JSPM University Pune

Faculty of Science and Technology

School of Civil Engineering and Environmental Sciences

NEP aligned Syllabus

for

M. Tech. (Environmental and Water Resource Engineering)

(Effective from AY: 2023-24)

JSPM University Pune

FACULTY OF SCIENCE & TECHNOLOGY	W. E. F	2024-2025
SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	RELEASE DATE	01/07/2024
FIRST YEAR MASTER OF TECHNOLOGY (ENVIRONMENTAL AND WATER RESOURCE ENGINEERING)	REVISION NO.	0.0 (NEP)

COURSE STRUCTURE (NEP 2020 Aligned)

SEMESTER I (LEVEL 6.5)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PSMC	230GMAM03_01	Probability and Statistics	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PSBC	240GEWM01_01	Water Quality Modelling and Management	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PCC	240GEWM03_01	Solid and Hazardous Waste Management	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	240GEWM04_01	Environmental Impact Assessment and Management	2	-	-	-	30	30	40	50	-	-	-	-	50	2
MMC	-	Multidisciplinary Minor Course- I	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GCSM26_01	Python Programming for Engineers	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IDCB01_01	Design Thinking and Creativity	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	230UENM01_01	Communicative English for Professionals	1	-	2	-	30	30	40	50	-	-	-	-	50	2
RMC	230IRMM01_01	Research Methodology	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	240GEWM24_01	Water Quality monitoring lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
TOTAL			16	1	8	4									**750**	**22**

Sem	Multidisciplinary Minor Course	
I (MMC – I)	Course Code	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	Course Code	230GETM16_02
	Course Name	IoT Basics and Applications

Mr. Mahesh Ananda Lokhande
Programme Coordinator, MTech-ENV

Dr. M. Nithya
Director, School of Civil and Environmental Sciences

Dr. R. S. Deshpande
Dean, Faculty of Science and Technology

Dr. Anuradha S. Deshpande
Associate Dean (Academics)

Prof. B.B. Ahuja
Vice Chancellor, JSPM University Pune

JSPM University Pune

COURSE STRUCTURE (NEP 2020 Aligned)

FACULTY OF SCIENCE & TECHNOLOGY	**W. E. F** — **2024-2025**
SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	**RELEASE DATE** — **01/07/2024**
FIRST YEAR MASTER OF TECHNOLOGY (REGULAR) (ENVIRONMENTAL AND WATER RESOURCE ENGINEERING)	**REVISION NO.** — **0.0 (NEP)**

SEMESTER II

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PCC	240GEWM05_02	Water and Wastewater Treatment	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PCC	240GEWM06_02	Hydrology and Watershed Management	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	240GEWM07_02	Irrigation and Drainage Engineering	3	-	-	-	30	30	40	100	-	-	-	-	100	3
MMC	230GETM16_02	IoT Basics and Applications	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GTEM19_01	Geospatial Analysis	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IINB02_02	Innovation	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	230UENM02_02	Business Communication	1	-	2	-	30	30	40	50	-	-	-	-	50	2
RMC	230IRMM02_02	Research Design and Techniques	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	240GEWM25_02	Advanced Environmental Engineering Lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
IITP/FP/ CEP	240GEWM26_02	Internship / Field Project / Community Engagement Programme	4 to 6 weeks										50	50	50	2
TOTAL			14	1	8	4									**750**	**22**

Note: A **Postgraduate Diploma** will be awarded if a student exits after first year.

For Exit at the end of first year the student must complete: (Total credits = 8)
a) An internship / OJT of 8 - 10 weeks (4 credits)
b) Additional Course 1 (4 credits) (Vocational Skill Course (VSC) / Skill Enhancement Course (SEC))

Sem	Multidisciplinary Minor Course	
I (MMC – I)	Course Code	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	Course Code	230GETM16_02
	Course Name	IoT Basics and Applications

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F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: PSMC	**Course Title:** Probability and Statistics	
Course Code: 230GMAM03_01	**Teaching Scheme:** (2 Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 1 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
1.

Course Objectives:
The course objective of this course is to give students a foundation in statistical and probabilistic analysis, which is usually utilized in a variety of engineering and scientific applications.

Course Outcomes: On completion of the course, learner will be able to
CO1: Understand statistical problem concepts.
CO2: Observe and analyze the behavior of given sample.
CO3: Apply the concept of correlation and regression to find relation between data.
CO4: Learn discrete and continuous probability
CO5: Acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
CO6: Understand of probability principles and be familiar with standard distributions, which can be used to explain phenomena in real life.

Course Contents

Unit I	**Introduction to Statistics**	**(5 Hrs)**
Statistical methods, Scope and limitations, Population and sample, Frequency distribution, Measures of Central Tendency		
Unit II	**Measures of Dispersion**	**(5 Hrs)**
Mean Deviation, Standard Deviation, Coefficient of Variation, Moments, Skewness, Kurtosis		
Unit III	**Correlation and Regression**	**(5 Hrs)**

Coefficient of correlation, Rank correlation, Regression coefficients, Lines of regression		
Unit IV	**Probability Distributions**	**(5 Hrs)**
Binomial Distributions, Mean, Variance and Recurrence formula for Binomial distribution, Poisson Distributions, Mean, Variance and Recurrence formula for Poisson distribution, Normal Distributions		
Unit V	**Statistical Decisions**	**(5 Hrs)**
Significance levels-Tests concerning Mean, Type I & Type II errors, critical region, Null and Alternative hypothesis, Chi-square test for goodness of fit, The T-Test, Confidence interval, Forecasting and time series analysis problems		
Unit VI	**Probability**	**(5 Hrs)**
Review, Dependent and Independent events, Addition & Multiplication Rules, Conditional Probability, Total Probability, Bayes' Theorem and independence		

Learning Resources

Text Books:

1. Gupta, S.C. and Kapoor V.K. "Fundamentals of Mathematical statistics", Sultan Chand and Sons, 1978.

Reference Books:

1. Johnson R and G. Bhattacharya, "Statistics-Principles and methods". John Wiley, NY, 1985.
2. Miller & Freund's, "Probability & Statistics, for Engineers & Scientists", 6th Edition, Pearson Education.
3. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, "An Introduction to Probability and Statistics", John Wiley, second edition, 2001.
4. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press, 2009.

MOOC / NPTEL Courses:

1. NPTEL Course "Introduction to theory of probability", Prof. Mrityunjoy Chakraborty, IIT Kharagpur.

Link of the Course: http://nptel.ac.in/courses/117105085/

2. NPTEL Course "Introduction to probability theory and Statistics", Prof. S. Dharmaraja, IIT Delhi.

Link of the Course: https://onlinecourses.nptel.ac.in/noc22_ma81/preview

3. Swayam Course "Probability and Probability Distribution" by Dr. P. Nagesh.

Link of the Course: https://onlinecourses.swayam2.ac.in/cec23_ma09/preview

Additional Web Resources:

1. https://www.coursera.org/learn/probability-statistics
2. https://www.coursera.org/learn/introductiontoprobability
3. https://www.coursera.org/learn/basic-statistics

JSPM University Pune

F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: PSBC	**Course Title:** Water Quality Modelling and Management	
Course Code: 240GEWM01_01	**Teaching Scheme:** (3 Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1. Basic Environmental Engineering,
2. Fundamentals of Hydrology
3. Fluid Mechanics.

Course Objectives:

- To provide in-depth knowledge of the key physical, chemical, and biological parameters that determine water quality.
- To develop skills in water quality modelling techniques for various aquatic systems.
- To explore integrated management practices aimed at improving and maintaining water quality in natural and artificial water bodies.
- To assess the impact of point and non-point source pollution on water systems.
- To apply theoretical knowledge using water quality simulation models to predict future scenarios and devise mitigation measures.

Course Outcomes: On completion of the course, learner will be able to

CO1: Analyze water quality data using physical, chemical, and biological indicators.
CO2: Develop and apply water quality models for rivers, lakes, reservoirs, and groundwater systems.
CO3: Predict the impact of pollution from both point and non-point sources.
CO4: Design appropriate water quality management strategies for maintaining and restoring water bodies.
CO5: Use computational tools and software for modelling and simulation of water quality scenarios.

CO6: Evaluate water quality policies and their implementation at local, regional, and global levels.

Course Contents

Unit I	**Introduction to Water Quality Modelling**	**7 Hrs**

Water Quality Parameters, Concept of Water Quality Standards: National and international guidelines, Basics of Modelling: Overview of different types of models (e.g., deterministic, stochastic, and empirical models), Model Development Process.

Unit II	**Transport Processes in Water Bodies**	**7 Hrs**

Advection, Dispersion, and Diffusion: Mechanisms and mathematical representation, Mass Balance Approach: Fundamental principle of continuity for modelling pollutant transport, Hydrodynamics of Rivers and Lakes: Flow velocity, mixing processes, stratification, and residence time, Modelling Pollutant Transport in Surface Water

Unit III	**Water Quality Modelling in Rivers and Streams**	**7 Hrs**

One-Dimensional River Models: Introduction to QUAL2K, WASP, and other commonly used software, Oxygen Demand and Reaeration: BOD-DO modelling, Streeter-Phelps equation, Nutrient Cycling: Nitrogen and phosphorus dynamics in rivers, Pollutant Source Identification and Control.

Unit IV	**Water Quality Modelling in Lakes and Reservoirs**	**8 Hrs**

Two-Dimensional and Three-Dimensional Models, Eutrophication Modelling: Causes, effects, and control of nutrient enrichment, Phytoplankton and Algal Growth Modelling, Thermal Stratification and its Impact on Water Quality.

Unit V	**Groundwater Quality Modelling**	**8 Hrs**

Groundwater Flow and Contaminant Transport: Darcy's Law, advection-dispersion equation, Source of Contamination in Groundwater, Modeling Tools: Overview of MODFLOW and MT3DMS, Groundwater Remediation Strategies.

Unit VI	**Water Quality Management and Case Studies**	**8 Hrs**

Water Quality Monitoring and Assessment, Integrated Water Quality Management, Climate Change and Water Quality, Case Studies: Ganga Action Plan, Chesapeake Bay, etc., Emerging Contaminants and Modelling Challenges.

Learning Resources

Text Books:

1. Thomann, R. V., & Mueller, J. A. (1987). Principles of Surface Water Quality Modeling and Control. Harper & Row.
2. Schnoor, J. L. (1996). Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil. Wiley

Reference Books:

1. Chapra, S. C. (2008). Surface Water Quality Modeling. Waveland Press.
2. Bear, J. (1972). Dynamics of Fluids in Porous Media. Dover Publications.
3. WHO Guidelines for Drinking Water Quality (4th Edition).

MOOC / NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc24_ag06/preview

JSPM University Pune F.Y. M. Tech "Environmental and Water Resource Engineering" Semester I		
Course Type: PCC	**Course Title:** Solid and Hazardous Waste Management	
Course Code: 240GEWM03_01	**Teaching Scheme:** (2 Hrs. / Week)	**Examination Scheme:**
Credits: 2.5	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Theory:** 100 Marks
Prerequisite Courses, if any: 1. Basics of Environmental Science		
Course Objective: Learners will be able to ● To provide an in-depth understanding of the types, sources, and characteristics of solid and hazardous wastes. ● To analyze the various methods of waste collection, transportation, processing, and disposal. ● To explore advanced technologies for resource recovery, recycling, and energy generation from waste. ● To evaluate the design, operation, and environmental impact of landfills and other waste disposal methods. ● To understand the principles and practices of hazardous waste management, including treatment, storage, and disposal. ● To discuss contemporary issues, regulatory frameworks, and emerging technologies in solid and hazardous waste management.		

Course Outcomes: At the end of course, Students will be able to
CO1: Classify different types of solid and hazardous wastes and understand their sources, characteristics, and environmental impacts.
CO2: Design and evaluate waste collection and transportation systems for efficiency and environmental compliance.
CO3: Apply advanced waste processing techniques for material recovery, recycling, composting, and energy generation.
CO4: Develop and assess landfill designs, including leachate and gas management systems, with a focus on post-closure care.
CO5: Manage hazardous wastes by selecting appropriate treatment technologies and ensuring compliance with regulatory requirements.
CO6: Analyze contemporary challenges in waste management and propose innovative solutions using emerging technologies and sustainable practices.

