources engineering
CO5	To understand the basic concept of Mathematical modeling in water resources engineering

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Calculus	Multiple integration, spherical coordinate systems, ordinary differential equations, partial differential equations, polar coordinates, conformal mapping.	08hrs	CO1
2	Linear Algebra	Eigen values and eigen vectors, singular value decomposition, orthogonal decomposition, crouts and do littel algorithm, solution of linear equations.	08hrs	CO2
3	Probability and Statistics	Distributions, CDF and PDF, measures of central tendency, application to hydraulic engineering, Fractals.	08hrs	CO3
4	Fourier Transform and Integrals	Fourier and integral transform, Fourier sine series, cosine series, application to decomposition problems.	08hrs	CO4
5	Mathematical Modelling	Numerical methods, Eulers method, Newton's Raphsons method, Gauss Siedel method, Gauss elimination method.	08hrs	CO5

Reference Books:
Shanti Narayan: A Text Book of Martices, S. Chand & Co.
Thomas/Finny: Calculus and Analytical Geometry, Narosa Pub.
Piskunov, M. Differential and Integral Calculus, Moscow Peace Pub.
Jaggi and Mathur: Advanced Engineering Mathematics, Khanna Pub.
e-Learning Source:
https://nptel.ac.in/courses/105105105/
https://nptel.ac.in/downloads/105105104/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	2	1	2	1	2	1	0	0
CO2	2	1	2	1	1	1	1	1	1	1	2	2	0	0
CO3	1	3	2	2	2	1	2	1	1	2	0	2	0	0
CO4	3	2	0	2	1	2	2	1	1	2	2	1	0	0
CO5	2	2	2	2	2	2	1	1	2	1	3	2	0	0

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE565	**Title of the Course**	Applied Hydrology	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	2nd	-	-	3	2
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To analyse the water budget and plan strategies for water conservation and management						

Course Outcomes	
CO1	To understand 'Hydrologic cycle, systems concept, hydrologic model classification; Reynold's Transport Theorem.
CO2	To understand the concept of Thunderstorm Cell model, IDF relationships and measurement of evaporation, energy balance method, ,
CO3	To understand the concept of Hortonian and saturation overland flow, stream flow hydrographs and Unit Hydrograph concept
CO4	To understand the concept of convolution equation; definition and limitations of a UH;
CO5	To understand the basic concept of infiltration and its equation, Groundwater Hydrology, Darcy's law,

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Hydrology	Hydrologic cycle, systems concept, hydrologic model classification; Reynold's Transport Theorem, continuity, momentum, and energy equations; Atmospheric hydrology: atmospheric circulation, water vapor, formation and forms of precipitation, precipitable water, monsoon characteristics in India.	08hrs	CO1
2	Methods of Estimating Rainfall Losses	Thunderstorm Cell model, IDF relationships; factors affecting evaporation, estimation and measurement of evaporation, energy balance method, aerodynamic method, Priestley Taylor method, and pan evaporation; Surface Water: Catchment storage concept.	08hrs	CO2
3	Runoff Estimation	Hortonian and saturation overland flow, stream flow hydrographs, base flow separation, index, ERH & DRH, algorithm for abstraction using Green Ampt equation, SCS method, overland and channel flow modeling, time area concepts, and stream networks; Unit Hydrograph: General hydrologic system model, response functions of a linear hydrologic systems and their interrelationships.	08hrs	CO3
4	Unit Hydrograph	Convolution equation; definition and limitations of a UH; UH derivation from single and complex storms; UH optimization using regression, matrix, and LP methods; Synthetic unit hydrograph, S-Curve, IUH; Subsurface Water: Soil moisture, porosity, saturated and unsaturated flow.	08hrs	CO4
5	Ground Water Hydrology	Richards' equation, infiltration, Horton's, Philip's, and Green Ampt methods, parameter estimation, ponding time concepts; Groundwater Hydrology: Occurrence of groundwater, aquifers & their properties, Darcy's law, permeability, transmissibility, stratification, confined groundwater flow	08hrs	CO5

Reference Books:

K subramanya "*Engineerign Hydrology* ", McGraw Hill.; 7th Edition 2012

V T Chow , "*Apploed hydrology",* McGraw Hill Education; 3rd Edition 1981

F.M.White "*Fluid Mechanics ",* Mc-Graw Hill Publications,1st Edition Reprint 2007

e-Learning Source:

http://nptel.ac.in/courses/105105105/

http://nptel.ac.in/downloads/105105104/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	1	1	2	1	1	1	2	1	0	0
CO2	2	1	2	1	3	1	1	2	1	2	2	2	0	0
CO3	3	1	3	1	2	1	2	1	2	2	1	2	0	0
CO4	2	2	1	2	1	2	2	1	0	1	2	1	0	0
CO5	2	2	2	2	2	2	1	1	2	1	3	2	0	0

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE567	**Title of the Course**	Computer Methods in Hydraulics and Hydrology	**L**	**T**	**P**	**C**
Year	1st	**Semester**	2nd	0	0	3	2
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• Students will learn about the computer programming and computation with MATLAB. • Students will learn about the Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation. • Students will learn about the Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.						

Course Outcomes	
CO1	Students will be able to understand about the application of MATLABin Open channel flow for the Estimation of normal and critical depth etc.
CO2	Students will be able to learn about the Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation.
CO3	Students will be able to learn about the Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exercise 1	Introduction to computer programming and computation with MATLAB. Open channel flow : Estimation of normal and critical depth; uniform flow computations; computation of water surface profile (WSP) gradually varied flow estimation using standard step and direct step methods,	08hrs	CO1
2	Exercise 1	WSP in presence of hydraulic structures; unsteady flow Saint Venant equation, kinematic wave routing, diffusion routing, overland flow; steady and unsteady modeling using HECRAS.	08hrs	CO1
3	Exercise 1	Closed conduit flow: Steady and unsteady state modeling; pipe network analysis; introduction to EPANET/Water CAD. Surface water hydrology:	08hrs	CO2
4	Exercise 1	Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation, time series analysis, frequency analysis, geo-statistics; hydrologic modeling using HECHMS.	08hrs	CO2
5	Exercise 1	Groundwater hydrology: Solving groundwater flow equation saturated and unsaturated flow, Richards' equation, Green Ampt infiltration model; introduction to MODFLOW;	08hrs	CO3
6	Exercise 1	Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling. Laboratory: Programming exercises for the related topics.	08hrs	CO3

Reference Books:

Chow, V.T, Maidment, D.R, and Mays, L.W, Applied Hydrology, Tata McGraw Hill Edition, 2010.

McCuen R.H, Hydrologic Analysis and Design, Prentice Hall Inc. New York, 2005

Terry Sturm, Open Channel Hydraulics, Tata McGraw Hill Pub., 2011.

Mujumdar, P.P. and D. Nagesh Kumar, Floods in a Changing Climate – Hydrologic Modeling, Cambridge University Press, New York, 2012.

Terry Sturm, "Open Channel Hydraulics", Tata McGraw Hill Pub, 2011.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	3	0	3	0	0	0	0	2	0	0	0	0
CO2	2	0	3	0	3	0	0	0	0	2	0	0	0	0
CO3	2	0	3	0	3	0	0	0	0	2	0	0	0	0

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**