Course Contents

Unit I	**Introduction to Solid Waste Management**	**(5 Hrs)**
Types and Sources of Wastes: Municipal solid waste (MSW), industrial, agricultural, and hazardous wastes, Waste Generation and Composition, Environmental Impacts of Improper Waste Management, Regulatory Framework.		
Unit II	**Waste Collection, Transportation, and Storage**	**(5 Hrs)**
Waste Collection Systems: Types (curbside, community bins), routes, and collection frequency, Waste Handling and Separation: Source segregation, on-site handling, and storage, Transportation of Waste: Vehicle types, route optimization, and economics of waste transport, Transfer Stations.		
Unit III	**Solid Waste Treatment and Disposal Methods**	**(5 Hrs)**
Mechanical and Biological Treatment (MBT): Composting, anaerobic digestion, and mechanical separation, Thermal Treatment: Incineration, pyrolysis, and gasification technologies, Landfills: Design, operation, and closure of sanitary landfills. Leachate and landfill gas management, Recycling and Resource Recovery: Materials recovery facilities, waste-to-energy systems, and circular economy practices.		
Unit IV	**Hazardous Waste Management**	**(5 Hrs)**
Classification and Characteristics of Hazardous Waste: Toxicity, reactivity, ignitability, corrosivity, and persistence, Hazardous Waste Treatment, Hazardous Waste Disposal, Regulations for Hazardous Waste Management.		
Unit V	**Emerging Technologies and Sustainability in Waste Management**	**(5 Hrs)**
Integrated Solid Waste Management (ISWM), Innovative Technologies: Plasma gasification, bio-electrochemical systems, and advanced thermal conversion processes, Zero Waste Strategies, Life Cycle Assessment (LCA) of Waste Systems.		
Unit VI	**Case Studies and Waste Management Policies**	**(5 Hrs)**
Case Studies: Examples from developed and developing countries (Eg. Japan, Sweden, India etc.), Urban Solid Waste Management in Indian Cities, Policy and Governance, Waste Management during Disasters.		

Learning Resources
Test Books: 1. "Integrated Solid Waste Management: Engineering Principles and Management Issues" by George Tchobanoglous and Frank Kreith. 2. "Solid Waste Engineering" by William A. Worrell and P. Aarne Vesilind. 3. "Hazardous Waste Management" by Michael D. LaGrega, Phillip L. Buckingham, and Jeffrey C. Evans.
Reference Books: 1. "Handbook of Solid Waste Management" by George Tchobanoglous and Frank Kreith. 2. "Solid and Hazardous Waste Management" by M. N. Rao, Razia Sultana published by Oxford University Press
MOOC / NPTEL Courses: 1.https://archive.nptel.ac.in/courses/105/106/105106056/ 2.https://mohua.gov.in/publication/manual-on-solid-waste-management-systems-cpheeo-2016.php

JSPM University Pune F.Y. M. Tech "Environmental and Water Resource Engineering" Semester I		
Course Type: PCC	**Course Title:** Environment Impact Assessment and Management	
Course Code: 240GEWM04_01	**Teaching Scheme:** (2 Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 02 **Tutorial (T):** 00 **Practical (P):** 00 **Experiential Learning (EL):** 00	**Theory (TH) :** 100 Marks
Prerequisite Courses, if any: 1. Basic knowledge of environmental engineering and environmental project planning		
Course Objective: ● Understand the ecological stability and ecological systems concept and formulate the real problem due to manmade developmental activities ● Select Environmental, Economic and social indicators, collect data and conduct analysis. ● Select appropriate technique and methodology to carry out Environmental Impact Assessment		
Course Outcomes: At the end of course, Students will be able to **CO1:** Understand the EIA as integral part of planning process **CO2:** Explore the concept and methodology of EIA and its documentation. **CO3:** Select Environmental, Economic and social indicators, collect data and conduct analysis for assessing the EIA **CO4:**Select appropriate technique and methodology to carry out Environmental Impact Assessment **CO5:** Predict and assess the impact of environment and mitigation strategies **CO6:** Explore the environmental management plan and post processing of EIA		
Course Contents		
Unit I	**Introduction to EIA**	**(7 Hrs)**

Environment and its interaction with human activities – Environmental imbalances, impacts, Definition of environmental impact assessment (EIA), Concepts, Methodologies, Screening, Scoping, Mitigation, Matrices, Check list, EIA- As An Integral Part of The Planning Process, General flow chart of EIA		
Unit II	**Methods for impact assessment**	**(8 Hrs)**
Background information, interaction matrix methodologies, network methodologies, etc. environmental setting various factors, environmental impact assessment methodology, environmental indices and indicators for describing affected environment, Life cycle assessment		
Unit III	**Prediction and assessment of impact for air and noise environment**	**(7 Hrs)**
Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.		
Unit IV	**Prediction and assessment of impact for water and soil environment**	**(7 Hrs)**
Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.		
Unit V	**Prediction and assessment of impact on cultural and socioeconomic environment**	**(8 Hrs)**
Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.		
Unit VI	**Environmental management plan**	**(8 Hrs)**
EIA clearance, Provisions in the EIA notification, Categorization of Industries for seeking environmental clearance from concerned authorities, environmental clearance and EIS report, Comprehensive EIA, Environmental management plan, post environmental monitoring, Case studies of EIA		

Learning Resources

Textbooks:

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.

References:

1. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988).
2. Environmental Impact Analysis – A Decision Making Tool by R K Jain

MOOC / NPTEL Courses:

1. Swayam Course “Environmental Impact Assessment for Environmental Health”, Prof. B. Rupini & Dr. Sushmitha Baskar, (Link of the Course: https://onlinecourses.swayam2.ac.in/nou22_bt06/preview)

2. NPTEL course “Environmental Impact Assessment”, Prof. Harshit Sosan Lakra (Link of Course: https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ar07/)

JSPM University Pune

F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: MMC	**Course Title:** Sensors & Automation	
Course Code: 230GRAM24_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic Electronics
2. Instrumentation & Control

Course Objectives:

- Study of means of measuring various physical variables using sensors.
- Study of various kinds of actuators.
- Introduce technologies related to upcoming Industry 4.0 paradigm.
- To prepare the learner for a career in industrial automation.

Course Outcomes: On completion of the course, learner will be able to…

CO1: Identify sensor characteristics, calibration and error analysis
CO2: Understand how different physical variables are measured
CO3: Identify different types of actuators and their implementation
CO4: Understand Hydraulic and Pneumatic actuators
CO5: Explain scope and benefit of industry 4.0 technologies.
CO6: Plan, design and implement automation systems

Course Contents

Unit I	**Instrumentation & Sensors characteristics**	**(3Hrs)**

Instrumentation & Sensors: Significance of Sensor Measurements, Classification of sensors based on domain, technology and operation.
Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.
Dynamic Characteristics: Sensor bandwidth and frequency response.
Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering

Unit II	Measurements	(3Hrs)
Proximity and Distance Measurement: Limit Switch, Reed switch, Inductive, Capacitive, Hall Effect Sensors, Optical and Ultrasonic distance measurement. **Displacement Measurement:** Transducers for displacement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder). **Measurement of Angular Velocity:** Tachometers, Digital tachometers and Stroboscopic Methods. MEMS 3 axis Gyroscope. **Acceleration Measurement: T**heory of accelerometer and vibrometers, accelerometers, strain gauge based and piezoelectric accelerometers. MEMS 3 Axis Accelerometer.		
Unit III	**Electrical Actuating systems**	**(2Hrs)**
Electrical Actuating systems: **DC motors:** Review of DC motor, Modelling of DC motor behaviour, Servo Amplifier, DC motor drive. DC Servo Motors. **Stepper Motors:** Characteristics of a Stepper motor, Classification of a Stepper motor, Principle of Operation, Step Angle, Electrical model of energized coil, Drive method, Stepper motor performance.		
Unit IV	**Pneumatic and Hydraulic actuating systems**	**(2Hrs)**
Pneumatic and Hydraulic actuating systems: Components of pneumatic and hydraulic systems, pumps, compressor, filter, control valves, pressure regulation, relief valves, accumulator. Single Acting and Double acting cylinders, Hydraulic motors. Simple single actuator circuits. Harmonic drive, Comb drive.		
Unit V	**Industry 4.0 and Evolution of automation**	**(3Hrs)**
Industry 4.0: Industrial Revolutions 1,2,3,4, Productivity in Manufacturing, how manufacturing changed at each IR, Work Study & motion study, Need and Types of Automation, **Evolution of automation: Automation hierarchy.** Relentless increase in computational power (Moore's law), basket of technologies, which make up Industry 4.0. Reference Architecture Model of Industry 4.0 (RAMI)		
Unit VI	**Automation Circuits**	**(2Hrs)**
Automation Circuits: Introductory Principles in Designing, Electrical and mechanical latch, Logical Design of Automation PLC and SCADA. **Case Studies:** Data Acquisition & Control Systems in Process Plants like chemical, railways and defence applications **Communication: C**ommunication protocols, Device Interfaces		

Learning Resources

Text Books:

1. Clarence W Silva, "*Sensors and Actuators: Control System Instrumentation*", CRC Press USA.
2. Frank Lamb, "*Industrial Automation Hands-On*", McGraw Hill Education 2013.

Reference Books:

1. E.O. Doebelin, "*Measurement Systems (Applications and Design)*", McGraw Hill., 5th Ed.
2. A. Smaili and F. Mrad, "*Applied Mechatronics*", OXFORD university press.
3. Thomas Beckwith, N.Lewis Buck, "*Mechanical Engineering Measurement*", Roy Marangoninarosa Publishing House, Bombay
4. Kataria Sanjay *"Industrial Automation Solutions For Plc, Scada, Drive And Field Instruments: Easy To Learn Industrial Automation"*
5. Arshadeep Bagha , Vijay Madisetti "I*nternet of Things A Hands-on Approach*", Universities Press 2018

MOOC / NPTEL Courses:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/112/107/112107242/
3. https://nptel.ac.in/courses/108105088
4. https://nptel.ac.in/courses/106105195

JSPM University Pune F.Y. M. Tech "Environmental and Water Resource Engineering" Semester I		
Course Type: MMC	**Course Title:** Sensors & Automation	
Course Code: 230GRAM24_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments (Minimum 10)	
Group A	
1.	Characterization of Temperature Sensor (RTD).
2.	Linear Conveyor Control System
3.	Study of Two-Dimensional Position Control
4.	Demonstration of Electro hydraulic Controls through Trainer Kit
5.	Characterization of Linear Variable Differential Transformer (LVDT) (Virtual Lab) https://sl-coep.vlabs.ac.in/exp/characterize-temperature-sensor/
Group B	
6.	Demonstration of Electro pneumatic Controls through Trainer kit
7.	Study of Rotary Encoder for Speed & angle measurement
8.	Data acquisition system
9.	Demonstration of Programmable Logic Controller (PLC) based Servo motor Controller

Group C	
10.	Characterization of Strain Gauges (virtual Lab) https://sl-coep.vlabs.ac.in/exp/strain-gauge-sensor/

Virtual LAB Links:

1. Lab Name: COEP, Pune

https://sl-coep.vlabs.ac.in/exp/characterize-temperature-sensor

https://sl-coep.vlabs.ac.in/exp/strain-gauge-sensor

JSPM University Pune
F.Y. M. Tech. "Environmental and Water Resource Engineering"
Semester I

Course Type: SEC	**Course Title:** Python Programming for Engineers	
Course Code: 230GCSM26_01	**Teaching Scheme:** (Hrs./ Week)	**Examination Scheme:**
Credits: 3	**Lecture (L): 2** **Tutorial (T): 0** **Practical (P): 2** **Experiential Learning (EL): 0**	**Practical (PR):** 50 Marks **Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To introduce basic concepts of Python programming language as well as common packages and libraries.
- To generate an ability to design, analyze and perform experiments on real life problems in mechanical engineering using python

Course Outcomes: On completion of the course, learner will be able to
CO1: To understand of basic concepts of python programming**.**
CO2: Illustrate the process of structuring the data using lists, tuples.
CO3: Identify, install and utilize python packages.
CO4: Demonstrate the use of built-in functions to navigate the file system.
CO5: Implement the Object-Oriented Programming concepts in Python.
CO6: Develop and build python program to solve real-world engineering problems

Course Contents

Unit I	**Introduction**	**4 Hrs**
Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.		
Unit II	**Python Complex Data Types**	**5 Hrs**

Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, organizing python codes using functions.

Unit III	**Program Flow Control in Python**	**6 Hrs**

Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, for loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

Unit IV	**Python Object Oriented Concepts**	**5 Hrs**

Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example, The init method, The_str method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation,

Unit V	**Basics Python Libraries**	**5 Hrs**

Python libraries: Installing of different libraries, packages or modules. Basic concepts of the following libraries: NumPy, Matplotlib, Pandas, SciPy.
Case Study1- Solve Mechanical Engineering problems using Python.

Unit VI	**Advanced Python Libraries**	**5 Hrs**

Optional libraries based on case studies: Pillow, Scikit, Open CV, Python in Raspberry Pi. **Case Study -2** Solving a linear differential equation using SciKit and plotting the result in matplotlib. Students can use differential equations from any previous topic studied in the programme such as mechanics, materials science, fluid mechanics, kinematics of machines, thermodynamics, production etc**.**

Learning Resources

Text Books:

1. Dr. R. NageswaraRao," *Core Python Programming*", Dreamtech Press

2. M.T.Savaliya and R.K.Maurya*," Programming through Python*," StarEdu Solutions

Reference Books:

1. James Payne, "*Beginning Python: Using Python 2.6 and Python*" Wrox publication.

MOOC / NPTEL Courses: https://onlinecourses.nptel.ac.in/noc19_cs41/preview

Additional Web Resources:
http://docs.python.org/release/3.0.1/tutorial/

JSPM University Pune
F.Y. M. Tech. "Environmental and Water Resource Engineering"
Semester I

Course Type: SEC	**Lab Course Title: :** Python Programming for Engineers	
Course Code: 230GCSM26_01	**Teaching Scheme:** (Hrs./ Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):2** **Experiential Learning (EL):0**	**Practical (PR):** 50 Marks **Oral (OR):** 50 Marks

Prerequisite Courses, if any: -No

List of Laboratory Experiments	
Group A	
1.	Install and configure Python IDE and Write simple Python program to display message on screen
2.	**Arithmetic Operations**: Write simple Python program using operators: a) Arithmetic Operators b) Logical Operators c) Bitwise Operators
3.	**Data Types:** Write Python program to perform following operations on Lists, tuples, dictionary a) Create b) Access c) Update d) Delete
4.	**Control Statements Loops**: Write simple Python program to demonstrate use of conditional statements: a) 'if' statement b) 'if … else' statement c) Nested 'if' statement Write Python program to demonstrate use of looping statements 'while' loop b) 'for' loop c) Nested loops
5.	**Built-in Functions**: Write Python program to demonstrate math built- in functions (Any 2 programs)
Group B	
6.	**Classes and Objects:** Write Python program to demonstrate object-oriented concepts.
7.	**Built-in Modules:** Write Python program to demonstrate use of: a) Built in module (e.g., keyword, math, number, operator)

8.	**Built in Packages:** NumPy, Matplotlib, Pandas, SciPy- Write Python program

	to demonstrate use of: a) built-in packages (e.g. NumPy, Pandas) b) user defined packages
Group C	
9.	**Advanced Python Library:** OpenCV
10.	**Case Study Report:** Solving a linear differential equation using SciKit and plotting the result in matplotlib.

Virtual LAB Links:

1. Lab Name: https://python-iitk.vlabs.ac.in

JSPM University Pune

F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: VSC	**Course Title:** Design Thinking and Creativity	
Course Code: 230IDCB01_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 1.5	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Oral (OR):** 50 marks

Prerequisite Courses, if any: -

Course Objectives:

Course Outcomes: On completion of the course, learner will be able to
CO1: Describe the Design thinking principles of Human Centered approach to real life problem solving
CO2: Demonstrate through the project-oriented approach the basic theories and knowledge of design thinking and master the tools and principles of design thinking, and their application.
CO3: Experiment with design thinking principles to come up with innovative solutions to the problems, as new products, services, experiences, or new Business models.
CO4: Analysis of various applications of design thinking.
CO5: Determine the suitable design thinking approach to solve the problem.
CO6: Develop a low fidelity prototype of the alternative Solutions to the identified Problem

Course Contents

Unit I	**Design Thinking Introduction**	**(3 Hrs)**

Introduction & definition of design thinking, Principles, the process, Innovation in design thinking, importance of design thinking method, the relationship between design thinking and innovation & entrepreneurship. Five step method of Design thinking (Empathize, Define, Ideate, Prototype, Test).
Class Activity: Students are asked to form groups. Classroom Project begins: Share ideas with team members, discuss about meaning of DT, it"s importance in today"s world.
Case: ABC Nightline- IDEO Shopping Cart, (the video can be shown in classroom for discussion.)

Unit II	**Awareness of the five stages of design thinking, Empathize & Define**	**(5 Hrs)**

Stage 1 & 2: Empathize & Define
Introduction of the tools in the stage of empathy. Emphasize the skills and tactics of interviews. Understand the persona, Methods of collecting the data from interviews. The empathy map. Establishing the Problem statement using 5 Why"s technique as a tool to understand the root cause.
(Ex.26/11 attack, rescue team not able to move with ambulance due to stagnation) & Emphasis on establishing the "Problem Statement" only for faculty ref.

Classroom Project: Each group will write the Problem Statement by using Stages of Empathy and technique of 5 Why"s.
Each group member will do the interview round for writing the problem statement.
Take record of the interview process.

Unit III	**Ideate**	**(5 Hrs)**

Stage 3, Ideate
Process to Find and select ideas, The creative process and creative principles, Creativity techniques, Evaluation of ideas. Idea Generation Stage-Fine tuning process of ideas (every team member comes up with 1 idea and passes on to next person, each idea will be fine-tuned by each team member and ultimately matured ideas are established- round robin method) and selection of best three ideas by voting method.

Classroom Project: Through the project, students will know how to propose the point of view (POV) statement based on the analyses of data from user research via the brainstorm and others.
Students are asked to submit ideas as many as possible.
Note in POV practice: please define the problem which each group is finally going to resolve.
The practice process: unpack the interview data, select one interviewee as analysis target and solution. Make inferences to generate ideas and POV statement. Please remember:
No solution in the POV statement.

Unit IV	**Prototype & Test**	**(4 Hrs)**

Stage 4 and 5, Prototype & Test
Prototype and test stage, Prototype model, The role of prototype and test in the innovation and entrepreneurship. prototype and the way to test, visualization of ideas.
Classroom project: groups design the prototype to show ideas about the innovative way to resolve the problem in the dormitory life.
Concerning the test practice: Ask other group to visit your group and test your prototype, and then in turn.

Unit V	**Understanding Business Viability**	**(3 Hrs)**

Checking the Business viability of selected ideas derived in stage 3 using BXT model, Tools for the Design Journey, Pillars of Design thinking.

Unit VI	**Presentation and closure**	**(3 Hrs)**

The student groups will give the final presentation of the project they have done (Unit 1 to 5) and close the DT process.

Learning Resources
MOOC / NPTEL Courses: **Additional Web Resources:** 1. How design thinking is transforming lives in rural India - https://www.youtube.com/watch?v=EH9u1bHqwpc. 2. Design Thinking in Netflix | | Case Studio - 04 - https://www.youtube.com/watch?v=8P8gspd_Bx8)

JSPM University Pune

F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: AEC	**Course Title:** Communicative English for Professionals	
Course Code: 230UENM01_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Theory (TH): 50 Marks**

Prerequisite Courses, if any: -

Course Objectives:

- **Remember** the different aspects of communication.
- **Understand** basics of grammar, sentence construction and vocabulary to write and speak effectively.
- **Apply** appropriate modes of expressions in written and oral communication.
- **Analyze** the attitude and aptitude of the speaker in the professional sphere for effective listening skill.
- **Evaluate** the non-verbal clues of the speaker for effective communication.
- **Cultivate** students to create commendable personalities.

Course Outcomes: On completion of the course, learner will be able to
CO1: Understand and practice different types of communication.
CO2: Reflect on basic language skills-listening, speaking, reading, and writing and attempt tasks by using functional grammar and vocabulary effectively.
CO3: Reproduce their understanding of concepts/principles of business communication skills.
CO4: Build relationships, solve problems, ensure understanding, resolve conflicts, and improve accuracy.
CO5: Become more self-confident and develop a strong determination.
CO6: Build social skills with ease and comfort.

Course Contents

Unit I	**Foundation of Communication**	**(3 Hrs)**
Importance and types of Communication, Types of communication: Verbal and Non-verbal, Channels of communication, Barriers to Effective Communication and ways to mitigate.		
Unit II	**Language Competency/Functional English**	**(3 Hrs)**
Basic rules of Phonics, Parts of Speech, Sentence Constructions, Prefixes and Suffixes		

Unit III	**Business Communication at Workplace**	**(2 Hrs)**
Types of business letter, Characteristics of good business letter, Letter Components and Layouts, Email Communication, memo		
Unit IV	**Mindful Listening**	**(2 Hrs)**
The purpose and types of listening, Principles of effective listening, Ways to improve listening skills, Role of Active listening in professional interactions and conflict resolutions		
Unit V	**Art of Effective Verbal Interaction**	**(2 Hrs)**
Identifying common fears and anxieties related to speaking, Techniques to build confidence and overcome stage fright, Voice modulation, pitch, and pace for engaging delivery, Impromptu Speaking		
Unit VI	**Effective Body Language**	**(3 Hrs)**
Basic Principles of Body Language and Nonverbal Communication, Signs and Clusters, Kinesics & Proxemics, Gesture & Posture		

Learning Resources
Textbook: 1. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
Reference Book: 1. Carnegie, Dale. The Quick and Easy Way to Effective Speaking. New York: Pocket Books, 1977. 2. Mitra, Barun. Personality Development & Soft Skills, New Delhi: Oxford Press, 2011
MOOC / NPTEL Course: N NPTEL Course “Developing Soft Skills and Personality” by Prof. T Ravichandran, IIT Kharagpur **Link of the Course:** https://nptel.ac.in/courses/109104107 **Additional Web Resources:** https://www.britishcouncil.in/english/online/resources-websites/moocshttps://www.dailywritingtips.com/

JSPM University Pune F.Y. M. Tech "Environmental and Water Resource Engineering" Semester I		
Course Type: AEC	**Course Title:** Communicative English for Professionals	
Course Code: 230UENM01_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks
Prerequisite Courses, if any: - Nil		
List of Laboratory Experiments		
Group A		
1.	Phonics	
2.	Parts of Speech	
3.	Presentation Skills	
4.	Tenses	
5.	Verbal and Non-verbal Communication	
Group B		
6.	Listening Skills	
7.	Reading Skill	
8.	Body Language	
9.	Formal Writing	
10.	Email Writing	
Virtual LAB Links:		

JSPM University Pune

F.Y. M. Tech "Environmental and Water Resource Engineering"

Semester I

Course Type: RMC	**Course Title:** Research Methodology	
Course Code: 230IRMM01_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 marks

Prerequisite Courses, if any: -

Course Objectives:

- To develop a research orientation among the students and to acquaint them with fundamentals of research methodology, research process and research design
- To develop skills in effectively searching for relevant literature sources and familiarize with formulation of research hypotheses
- To establish an understanding of various data types, data collection methods, and the importance of research ethics and integrity.
- To acquaint students with the process of crafting research reports and thesis

Course Outcomes: On completion of the course, learner will be able to

CO1: Demonstrate Proficiency in Research Fundamentals
CO2: Identify and Frame Research Problems
CO3: Conduct Comprehensive Literature Reviews and Formulate Testable Hypotheses
CO4: Collect and Differentiate the Types of Research Data
CO5: Practice Ethical Research Conduct
CO6: Create Effective Scientific Papers Through the Application of Scientific Writing Principles

Course Contents

Unit I	**Introduction to Research**	**(5 Hrs)**
Meaning and Definition of Research, Objectives of Research, Characteristics of Research Need of Research, Importance of Research, Types of Research		
Unit II	**Problem Identification & Formulation**	**(5 Hrs)**
Research Process, Research design, Defining the Research Problem, Formulation of Research Problem, Errors in selecting Research Problem, Research Questions, Research Methods vs. Research Methodology		

Unit III	Literature Review and Hypothesis	(5 Hrs)
Literature Review Concepts and Theories, Meaning of Hypothesis and Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis		
Unit IV	**Research Data**	**(5 Hrs)**
Sampling Design and Types and Techniques, Types of Data, Methods of Data Collection, Questionnaires, Observation Method and Interview Method, Case Study Method		
Unit V	**Ethics in Research**	**(5 Hrs)**
Ethics in conduct of Research, Ethical challenges in Data Collection, Ethical issues in scientific Publication, Plagiarism and Self-Plagiarism, Cases of Scientific Misconduct		
Unit VI	**Scientific Writing**	**(5 Hrs)**
Preparation of Title, Keywords and Methods Section, Preparation of Figures and Schematics, Citations and Referencing, Report writing and Presentation, Layout of a Research Paper, Research Journals and its Impact factor, Research Metrics.		

Learning Resources

Text Books:

1. Wayne Goddard, Stuart Melville, "*Research Methodology: An Introduction*", Juta, Lansdowne, Second Edition.
2. Ranjit Kumar "*Research Methodology*: A Step-by-Step Guide for Beginners", SAGE Publications Pvt. Ltd Fourth Edition.
3. Dr. C. R. Kothari, "*Research Methodology: Methods and Trends*",

Reference Books:

1. Nicholas Walliman, *"Research Methods: The Basics",* Routledge – Taylor and Francis Group, Third Edition.
2. Vinod Chandra, Anand, Hareendran "*Research Methodology*", Pearson 1st Edition
3. Dr. Prabhat Pandey, Dr. Meenu Mishra Pandey, "Research Methodology: Tools and Techniques", Bridge Center, 2015.
4. Alan Bryman & Emma Bell, "*Business Research Methods*", Oxford University Press, Third Edition.

MOOC / NPTEL Courses:

1. NPTEL Course "*Research Methodology*", Prof. Edamana Prasad, Prof. Prathap Haridoss, IIT Madras.

Link of the Course: https://onlinecourses.nptel.ac.in/noc23_ge36/preview

2. NPTEL Course "*Research Methodology*", Prof. Soumitra Banerjee, IISER Kolkata.

Link of the Course: https://archive.nptel.ac.in/courses/127/106/127106227/

Additional Web Resources:

4. https://www.coursera.org/learn/research-methods
5. https://www.coursera.org/specializations/data-collection
6. https://www.coursera.org/learn/introduction-to-academic-writing

JSPM University Pune F.Y. M. Tech "Environmental and Water Resource Engineering" Semester I		
Course Type: LC	**Lab Course Title:** Water Quality monitoring lab	
Course Code: 240GEWM24_01	**Teaching Scheme:** (2 Hrs. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 0 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks
Prerequisite Courses, if any: -		
List of Laboratory Experiments		
Group A Test		
1.	Determination of pH from given waste water sample	
2.	Determination of Alkalinity from given waste water sample	
3.	Determination of Solids	
4.	Determination of Oil & Grease from given waste water sample by separating funnel method	
Group B Test		
5.	Determination of Dissolved Oxygen (D.O.) from given water sample by Wrinkler's Iodometric method.	
6.	Determination of Chloride content of given waste water sample	
7.	Determination of Biochemical Oxygen Demand (B.O.D.) from given waste water sample	
8.	Determination of Chemical Oxygen Demand (C.O.D.) from given waste water sample	
Virtual LAB Links: **1. Lab Name: NDT & Concrete Lab** **Link of the Virtual Lab: https://ee1-nitk.vlabs.ac.in/**		

JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

FY M. Tech (Environment and Water Resource Engineering)

(Effective from AY: 2024-25)

JSPM University Pune

COURSE STRUCTURE (NEP 2020 Aligned)

FACULTY OF SCIENCE & TECHNOLOGY	W. E. F	2024-2025
SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	RELEASE DATE	01/07/2024
FIRST YEAR MASTER OF TECHNOLOGY (ENVIRONMENT AND WATER RESOURCE ENGINEERING)	REVISION NO.	0.0 (NEP)

SEMESTER I (LEVEL 6.5)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PSMC	230GMAM03_01	Probability and Statistics	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PSBC	240GEWM01_01	Water Quality Modelling and Management	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PCC	240GEWM03_01	Solid and Hazardous Waste Management	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	240GEWM04_01	Environmental Impact Assessment and Management	2	-	-	-	30	30	40	50	-	-	-	-	50	2
MMC	-	Multidisciplinary Minor Course- I	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GCSM26_01	Python Programming for Engineers	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IDCB01_01	Design Thinking and Creativity	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	230UENM01_01	Communicative English for Professionals	1	-	2	-	30	30	40	50	-	-	-	-	50	2
RMC	230IRMM01_01	Research Methodology	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	240GEWM24_01	Water Quality monitoring lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
TOTAL			16	1	8	4									**750**	**22**

Sem	Multidisciplinary Minor Course (MMC)	
I (MMC – I)	**Course Code**	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	**Course Code**	230GETM16_02
	Course Name	IoT Basics and Applications

Dr. Dipak Jadhav
Programme Coordinator, MTech-EWRE

Dr. M. Nithya
Director (I/C), School of Civil and Environmental Sciences

Dr. R. S. Deshpande
Dean, Faculty of Science and Technology

Dr. Anuradha S. Deshpande
Associate Dean (Academics)

Prof. B.B. Ahuja
Vice Chancellor, JSPM University Pune

JSPM University Pune

COURSE STRUCTURE (NEP 2020 Aligned)

FACULTY OF SCIENCE & TECHNOLOGY | **W. E. F** | **2024-2025**

SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES | **RELEASE DATE** | **01/07/2024**

FIRST YEAR MASTER OF TECHNOLOGY (REGULAR)
(ENVIRONMENT AND WATER RESOURCE ENGINEERING) | **REVISION NO.** | **0.0 (NEP)**

SEMESTER II

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PCC	240GEWM05_02	Water and Wastewater Treatment	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PCC	240GEWM06_02	Hydrology and Watershed Management	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	240GEWM07_02	Irrigation and Drainage Engineering	3	-	-	-	30	30	40	100	-	-	-	-	100	3
MMC	-	Multidisciplinary Minor Course- II	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GTEM19_02	Geospatial Analysis	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IINB02_02	Innovation	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	230UENM02_02	Business Communication	1	-	2	-	30	30	40	50	-	-	-	-	50	2
RMC	230IRMM02_02	Research Design and Techniques	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	240GEWM25_02	Advanced Environmental Engineering Lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
IITP/FP/ CEP	240GEWM22_02	Internship / Field Project / Community Engagement Programme	4 to 6 weeks										50	50	50	2
TOTAL			14	1	8	4									**750**	**22**

Note: A **Postgraduate Diploma** will be awarded if a student exits after first year.
For Exit at the end of first year the student must complete: (Total credits = 8)
a) an internship / OJT of 8 - 10 weeks (4 credits)
b) Additional Course 1 (4 credits) (Vocational Skill Course (VSC) / Skill Enhancement Course (SEC))

Sem	Multidisciplinary Minor Course (MMC)	
I (MMC – I)	Course Code	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	Course Code	230GETM16_02
	Course Name	IoT Basics and Applications

Dr. Dipak Jadhav
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Dr. R. S. Deshpande
Dean, Faculty of Science and Technology

Dr. Anuradha S. Deshpande
Associate Dean (Academics)

Prof. B.B. Ahuja
Vice Chancellor, JSPM University Pune

JSPM University Pune
School of Civil and Environmental Sciences
F.Y. M.Tech. "Environmental and Water Resource Engineering"

Semester- II

Course Type: PCC	**Course Title:** Water and Wastewater Treatment	
Course Code: 240GEWM05_02	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 1 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
1 Required basic knowledge of environmental engineering

Course Objectives: This course will enable students to
- To understand the basic characteristics of wastewater.
- Understanding the kinetics of biological system.
- Understand the design and working principle of various treatment methods.
- Understand magnitude and influence of hazardous content.

Course Outcomes: Students completing the course will be able to:
CO1: Understand basic characteristics of water and wastewater and treatment processes.
CO2: Analyze the design and illustrate the working principles of different wastewater treatment methods.
CO3: Develop and design various wastewater treatment processes considering design parameters.
CO4: Appraise the suitability of the design of water treatment plants and unit processes
CO5: Assess the operational efficiency and performance of water treatment processes
CO6: Examine residual management techniques and analyze advanced treatment processes.

Course Contents

Unit I	**Introduction to water and Wastewater systems**	**(6 Hours)**
Overview of water and Wastewater systems, Urban water system, Treatment plants, Design process, Wastewater treatment, Quality and Quantity and treatment necessities, wastewater treatment and recycling		
Unit II	**Wastewater treatment**	**(6 Hours)**
Overview of wastewater treatment processes, Primary sedimentation, Biological treatment, Activated sludge process, Biological processes, Nutrient removal in activates sludge, Attached growth, Trickling filter, Rotating biological contactors		
Unit III	**Tertiary Wastewater treatment**	**(5 Hours)**

Disinfection / Disinfectant removal, Chlorine disinfection, UV light disinfection, Other treatment process, Advanced wastewater treatment process, Wastewater recycling, Waste-to-energy recovery approaches		
Unit IV	**Water treatment**	**(6 Hours)**
General considerations, Quantities and Quality, Water treatment plants, Preliminary treatment, Coagulation and flocculation, Rapid mix, Flocculation basin, Sedimentation, Filtration		
Unit V	**Water treatment process**	**(5 Hours)**
Filtration, Disinfection and disinfection by products, Lime softening, Ion exchange softening, Nano filtration softening, Desalination		
Unit VI	**Residual management**	**(5 Hours)**
Overview, Types of residuals, Sources, Conventional residual management systems, Stabilization, Conditioning, Dewatering, Advance treatment processes		

Learning Resources

Text Books:

1. Davis, Mackenzie L., Water and Wastewater Engineering: Design Principles and Practice, 2nd Edition, McGraw-Hill, New York, 2010.
2. Metcalf and Eddy, Wastewater Engineering: Treatment and Resource Recovery, Fifth Edition, Metcalf & Eddy, Inc., McGraw-Hill Publishers, New York, 2013.

Reference Books:

1 Tchobanoglous, G., et al., Wastewater Engineering: Treatment, Disposal, and Reuse, Fifth Edition, Metcalf & Eddy, Inc., McGraw-Hill Publishers, New York, 2013.
2. Crittenden, J.C., et al., Water Treatment Principles and Design, 2nd Ed., Montgomery, Inc., John Wiley and Sons, New York, 2005.
3. Reynolds, T.D., Richards, P.A., Unit Operations and Processes in Environmental Engineering, PWS Publishing Company, Boston, 1996.

MOOC / NPTEL Courses:

1. NPTEL Course (Link of the Course: https://onlinecourses.nptel.ac.in/noc23_ce12/preview

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- II

Course Type: PCC	**Course Title:** Hydrology and Watershed Management	
Course Code: 240GEWM06_02	**Teaching Scheme:** (2 Hrs./Week)	**Examination Scheme:**
Credits: 2.5	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

Course Objectives:

- To provide a comprehensive understanding of the key hydrological processes and their significance in watershed ecosystems.
- To explore principles of integrated watershed management for the sustainable development and use of natural resources.
- To analyze the hydrologic cycle, including precipitation, evaporation, infiltration, and runoff, and evaluate water budgets for effective watershed planning.
- To examine the interactions between groundwater, streamflow, and soil erosion, and propose strategies for soil and water conservation within watersheds.
- To study sediment transport, fluvial processes, and water quality parameters to assess and enhance watershed health and ecosystem services.
- To integrate socioeconomic considerations and emerging technologies into watershed management strategies, addressing policy, climatic variability, and community needs.

Course Outcomes: Students completing the course will be able to:

CO1: To explain the fundamental concepts of watershed management and its importance in sustainable resource development.

CO2: To analyze the components of the hydrologic cycle and calculate the water budget for a given watershed.

CO3: Understand the processes of precipitation, evaporation, and water flow, and assess their impact on watershed hydrology.

CO4: To measure streamflow, evaluate groundwater-surface water interactions, and propose methods to control soil erosion.

CO5: To evaluate sediment transport processes and water quality parameters in watershed streams, and recommend stream management practices.

CO6: To develop and apply integrated watershed management strategies, considering environmental, regulatory, and socioeconomic factors

Course Contents

Unit I	**Introduction to Watersheds and Hydrologic Processes**	**(5 Hours)**
Overview of Hydrology and Watershed Management, Watersheds: Definition, types, importance , Integrated Watershed Management, Sustainable Use and Development of Natural Resources, Ecosystem Management and Cumulative Effects Reconciling Watershed and Political Boundaries		
Unit II	**The Hydrologic Cycle and Water Budget**	**(5Hours)**

Properties of Water, The Hydrologic Cycle: Processes and phases, Energy and the Hydrologic Cycle, Water Flow in Soil and Stream Channels Water Budget Calculations		
Unit III	**Precipitation, Evaporation, and Water Flow**	**(5 Hours)**
Precipitation Process Rainfall and Snowfall: Measurement and patterns, Evaporation and Interception Processes, Transpiration and Evapotranspiration, Infiltration and Recharge, Pathways of Water Flow		
Unit IV	**Streamflow, Groundwater, and Soil Erosion**	**(5 Hours)**
Measurement and Estimation of Streamflow, Groundwater and Groundwater-Surface Water Interactions, Surface Soil Erosion: Processes and control, Erosion from Gullies and Ravines		
Unit V	**Sediment Transport, Water Quality, and Fluvial Processes**	**(5 Hours)**
Sediment Supply, Transport, and Yield Fluvial Geomorphology and Stream Management, Water Quality Characteristics: Physical, chemical, biological, Cumulative Effects on Water Quality, Stream Classification and Management		
Unit VI	**Watershed Management Strategies and Socioeconomic Considerations**	**(5 Hours)**
Managing Wildland Watersheds: Forests, woodlands, rangelands, Riparian Communities and Wetlands Management, Best Management Practices (BMPs) and Water Harvesting, Regulatory Compliance and Climatic Variability, Socioeconomic Considerations in Watershed Management: Policy and planning. Emerging Tools and Technologies		

Learning Resources

Text Books:

01	Groundwater Hydrology	David Keith Todd, Larry W. Mays	3rd Edition Wiley 2005
02	Hydrology and management of Watershed	Kenneth N. Brooks Peter F. Ffolliott Joseph A. Magner	4th Edition Wiley 2013

1.

Reference Books:

1. Ground Water Hydrology Bhagu R Chahar McGraw Hill India Pvt Ltd. 2015

MOOC / NPTEL Courses:

1. https://archive.nptel.ac.in/courses/105/103/105103213/

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- II

Course Type: PCC	**Course Title:** Irrigation and drainage engineering	
Course Code: 240GEWM07_02	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
1 Required basic knowledge of soil mechanics
2. Understand basics of fluid mechanics

Course Objectives:
- To introduce the students about various irrigation practices & irrigation management
- To analyze and design various irrigation systems
- To inculcate the knowledge about irrigation structures with design
- To study soil-water-plant relationship and irrigation scheduling

Course Outcomes: Students completing the course will be able to:
CO1: Analyze the need for irrigation and drainage in agricultural fields and summarize their impact on crop productivity.
CO2: Develop irrigation structures and channels based on hydrological and soil parameter
CO3: Evaluate the soil-plant-water relationship and formulate irrigation scheduling strategies for efficient water management.
CO4: Design and optimize drip and sprinkler irrigation systems for various crop and soil condition.
CO5: Assess the characteristics of salt-affected soils and calculate the leaching requirement for soil reclamation.
CO6:Design surface and subsurface drainage systems to enhance soil productivity.

Course Contents

Unit I	**Introduction to Irrigation and drainage**	**(8 Hours)**
Irrigation Terminologies, Water resources utilization, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country. Measurement of irrigation water-Units, Methods of water measurements, application of AI in irrigation and drainage.		
Unit II	**Water conveyance and Control**	**(8 Hours)**
Water conveyance and Control- Design of irrigation field channels, underground pipe conveyance system, irrigation structures, channel lining.		
Unit III	**Soil–Plant-water relationships**	**(8 Hours)**

Properties influencing Irrigation, Soil water relation, soil water movement in different conditions, infiltration, soil moisture Characteristics, measurements, plant structure, Terminologies, Evaporation, Potential Evapotranspiration, Net and gross irrigation requirement, Irrigation Efficiency, Irrigation Scheduling & Water management		
Unit IV	**Water application Methods**	**(8 Hours)**
Classification, Surface and Subsurface methods of irrigation with design, adaptabilities, its merits, demerits, selection and Design, Design aspects, cost estimation		
Unit V	**Irrigated agriculture, soil salinity and drainage**	**(6 Hours)**
Causes and effect of water logging, water logging prevention and control, need for land drainage. Inter-relation of irrigation and drainage, formulating drainage criteria under steady and unsteady state and on basis of dynamic equilibrium concept. Reuse of drainage water, Drainage problem of the state.		
Unit VI	**Surface And Subsurface drainage**	**(7 Hours)**
: Surface drainage system and components, factors affecting drainage, types of land requiring drainage, design consideration for surface drainage, design of surface drainage system. Special, Drainage systems: mole drains, vertical drainage, bio drainage. Salt accumulation and its causes, influence of salt on physical properties of		

Learning Resources

Text Books:

1. Irrigation, Theory and Practice, A. M. Michael, Vikas Publishing House Pvt. Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures, Garg, S. K., Khanna Publishers, New Delhi.

Reference Books:

1. Irrigation Engineering, H. M. Raghunath, Wiley India
2. Land Drainage, Battacharaya A. K. & Michael A. M., Vikas Publ.
3. Irrigation Engineering and Hydraulic Structures, S. R. Sahasrabudhe, Kataria & Sons, New Delhi.
4. Engineering Hydrology, K Subramanya, McGraw Hill Education (India) Pvt. Ltd.

MOOC / NPTEL Courses:

1. NPTEL Course (Link of the Course: https://onlinecourses.nptel.ac.in/noc21_ag04/preview

JSPM University Pune F.Y. M.Tech. (Environment and Water Resource Engineering) Semester- II		
Course Type: MMC	**Course Title**: IOT Basics and Applications	
Course Code: 230GETM16_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic Electronics
2. Basic Electrical engineering

Course Objectives:

- The knowledge and understanding of Internet of Things
- A strong foundation of fundamentals of Internet of Things and need of IoT Security
- Get acquainted with various communication protocols of Internet of Things
- Detailed understanding of present scope of Internet of Things with case studies

Course Outcomes: On completion of the course, learner will be able to
CO1: Understand various terms related to IOT.
CO2: Understand the working of IOT devices.
CO3: Identify different types of Sensors and actuators for IOT.
CO4: Understand working of sensors and actuators
CO5: Understand the concept of various IOT Protocols
CO6: Select sensors and actuators for industrial applications

Course Contents

Unit I	**IoT**	**(2 Hrs)**
Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications		
Unit II	**IoT Physical Devices and Endpoints**:	**(2 Hrs)**
Basic building blocks of and IoT device, Exemplary device: NodeMCU, Aurduino, and Other IoT Devices.		
Unit III	**Sensors**	**(2 Hrs)**
Roles of Sensors & Actuators, Types of sensors, Active and passive, analog and digital, Contact and no-contact, Absolute and relative		
Unit IV	**Working of Sensors**	**(3 Hrs)**

Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera. Development boards		
Unit V	**IoT Protocols**	**(2 Hrs)**
MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, Wi-Fi, Interfacing of wifi, RFID, Zigbee,NFC with development board		
Unit VI	**Applications of IOT**	**(3 Hrs)**
Smart Home: Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. Smart Agricultural: characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring)		

Learning Resources

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515 2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN : 9781439892992
2. Raj Kamal, Internet of Things: Architecture and Design Principle” , ISBN-13: 978-93-5260- 522-4, McGraw Hill Education (India) 2017

Reference Books:

1. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning.
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally HakimaChouchi, “The Internet of Things Connecting Objects to the Web”, ISBN 078 -1- 84821-140-7, Wiley Publications Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.

MOOC / NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://nptel.ac.in/courses/106105166

JSPM University Pune F.Y. M.Tech. (Environment and Water Resource Engineering) Semester II		
Course Type: MMC	**Lab Course Title**: IOT Basics and Applications	
Course Code: 230GETM16_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):**	**Practical (PR):** 50 marks **Oral (OR):** 50 marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments	
Group A	
1.	Controlling GPIO pins in NodeMCU.
2.	LED blinking using Node MCU(Digital Write)
3.	Controlling LED using push button with NodeMCU (Digital Read)
4.	Temperature measurement using thermistor and NodeMCU Communication between Two NodeMCU using
5.	Smart lighting system using LDR and NodeMCU Study of smart material actuators.
Group B	
6.	Motion Detection using PIR Sensor and NodeMCU
7.	Gas detection using MQ135 and NodeMCU Experimental characterization of any one sensor.
8.	Servo motor (SG-90) control using NodeMCU Experimental characterization of DC motor
9.	Harmful gas monitoring using NodeMCU and ThingSpeak
Group C	
10.	Designing Weather station by HTTP GET REQUEST-RESPONSE using NodeMCU
11.	Design based experiment aiming selection of sensors for industrial application.

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester II

Course Type: SEC	**Course Title:** Geospatial Analysis	
Course Code: 230GTEM19_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:
1. Basic Computer Knowledge
2. Remote Sensing basics

Course Objectives:
- Apply the concepts of Photogrammetry and its applications such as determination of heights of objects on terrain.
- Understand the basic concept of Remote Sensing and know about different types of satellite and sensors.
- Illustrate Energy interactions with atmosphere and with earth surface features, interpretation of satellite and top sheet maps.
- Understand different components of GIS and Learning about map projection and coordinate system.
- Develop knowledge on conversion of data from analogue to digital and working with GIS software.

Course Outcomes: On completion of the course, learner will be able to
CO1: Understand the concepts of Photogrammetry and compute the heights of objects
CO2: Apply knowledge of GIS and understand the integration of Remote Sensing and GIS
CO3: Understand the basic concept of GIS and its applications, know different types of data representation in GIS
CO4: Understand and Develop models for GIS spatial Analysis and will be able to know what the questions that GIS can answer are
CO5: Apply knowledge of GIS software and able to work with GIS software in various application fields
CO6: Illustrate spatial and non-spatial data features in GIS and understand the map projections and coordinates systems

Course Contents

Unit I	**Introduction to GIS**	**(5 Hours)**

Basic concepts: Definition and history, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Data base design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error.		
Unit II	**Data Types and Data Models**	**(5 Hours)**
Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.		
Unit III	**Spatial Data Editing**	**(5 Hours)**
Types of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.		
Unit IV	**Attribute Data and Data Exploration**	**(5 Hours)**
Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation,		
Unit V	**Spatial Analysis**	**(5 Hours)**
Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector- Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification, Map Comparison,		
Unit VI	**Geo Statistical Analysis Techniques:**	**(5 Hours)**
Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principle of AHP. Principal and components of multiple criteria decision making		

Learning Resources

Text Books:

1. Jahne, B. *"Digital Image Processing"* New York: Springer-Verlag
2. Lillsand, R.M. and R.W. Kiefer, *"Remote Sensing and Image Interpretation"*, New York: Wiley.

Reference Books:

1. Pratt, W.K., "*Digital Image Processing"* New York Wiley.
2. Jain, A.K., "*Fundamentals of Digital Image Processing*", Englewood Cliffs, NJ, Prentice Hall.

MOOC / NPTEL Courses:

1. Link of the Course: https://archive.nptel.ac.in/courses/107/105/107105088/, IIT Kharagpur

Additional Web Resources:

1. https://docs.qgis.org/3.28/en/docs/training_manual/index.html

JSPM University Pune F.Y. M.Tech. (Environment and Water Resource Engineering) Semester II		
Course Type: SEC	**Course Title:** Geospatial Analysis	
Course Code: 230GTEM19_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (PR):** 50 marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments

1. Familiarization with GIS Software, Data Input
2. Geo Referencing and Projections
3. Digitization of Map/ Toposheet
4. Creation of Thematic Maps
5. Base Map Preparation
6. Data Conversion – Vector to Raster, Raster to Vector
7. Adding Attribute Data – Querying on Attribute Data
8. Vector Analysis
9. Raster Analysis
10. Map Composition
11. Developing Digital Elevation Model
12. Simple Applications of GIS in Transportation Engineering

GIS SOFTWARE: Arc GIS 10.3

TEXT BOOKS:

1. "*Concept and Techniques of GIS*" by C.P.L.O. Albert, K.W. Yong, Printice Hall Publishers

JSPM University Pune F.Y. M.Tech. (Environment and Water Resource Engineering) Semester II		
Course Type: VSC	**Course Title:** Innovation	
Course Code: 230IINB02_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 1.5	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To understand the concept of innovation and creativity
- To familiarize with the tools for innovation
- To understand fundamentals of innovation management
- To get overview of real-world implementation of innovation and creativity

Course Outcomes: On completion of the course, learner will be able to

CO1: apply the concepts of creativity and innovation in all walks of life.
CO2: inculcate and incorporate individual creativity and innovative skill set at conceptual, product design and management level.
CO3: solve real time problems with enhanced ability in respective sectors of work for increased productivity and improved organizational behaviour.
CO4: perform with improved skill set in entrepreneurship and start up ecosystem.
CO5: to find solutions to social, corporate and personal problems with de novo approach.

Course Contents

Unit I	**Innovation & Creativity**	**(3Hrs)**

Innovation: Meaning, Concept, Characteristics, Importance, Principles of Innovation, Process of Innovation.
Creativity: Meaning, Concept, Importance, Creativity Process, Components of creative performance, Hurdles to Creativity

Unit II	**Tools for Innovation**	**(5Hrs)**

Creative Thinking: Traditional V/S Creative Thinking,
Individual Creativity Techniques: Meditation, Self-Awareness, & Creative Focus
Group Creative Techniques: Brainstorming, Off the Wall Thinking &Thinking Hats Method.
Dimensions of Innovation:
Innovation Eco-system in India and abroad, Social Innovation, Grass root Innovation, Frugal Innovation, Global Innovation- Global Innovation Index framework, GII, Case studies in India and abroad.

Unit III	**Innovation Management**	**(3Hrs)**

Concept, Scope, Characteristics, Evolution of Innovation Management, Significance, Factors Influencing Innovation, Commercialization of Innovation, Innovation and Start up ecosystem

Unit IV	**Areas of Innovation**	**(2Hrs)**

Innovation in Entrepreneurship, Product innovation, Process Innovation, Social Innovation, Case studies highlighting types, implementation imperatives and sector specific impact.

Unit V	**Group innovation study**	**(1Hrs)**

Each student group will prepare a case study on one innovation topic either from their area of work or through participation in the exposition, symposia, workshop of any relevant forum. The project report will be submitted for the study.

Unit VI	**Presentation and Closure**	**(1Hrs)**

The student group will give the presentation of the project in the chosen area. The report will highlight the process of exploring executing and exploiting the innovation. It will also mention methodology to manage the innovation.

Learning Resources

Text Books:

1. Wagner, Tony. Creating Innovators: The Making of Young People Who Will Change the World. New York: Scribner, 2012.
2. “Managing Creativity and Innovation” Harvard Business School Press

Reference Books:

1. “Organizational Innovation”, SAGE Publication, London, 2001.
2. “Jugaad Innovations, Navi Radjou and Jaideep Prabhu, Random House India
3. “Kelley, Tom, Jonathan Littman, and Tom Peters. The Art of Innovation: Lessons in Creativity from IDEO, America’s Leading Design Firm. New York: Doubleday, 2001.
4. “Innovation Management & New Product Development”, Paul Trott, published by Pitman, 2000.

MOOC / NPTEL Courses:

1. NPTEL Course "*Innovation, Business Models and Entrepreneurship",* Prof Rajat Agrawal, Prof Vinay Sharma, IIT Roorkee.
   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_mg116/preview

Additional Web Resources:

https://youtu.be/FXJUDyqobbM
https://youtu.be/FF_38_ZuRbQ
https://youtu.be/33JjV_NDbpY
https://youtu.be/DNUwZctwwhw
https://youtu.be/_PC1gbAhKz0
https://youtu.be/wbFVNBNl7Bk
https://youtu.be/kfpERveB8kM
https://youtu.be/Y6R9ps2E1oM
https://youtu.be/66N5SM73AEc
https://youtu.be/1YLtkc6U3Rs

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester II

Course Type: AEC	**Course Title:** Business Communication	
Course Code: 230UENM02_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: Nil

Course Objectives:

- Remember the theoretical basics of Communication.
- Understand skills required for efficient interpersonal communication and leadership abilities.
- Apply Presentation Techniques in the Professional Environment.
- Analyze trends in the respective market to accommodate accordingly.
- Evaluate the skills related to production & presentation of messages in multiple formats.
- Create placement ready personalities.

Course Outcomes: On completion of the course, learner will be able to

CO1: Apply Verbal and Non-Verbal Communication Techniques in the Professional Environment

CO2: write impressive official correspondence and learn to make and give effective presentations in a professional environment.

CO 3: Write an impressive resume and face the interview confidently.

CO 4: Present themselves well in front of large audience on a variety of situations related to group communication and presentation in a relevant scenario.

CO5: Socialize with ease and comfort.

CO6: Develop Corporate Communication Skills

Course Contents

Unit I	**Employment Communication**	**(2 Hrs)**

Introduction and objectives of Report Writing, Types of Business Reports-Informational Reports, Analytical Report, Research Report, Progress Report, Explanatory Report, Structure of Reports- Title page, table of content, summary, the main body, conclusion, and recommendations, Writing Abstracts and Summaries

Unit II	**Resume Writing**	**(2 Hrs)**
Introduction to Resume Writing- Concept and Details, Types of Resume Writing- chronological and functional, Key components of effective Resume Writing, Structure and contents of Cover Letter		
Unit III	**Interview Skills / Techniques**	**(3 Hrs)**
Interview Skills / Techniques – Concept and Process, Peer Interview/Mock Interview- Pre-interview planning and performance, Opening Strategies and Answering Strategies, Interview through tele and video- conferencing		
Unit IV	**Group Discussion**	**(3 Hrs)**
Group Discussion – Concept and important points, Roles and Phases in Structured Group Discussion, Expectations of the Panel, Do's and Don'ts in Group Discussion		
Unit V	**Presentation Skills**	**(2 Hrs)**
Elements of Presentation- Content, Organization, Delivery, Design of Presentation- Typography, colour, layout, images and animation, Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs, Written Presentations through Posters/Projects/Reports/ E-mails/Assignments		
Unit VI	**Essential Soft Skills**	**(3 Hrs)**
Soft Skills development- Grooming Etiquettes and Manners, Stress and Conflict Management- Coping styles and symptoms, Time Management- Pomodoro Technique, Pareto Technique, Leadership Skills- Definition, Strategies, and Styles		

JSPM University Pune F.Y. M.Tech. (Environment and Water Resource Engineering) Semester II		
Course Type: AEC	**Course Title:** Business Communication	
Course Code: 230UENM02_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments	
Group A	
1.	Report Writing
2.	Resume Writing
3.	Interview technique
4.	Group Discussion
5.	Presentation Skills
Group B	
6.	Soft Skills: Grooming, Etiquettes and Manners
7.	Stress Management
8.	Time Management
9.	Leadership Skill
10.	PowerPoint Presentation

Learning Resources

Textbooks:

1. Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. *Business Communication Today*: Tenth Edition. New Jersey: Prentice Hall, 2010.

Reference Books:

1. Collins, Patrick. *Speak with Power and Confidence*. New York: Sterling, 2009.
2. Barun, Mitra. Personality Development and Soft Skills, Barun K Mitra, Oxford Press, 2011.

MOOC / NPTEL Courses:

1. NPTEL Course "Soft skill Development" Prof. Priyadarshi Patnayak, Prof. V.N, Giri, Prof. D. Suar, IIT Kharagpur

Link of the course: https://youtu.be/Af9RoDvhTLE?si=cqQim2DX2Cepi0eX

Additional Web Resources:

http://www.englishdaily626.com/c-errors.php

https://www.stressdirections.com/personal/about_stress/stress_statistics.html

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester II

Course Type: RMC	**Course Title:** Research Design and Techniques	
Course Code: 230IRMM02_02	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To develop the ability to create visual representations of data using appropriate tools
- To equip with various statistical techniques to draw meaningful conclusions from data
- To enable the students with the principles of experimental design, the formulation and execution of experiments
- To enable students to comprehend the concept of Analysis of Variance, and different types of ANOVA
- To develop proficiency in selecting and applying appropriate measures of association
- To acquaint students with the process of crafting research proposals

Course Outcomes: On completion of the course, learner will be able to

CO1: Demonstrate Proficiency in Data Visualization Techniques
CO2: Perform data analysis using statistical methods
CO3: Apply of Experimental Design Principles in various research contexts
CO4: Interpret research data using Analysis of Variance (ANOVA)
CO5: Demonstrate Proficiency in Measuring Associations
CO6: Develop Comprehensive Research Proposal

Course Contents

Unit I	**Data Visualization**	**5 Hrs**
Data preparation process, data presentation, data visualization techniques, effective communication of complex findings		
Unit II	**Data Analysis**	**5 Hrs**
Basic statistical concepts, measure of central tendency and variation, univariate statistics, sampling distribution, hypothesis testing		
Unit III	**Design of Experiments**	**5 Hrs**
Basics of experimental design, principles of randomization, factorial experiments, fractional		

factorial designs, Design of Experiments (DOE)		
Unit IV	**ANOVA**	**5 Hrs**
Introduction to ANOVA, One-way ANOVA, Two – way ANOVA, Analysis of Covariance (ANCOVA)		
Unit V	**Measures of Association**	**5 Hrs**
Simple regression, Multiple Regression, Chi square tests, Equality of proportion test		
Unit VI	**Research Proposal Development**	**5 Hrs**
Importance of research proposals in academic and professional contexts, Components of a research proposal, creating a realistic research timeline, Submitting the research proposal for funding or approval, Research proposal drafts and peer reviews		

Learning Resources

Text Books:

2. Wayne Goddard, Stuart Melville, "*Research Methodology: An Introduction*", Juta, Lansdowne, Second Edition.
3. Ranjit Kumar "*Research Methodology*: A Step-by-Step Guide for Beginners", SAGE Publications Pvt. Ltd Fourth Edition.
4. Dr. C. R. Kothari, "*Research Methodology: Methods and Trends*", New Age International (P) Limited, Publishers, Second Edition.

Reference Books:

9. Nicholas Walliman, *"Research Methods: The Basics",* Routledge – Taylor and Francis Group, Third Edition.
10. Vinod Chandra, Anand, Hareendran "Research Methodology", Pearson 1st Edition
11. Dr. Prabhat Pandey, Dr. Meenu Mishra Pandey, "Research Methodology: Tools and Techniques", Bridge Center, 2015.
12. Alan Bryman & Emma Bell, "*Business Research Methods*", Oxford University Press, Third Edition.

MOOC / NPTEL Courses:

1. "*Research Methodology*", Prof. Edamana Prasad, Prof. Prathap Haridoss, IIT Madras.
   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_ge36/preview
2. "*Research Methodology*", Prof. Soumitra Banerjee, IISER Kolkata.
   Link of the Course: https://archive.nptel.ac.in/courses/127/106/127106227/

Additional Web Resources:

1. https://www.coursera.org/specializations/data-collection
2. https://www.coursera.org/learn/anova-and-experimental-design
3. https://www.coursera.org/learn/research-proposal-initiating-research

JSPM University Pune
F.Y. M.Tech. (Environment and Water Resource Engineering)
Semester II

Course Type: LC	**Lab Course Title: Advanced Environmental Engineering Lab**	
Course Code: 240GEWM25_02	**Teaching Scheme:** (2 Hrs. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 0 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks

Prerequisite Courses, if any: - None

Course Objectives:

- To provide hands-on experience in analyzing water quality parameters using advanced laboratory techniques and instruments.
- To enable students to apply their understanding of environmental engineering principles to evaluate and interpret water quality data effectively.

Course Outcomes:

Students completing this course will be able to:

CO1: Apply standard laboratory procedures to determine fundamental water quality parameters such as pH, acidity, alkalinity, hardness, and conductivity.

CO2: Estimate the concentration of chemical contaminants including nitrate, sulphate, and dye in water samples using appropriate analytical techniques.

CO3: Assess the impact of various chemical parameters on water quality and interpret results in accordance with environmental standards.

CO4: Compute and analyze the Water Quality Index (WQI) to derive a comprehensive assessment of water quality for environmental and public health purposes

List of Laboratory Experiments

Group A Test	
1.	Determination of pH
2.	Determination of acidity and alkalinity
3.	Determination of hardness in given sample
4.	Determination of conductivity in given sample
Group B Test	
5.	To determine nitrate content in given sample
6.	To determine sulphate content in given sample
7.	To determine dye concentration in given sample
8.	To Determine water quality index

Virtual LAB Links:

1. **Link of the Virtual Lab: https:vlabs.ac.in/**

References:

1. APHA (2017) Standard methods for the examination of water and wastewater. Rodger B. Baird, Andrew D. Eaton, Eugene W. Rice American Public Health Association 1-1545
2. IS 3035 Standard Sampling and testing methods.

JSPM University Pune **F.Y. M.Tech. (Environment and Water Resource Engineering)** **Semester II**		
Course Type: IITP / FP/CEP	**Lab Course Title:** Internship / Field Projects/ Community Engagement project	
Course Code: 240GEWM22_02s	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Duration:** 04 to 06 Weeks	**Oral (OR):** 50 Marks
Prerequisite Courses, if any: -		

Objectives:

- To expose students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
- To provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training.
- To providing practical experience in a field or discipline

Course Outcomes: On completion of the course, learner will be able to

CO1: Develop professional competence through internship.

CO2: Apply academic knowledge in a personal and professional environment.

CO3: Build the professional network and expose students to future employees.

CO4: Apply professional and societal ethics in their day to day life.

CO5: Become a responsible professional having social, economic and administrative considerations.

CO6: Decide own career goals and personal aspirations.

Duration and Evaluation:

- Internship to be completed after every even semester (2, 4 and 6) and before commencement of next odd semester (03, 05 and 07).
- Internship should be at least 4 to 6 weeks and it is to be assessed immediately after completion.

Framework of Internship/ Field Project / Community Engagement Project:

- During the vacation after even semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Field Project / Community Engagement Project

- Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him.
- The evaluation of these activities will be done by Programme Coordinator/ Project Head / faculty / TPO/ mentor or Industry Supervisor.

Internship Guidelines:

Step 1: The department will issue request Letter/ Email to the respective industry/ firm/ NGO/ organization to allot various slots of 4-6 weeks as internship**/** Field Project / Community Engagement Project periods for the students.

Step 2: Industry will confirm the training slots allocated for internships via Confirmation Letter/ Email.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training/ Field Project / Community Engagement Project at the concerned Industry / Organization. In- between Faculty Member(s) can evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.

Step 5: Students will submit training report after completion of internship.

Step 6: Training Certificate to be obtained from industry / Organization.

Internal Reporting Guidelines for students:

- Every intern should send weekly report to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guide on regular basis.
- Interns should have at least fortnightly verbal communication with the internal guide without fail.
- In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.

Internship Diary / Internship Workbook:

- Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students

should record in the daily training diary account of the observations, impressions, information gathered and suggestions given, if any.

- The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.
- Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Diary / workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries.
- Adequacy & quality of information recorded
- Data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Internship Work Evaluation:

- Every student is required to prepare and maintain documentary proofs of the activities done by him / her as internship diary or as workbook.
- The evaluation of these activities will be done by Programme Coordinator/ Project Head / faculty / TPO/ mentor or Industry Supervisor based on- overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Evaluation-Seminar presentation / Oral Examination at the institute:

The student will present a seminar based on his training report, before an expert committee constituted by the concerned department as per norms.

The evaluation will be based on the following criteria:

- Depth of knowledge and skills Communication & Presentation Skills.
- Team Work
- Creativity
- Planning & Organizational skills
- Adaptability and Analytical Skills
- Attitude & behaviour at work.
- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Log book
- Student's Feedback from External Internship Supervisor

- **Internship Report:**
- The report shall be presented covering following recommended fields but limited to:
- Title/Cover Page
- Internship completion certificate.

- Internship Place Details- Company background-organization and activities/Scope and
- object of the study / personal observation.
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor (External & Internal):

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

- Technical knowledge
- Discipline
- Punctuality
- Commitment
- Willingness to do the work
- Communication skill
- Individual work
- Team work
- Leadership

JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

M. Tech (Environment and Water Resource Engineering)

(Effective from AY: 2025-26)

	JSPM University Pune	**COURSE STRUCTURE (NEP 2020 Aligned)**
	FACULTY OF SCIENCE & TECHNOLOGY	**W. E. F** **2025-2026**
	SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	**RELEASE DATE** **01/07/2025**
	SECOND YEAR MASTER OF TECHNOLOGY (ENVIRONMENT AND WATER RESOURCE ENGINEERING)	**REVISION NO.** **0.0 (NEP)**

SEMESTER III (LEVEL 7)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PEC	-	Program Elective-I / MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PEC	-	Program Elective-II / MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
IOC	-	Interdisciplinary Open Elective Course -I / MOOCs	2	-	-	-	30	30	40	100	-	-	-	-	100	2
IOC	-	Interdisciplinary Open Elective Course -II/ MOOCs	2	-	-	-	30	30	40	100	-	-	-	-	100	2
VEC	230USYB01_03	Behavioral Science and Ethics	2	-	-	-	30	30	40	50	-	-	-	-	50	2
SLC	250GEWM03_03	Seminar	-	-	-	8	-	-	-	-	-	-	50	50	50	2
PROJ	250GEWM01_03	Field Project	-	-	4	8	-	-	-	-	50	50	50	50	100	4
TOTAL			**12**	**0**	**12**	**0**									**600**	**18**
MLC#	-	Audit Course - I	1	-	-	-	-	-	-	50	-	-	-	-	50	1

Sem.	Interdisciplinary Open Elective Course (IOC)		
	Specialization	(IOC – I)	(IOC – II)
III	Course Code	250GCSM03_03	230GCSM33_03
	Course Name	Fundamentals of Artificial Intelligence and Machine Learning	Introduction to Python Programming
III	Course Code	230VMSM11_03	230VBCB04_03
	Course Name	Fundamentals of Financial Management	Basics of Accounting

Sem.	Programme Elective Course (PEC)			
	Specialization	Environment and Water Resource Engineering		
III (PEC – I)	Course Code	240GEWM08_03	240GEWM09_03	240GEWM10_03
	Course Name	Environmental Chemistry and Microbiology	River Engineering and Sediment Transport	Bioremediation-Principles and Applications
III (PEC – II)	Course Code	240GEWM11_03	240GEWM12_03	240GEWM13_03
	Course Name	Sustainable Water Management	Groundwater Hydrology and Management	Advancement in Water and Wastewater Treatment
IV (PEC – III)	Course Code	240GEWM14_04	240GEWM15_04	240GEWM16_04
	Course Name	Decentralized Liquid Waste Management	Environmental Hydrology and Ecology	Environmental Law
IV (PEC – IV)	Course Code	240GEWM17_04	240GEWM18_04	240GEWM19_04
	Course Name	Environmental Process Design	Air Pollution and Control	Advanced Fluid Mechanics

Sem.	Mandatory Learning Course (MLC#) - Audit Course	
III (Audit Course - I)	Course Code	230GSEM29_03
	Course Name	Structural Audit
IV (Audit Course - II)	Course Code	230UPOB02_04
	Course Name	Introduction to Indian Constitution

JSPM University Pune
S.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- III

Course Type: PEC-I	**Course Title:** Environmental chemistry and microbiology	
Course Code: 240GEWM08_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
1. Basic knowledge of environmental science

Course Objectives:
- To study various aspects of chemistry and microbiology.
- To lay the foundation of electrochemistry, colloidal and surface chemistry. It encompasses water and wastewater analytical and instrumental methods of analysis.
- To provide detail understating of various aspects of chemistry, which are particularly valuable to environmental scientific practice and lay a foundation for understanding in specialized areas of environment management and practices

Course Outcomes: Students completing the course will be able to:
CO1: Identify types of chemical reactions and evaluate the feasibility of given reaction based on thermodynamics properties. List and describe types of electrodes and electrode potential. Measure pH, emf and other related parameters
CO2: Classify colloids, discuss their properties and their environmental significance. Apply the understanding of the underlying concepts of chemistry in the design of water and wastewater treatment systems.
CO3: Apply the knowledge of instrumental analytical techniques for measuring different types of environmental pollutants. Discuss the need for microbiology and identify different flora and fauna of importance in water, air and soil media
CO4: Distinguish bacterial metabolic processes as applied to aerobic, anaerobic and facultative modes. Apply various growth models and determine biokinetic coefficients. Solve numerical problems on generation time, specific growth rate and decay rate.
CO5: Distinguish between algae, fungi and virus. Classify and characterize using different methods. Formulate enzymatic relationships using kinetics
CO6: Apply the knowledge of using microbes in pollution control activities

Course Contents

Unit I	**Introduction to Environmental Chemistry**	**(8 Hours)**

Importance of Environmental Chemistry as applied to Environmental Engineering, types of reactions, acid/base, precipitation, reversible and irreversible reactions. Concepts of equivalent mass in relation to acids, bases, salts and oxidizing and reducing agents. Chemical equilibrium – redox and ionic equations. Modes of expression for molarity,		
Unit II	**Environmental Electrochemistry**	**(8 Hours)**
Electrolytes, types of conductance. Method of determining the specific conductance of water/wastewater and its correlation with dissolved salts. Electrode, types of electrodes, electrode potential, etc. Measurement of emf, electrochemical cells, electrochemistry and their applications in Environmental Engineering,		
Unit III	**Colloidal and Surface chemistry**	**(8 Hours)**
Colloids – Types, properties and environmental significance. Colloidal dispersions in water, air and emulsions. Theory of colloids – double layer theory, zeta potential, destabilization of colloids (Schulze – Hardy rule) as applied to coagulation process. Absorption and adsorption process, adsorption isotherms		
Unit IV	**Applied Microbiology**	**(7 Hours)**
Microscopic flora and fauna and their importance in environmental protection, microorganisms of importance in air, water and soil environment. Microbial enumeration techniques		
Unit V	**Microbial metabolism**	**(7 Hours)**
Metabolic activity, anabolism and catabolism, influencing parameters, microbial metabolism of toxic chemicals and trace organics, bio concentration and bio magnification		
Unit VI	**Recent trends in environmental remediation**	**(7 Hours)**
Use of microbial consortia in water and wastewater treatment, Emerging Microbial Contaminants- chemical and antibiotic-resistant microbes, advancement techniques and methods for resource recovery		

Learning Resources

Text Books:

1. McKinney R.E. “Microbiology for Sanitary Engineers”, McGraw Hill. •
2. Pelzer, Chan and Ried (1998), “Microbiology”, Tata McGraw Hill Publishers

Reference Books:

1. Sawyer C.N. and McCarty, P.L., (2003), “Chemistry for Environmental Engineering and Science”, 5th Edition, TATA McGraw Hill Publishing Co. Ltd., New Delhi
2. Gaudy and Gaudy (1980), “Microbiology for Environmental Scientists and Engineers”, McGraw Hill
3. APHA, (2002), “Standard Methods for Examination of Water and Wastewater”; 21st Edition

MOOC / NPTEL

1. Environmental Chemistry and Microbiology, IIT Kharagpur, Prof. Dr. Anjali Pal and Dr. Sudha Goel (Link of Course: https://archive.nptel.ac.in/courses/102/105/102105087/)

JSPM University Pune
S.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- III

Course Type: PEC-I	**Course Title:** River Engineering and Sediment Transport	
Course Code: 240GEWM09_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
2. Basic knowledge of fluid mechanics

Course Objectives:

- The course introduces the student to River Engineering. It unites the concepts and methods from open surface flow, sediment transport and river morphology and apply it to better comprehend, analyze and design the river and allied structures

Course Outcomes: Students completing the course will be able to:

CO1: Describe river morphological features and river channel migration, and outline the evolution of river systems

CO2: Explain sediment properties and transport mechanics, including bed load and suspended load transport, and apply sediment transport equations to analyze aggradation and degradation.

CO3: Interpret scouring mechanisms at hydraulic structures and demonstrate methods for stage, discharge, and channel geometry measurement with relevance to river hydraulics

CO4: Compare physical and mathematical river models for sediment transport, and select appropriate models for analyzing aggradation, degradation, and local scour

CO5: Design river protection structures, and evaluate suitable bed and bank control strategies based on river behavior and protection needs.

CO6: Develop river diversion and flood protection systems and propose restoration strategies to enhance river health and functionality.

Course Contents

Unit I	**Introduction to River Engineering**	**(8 Hours)**
River Morphology: Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations and Confluences; Flood Plains; River Channel Migration; River system evolution; Urban rivers and streams		
Unit II	**Sediment Transport Mechanics**	**(8 Hours)**

Sediment properties, Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Flocculation, Settling, Consolidation, Sediment Transport Equations; Aggradation and Degradation		
Unit III	**Scouring and stage measurement**	**(8 Hours)**
Local Scour at Bridge Piers and other Hydraulic Structures Measurement: Stage measurements, Channel geometry, Discharge, Stage Discharge Relationship		
Unit IV	**Sediment yield**	**(7 Hours)**
Sediment samplers and suspended load measurement; Bed load measurement River Models: Physical Models: Basic Scaling Laws, fixed and movable bed models; Sectional Models, Distorted Models; Mathematical models: 1D and 2D models for aggradations and degradation; 3D Models for turbulence and local scour		
Unit V	**River training and riverbank stabilization**	**(7 Hours)**
River Protection and Training Works: Design of Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures;		
Unit VI	**Diversion and river restoration**	**(7 Hours)**
Design of river training and flood protection structures, material specifications; Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration		

Learning Resources

Text Books:

3. River Engineering by Margaret S. Petersen, Prentice Hall, 1986.
4. Sediment and Contaminant Transport in Surface Waters by Wilbert Lick, CRC Press, Taylor and Francis Group, 2009

Reference Books:

4. River Training Techniques: Fundamentals, Design and Applications by B. Przedwojski and R. Blazejewski and K. W. Pilarczyk, A.A.Balkema, Rotterdam, Netherlands, 1995.
5. Loose Boundary Hydraulics by Arved J Raudkivi, A.A. Balkema, Rotterdam, Netherlands, 1998
6. Fluvial Hydraulics by Walter H. Graf, John Wiley and Sons, 1998

MOOC / NPTEL

1. River Engineering, IIT Guwahati, Prof. Subashisa Dutta (Link of Course: https://archive.nptel.ac.in/courses/105/103/105103204//)

JSPM University Pune
S.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- III

Course Type: PEC-I	**Course Title:** Bioremediation - Principles and Applications	
Course Code: 240GEWM10_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
3. Basic knowledge of environmental science

Course Objectives:
- The course will emphasize how bioremediation works, and the students will also learn the role of microbes and different enzymes in bioremediation. This course will also help to design different bioremediation strategies.

Course Outcomes: Students completing the course will be able to:
CO1: Explain the principles, categories, and methods of bioremediation along with the microbiological basis and limitations of biodegradation.
CO2: *Apply* microbial remediation techniques to treat xenobiotic and organic pollutants such as hydrocarbons and PCBs in contaminated soil environments.
CO3: Analyze the kinetics and pathways of pesticide and hydrocarbon biodegradation and various bioreactor designs used in wastewater and sludge treatment.
CO4: Evaluate the effectiveness of biostimulation and bioaugmentation strategies for in-situ and ex-situ bioremediation in organic and metal-contaminated environments
CO5: Design bioremediation approaches using biosorption, phytoremediation, and genetic engineering for the treatment of heavy metal and radionuclide contamination.
CO6: Describe the working principles and applications of gaseous bioremediation techniques and the role of biofilms and biosensors.

Course Contents

Unit I	**Introduction to bioremediation**	**(8 Hours)**
Objectives, principles, categories of bioremediation, Types, Bioremediation methods, applications, advantages and limitations of bioremediation, Biodegradation- principles and micrbiology		
Unit II	**Bioremediation of organic pollutants**	**(8 Hours)**
Xenobiotic compounds, their structure and persistance in environment, Bioremediation in soil, Biodegradation of hydrocarbons, PCB biodegradation, Microbial remediation, applications		
Unit III	**Biotransformation of pesticides and hydrocarbons**	**(8 Hours)**

Biodegradation kinetics, Bioavailability, Biomineralization, Testing for biodegradability, Numerical modelling of biodegradation. Biological processing of wastewater, Bioreactors designs used for treatment of sludge and removal of metals from wastewater. Biodegradable plastic, Biodegradation of PAH in environment.		
Unit IV	**Bioremediation strategies**	**(7 Hours)**
Biostimulation and bioaugmentation, Bioremediation techniques in-situ and ex-situ. Bioremediation of organic and metal contaminated environments, Bioremediation in soil		
Unit V	**Bioremediation of Metal toxicity and bioavailability**	**(7 Hours)**
Biosorption and precipitation. Bioremediation technologies for heavy metal and radionuclides removal. Phytoremediation and its processes, role of phytochelatins. Applications of genetic engineering in phytoremediation. Algal and fungal based bioremediation.		
Unit VI	**Gaseous bioremediation and biofilm applications**	**(7 Hours)**
Gaseous bioremediation, biofilms, bioscrubbers, bioventing, Soil Vapour Extraction (SVE), Water recirculation systems, Air sparging, Biobarriers, Composting, Phytoremediation for air technologies, Role of biosensors in bioremediation technologies, Biofilms and their applications.		

Learning Resources

Text Books:

5. Singh and Ajay. (2004). Biodegradation and Bioremediation- Vol 2. SpringerVerlang Berlin and Heidelberg GmbH & Co. Kg, Germany
6. Ronald M. Atlas and Jim Philp (2005). Bioremediation: Applied Microbial Solutions for Real-World Environment Cleanup

Reference Books:

7. Jordening H.-J., Winter, J. (2005). Environmental Biotechnology. Concepts and Applications. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim
8. Wackett, L. P., Hershberger, C. D. (2001). Biodegradation and Biocatalysis. ASM Press, American Society for Microbiology, N. W. Washington, DC.
9. Mitchell, T., Dong, G. J. (2010). Environmental Microbiology (2nd ed). John Wiley & Sons, Inc., Hoboken, New Jersey

MOOC / NPTEL

1. Environmental Biotechnology, IIT Kharagpur, Prof. Pinaki Sar (Link of Course: https://archive.nptel.ac.in/courses/102/105/102105088//)

JSPM University Pune S.Y. M.Tech. (Environment and Water Resource Engineering) Semester- III		
Course Type: PEC II	**Course Title: Groundwater Hydrology and Management**	
Course Code: 240GEWM12_03	**Teaching Scheme:**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3 Hrs./ week** **Tutorial (T): --** **Experiential Learning (EL): --**	**CIE: 100 Marks** **ESE: 100 Marks**
Prerequisite Courses, if any: Fundamentals of Physics, and Mathematics		

Course Objective:

- To understand the fundamental principles of groundwater occurrence, movement, and aquifer characteristics, enabling students to analyze subsurface hydrologic processes and groundwater budgets.
- To develop the ability to derive and solve governing equations for groundwater flow, including unsteady flow to wells in various aquifer conditions, and apply analytical methods for well hydraulics and aquifer testing.
- To impart skills in designing and evaluating wells, including the interpretation of field test data for estimating aquifer parameters such as transmissivity, hydraulic conductivity, and storativity.
- To introduce numerical modeling techniques for simulating groundwater flow, using finite difference and finite element approaches, along with the fundamentals of model development, calibration, and validation.
- To examine the processes of contaminant transport and seawater intrusion in aquifers, and to assess methods for controlling and predicting pollution in groundwater systems.
- To explore integrated groundwater management strategies, including artificial recharge, water-logging mitigation, stream-aquifer interactions, and conjunctive use of surface and groundwater to promote sustainable water resources management.

Course Outcomes: On completion of the course, learner will be able to

CO1. Explain the occurrence, distribution, and properties of groundwater, and classify different types of aquifers relevant to civil and environmental engineering applications.

CO2. Derive and apply governing equations for groundwater flow, and evaluate well hydraulics in confined and unconfined aquifers under steady and unsteady conditions.

CO3. Analyze and interpret aquifer test data to estimate key hydraulic parameters such as transmissivity, hydraulic conductivity, and storativity.

CO4. Develop and implement numerical models for simulating groundwater flow using finite difference and finite element methods.

CO5. Evaluate contaminant transport in groundwater systems and assess the impact of seawater intrusion in coastal aquifers.

CO6. Design groundwater management strategies involving artificial recharge, control of water-logging, stream-aquifer interaction, and conjunctive use of surface and groundwater resources.

Course Contents

Unit I	**Introduction to Groundwater Hydrology**	**(8 Hrs)**
Occurrence and distribution of groundwater; Hydrologic cycle and role of groundwater; Types of aquifers: confined, unconfined, leaky, perched; Aquifer properties: porosity, specific yield, transmissivity, storativity; Groundwater budget: inflow, outflow, and storage changes		
Unit II	**Governing Equations and Well Hydraulics**	**(7 Hrs)**
Formulation of governing equation for groundwater movement; Darcy's law and its validity; Steady and unsteady radial flow to wells; Solutions to unsteady flow in confined and unconfined aquifers: Fully and partially penetrating wells; Well design criteria and construction; Step-drawdown tests and well efficiency		
Unit III	**Aquifer Testing and Parameter Estimation**	**(8 Hrs)**
Methods of aquifer test: pumping tests and slug tests; Theis and Cooper-Jacob methods for confined aquifers; Neuman and Boulton solutions for unconfined and leaky aquifers; Estimation of transmissivity, storage coefficient, and hydraulic conductivity; Interpretation of test data		
Unit IV	**Numerical Modeling of Groundwater Flow**	**(7 Hrs)**
Introduction to numerical methods in groundwater modelling; Finite difference and finite element methods; Discretization of governing equations; Boundary conditions and grid generation; Introduction to MODFLOW and similar software		
Unit V	**Groundwater Contamination and Seawater Intrusion**	**(8 Hrs)**
Pollutant transport mechanisms: advection, dispersion, and diffusion; Solute transport equation; Sources of groundwater contamination; Concept and modeling of seawater intrusion in coastal aquifers; Ghyben-Herzberg relation and interface position		
Unit VI	**Groundwater Management and Augmentation**	**(7 Hrs)**

Artificial recharge techniques and site selection; Causes and remedies of water-logging; Stream-aquifer interaction and baseflow contribution; Conjunctive use of surface and groundwater resources; Groundwater management strategies for sustainable use.

Learning Resources

Text Books:

1. Karamouz, M., Ahmadi, A., and Akhbari, M., Groundwater Hydrology: Engineering, Planning and ManagementCRC Press, Taylor et Francis Group, 2020
2. 2. Todd, D.K., and Mays, L.W., Groundwater Hydrology, John Wiley & Sons, Singapore, 2018

Reference Books:

1. Rastogi, A.K., Numerical Groundwater Hydrology, Penram International Publishing Pvt. Ltd., 2012

2. Davis, S. N., and De Weist, R. J. M., Hydrogeology, John Wiley & Sons, New York, 2013

3. Chahar, B. R., Groundwater Hydrology, McGraw Hill Education (India) Private Limited, New Delhi,
2015

Website Links:

Groundwater Hydrology NPTEL Course: https://nptel.ac.in/courses/105/103/105103026

JSPM University Pune **S.Y. M.Tech. (Environment and Water Resource Engineering)** **Semester- III**		
Course Type: IOC	**Course Title**: Fundamentals of Artificial Intelligence and Machine Learning	
Course Code: 250GCSM03_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: Algorithms. Probability Theory; Statistics; Computer Science.

Course Objectives:

- To learn basics of Artificial Intelligence including core features.
- To study different types of AIML and its Application.
- To understand the importance of AI for Industries.
- To use AI and ML various domains of Civil Engineering.

Course Outcomes: On completion of the course, the learner will be able to:
CO1: Understand the basics of AI and ML application for Industries.
CO2: Apply various Tools & Technology for AIML.
CO3: Implement the AIML for real-world problems.
CO4: Analysis the functionality of AIML.
CO5: Evaluate the performance of Tools & Technology applied in Industries.

Course Contents

Unit I	**Introduction to AIML**	**(5 Hours)**

Scope of the Course, Introduction to AI and ML, Brief review of History of AI and ML, Related fields. Concept of AI, Types of AI, Characteristics of AI, Key aspects of AI, Important of AIML, Application of AI.

Unit II	**Regression Analysis**	**(5 Hours)**

Overview of Machine Learning, Linear regression, Types of linear regression, Application of linear regression, Real-world use cases of linear regression, Logistics Regression, Models with multiple features, Correlation and Classification.

Unit III	**Application of ML**	**(5 Hours)**

Introduction to Clustering, Types of Clustering, Segmentation, Anomaly detection, and pattern recognition. Clustering Algorithms in Machine Learning: K-Mean, Applications of Clustering, Advantages Clustering.

Unit IV	**Bayesian Application**	**(5 Hours)**

An overview of Bayesian Networks in AI, Application of Bayesian networks in AI, Bayesian Network Model, Probabilistic Graphical Model. Decision Graph, Risk Model with Bayesian Network, Dynamic Bayesian Model.		
Unit V	**Infrastructure Monitoring and Management**	**(5 Hours)**
Introduction to infrastructure monitoring, Data integration with AIML, Ethical considerations in AI and ML Applications, Regulatory challenges and standards in civil engineering,		
Unit VI	**Case Study/Project**	**(5 Hours)**
Structural Analysis and Design, Construction Management, Geotechnical Engineering, Transportation Engineering, Environmental Engineering, Smart Cities and Sustainable Development, Building Information Modeling, Responsible AI development and deployment.		

Learning Resources

Text Books:

1. AI and Machine Learning with Python for Everyone, Mark Fenner, Pearson
2. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley
3. Machine Learning with Python, U Dinesh Kumar Manaranjan Pradhan, Wiley

Reference Books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms : Synthesis and Applications By S. Rajshekharan, G. A. Vijayalakshmi Pai, PHI
2. KishanMehrotra, Chilukuri Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
3. Tom Mitchell, Machine Learning, TMH
4. AthemEalpaydin, Introduction to Machine Learning, PHI 8. Andries P. Engelbrecht, Computational Intelligence - An Introduction, Wiley Publication

MOOC / NPTEL Course:

1. NPTEL Course titled “AIML Applications” IIT Madars, by Prof. C.A. Murthy and Prof. Sukhendu Das.

Link:1. https://www.geeksforgeeks.org/machine-learning/
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

JSPM University Pune
S.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- III

Course Type: IOC - I	**Course Title:** Fundamentals of Financial Management	
Course Code: 230VMSM11_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

- Basics of Accounting
- Principles of Economics
- Business Mathematics

Course Objectives:

1. To provide an understanding of the core concepts of financial management and its importance in business decisions.
2. To equip students with the skills to analyze financial statements and understand the financial health of a business.
3. To develop the ability to make informed financial decisions and manage financial risks.
4. To introduce recent trends and industry practices in financial management.

Course Outcomes:

CO1: Explain the fundamental concepts of financial management (PO1, PO2).
CO2: Analyze financial statements to assess the financial performance of an organization (PO2, PO3).
CO3: Apply financial management techniques to make investment and financing decisions (PO4, PO5).
CO4: Evaluate financial risks and devise strategies to mitigate them (PO6, PO7).
CO5: Integrate knowledge of recent trends and industry practices in financial decision-making (PO8, PO9).
CO6: Demonstrate the ability to communicate financial information effectively (PO10).

Course Contents

Unit I	**Introduction to Financial Management**	**(5 Hours)**
Definition, nature, and scope of financial management; Goals of financial management; Recent trends in financial management. Basic financial calculations (e.g., profit margin, return on investment)		
Unit II	**Financial Analysis and Planning**	**(5 Hours)**
Financial statement analysis; Ratio analysis; Cash flow and fund flow analysis. Calculation of financial ratios and interpretation (e.g., liquidity ratios, profitability ratios).		
Unit III	**Time Value of Money**	**(5 Hours)**

Concept of the time value of money; Present value and future value calculations; Applications in financial decision-making. Present value and future value problems, annuity calculations, discounting cash flows.		
Unit IV	**Investment Decisions**	**(5 Hours)**
Capital budgeting techniques; Risk analysis in capital budgeting; Recent trends in investment decisions. Net present value (NPV), Profitability Index, IRR, payback period calculations.		
Unit V	**Financing Decisions**	**(5 Hours)**
Cost of capital; Capital structure theories and planning; Sources of long-term finance. Calculating the cost of equity, debt, and weighted average cost of capital (WACC).		
Unit VI	**Working Capital Management**	**(5 Hours)**
Concepts and components of working capital; Management of cash, receivables, and inventory; Financing of working capital. Working capital cycle, inventory turnover ratio, receivables turnover ratio.		

Learning Resources

Text Books:

1. I.M. Pandey "*Financial Management*"
2. Richard A. Brealey, Stewart C. Myers, and Franklin Allen "*Principles of Corporate Finance*"

Reference Books:

1. Aswath Damodaran "*Corporate Finance*: *Theory and Practice*"
2. Eugene F. Brigham and Michael C. Ehrhardt "*Financial Management: Theory & Practice*"
3. David Hillier, Mark Grinblatt, and Sheridan Titman "*Financial Markets and Corporate Strategy*"
4. R. Charles Moyer, James R. McGuigan, and Ramesh P. Rao "*Contemporary Financial Management*"

MOOC / NPTEL Course:

Coursera Course on Financial Management

JSPM University Pune
S.Y. M.Tech. (Environment and Water Resource Engineering)
Semester- III

Course Type: VEC	**Course Title:** Behavioral Science and Ethics	
Course Code: 230USYB01_03	**Teaching Scheme: (Hrs./Week)**	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any:

1. NIL

Course Objectives:

- To prepare students for their future endeavors by imparting a sense of self, understanding their surroundings and their nation.
- The course also teaches strategies to lead healthy lifestyles with a positive attitude.
- It enables students to learn the process of problem solving and creative thinking.
- In the second part of the course, the students are being prepared for their professional development by inculcating leadership skills and ethical work values.

Course Outcomes: On completion of the course, learner will be able to

CO1: Understanding sense of self, nation, and society they are living in.
CO2: Applying strategies to manage stress and understanding stress and its consequences.
CO3: Analyzing problem and Strategizing way to solve it.
CO4: Evaluating group dynamics and leadership skills.
CO5: Creating healthy and ethical workspace.
CO6: Remembering values, morality, and ethics through thick and thin of life.

Course Contents

Unit I	**Self**	**(5 Hrs)**

I. What is Behavioural science and its significance
II. Self-awareness and its importance
III. Components of self and self-identity
IV. Self-concept
V. Self confidence
VI. Self-image

Unit II	**Stress Management**	**(5 Hrs)**

I. What is stress? and understanding reasons for stress.
II. What are possible consequences of the stress?
III. How to accept stress and share your emotions.
IV. What are strategies to manage stress?
V. Why seeking help is important when needed?

Unit III	Thinking, Perceiving and Problem Solving	(5 Hrs)
I. How to approach and analyze a problem? II. How to think? III. How to strategize and plan actions? IV. How to implement plans of action? V. What is creative thinking and how to process it?		
Unit IV	**Group Dynamics and Leadership Skills**	**(5 Hrs)**
I. Definition and characteristics of group II. What are external and internal conditions affecting group functioning? III. What are group conflict and group cohesiveness? IV. Meaning, nature and functions of leadership V. What are characteristics of a good leader?		
Unit V	**Indian Ethics**	**(5 Hrs)**
I. Sources of Moral Ideals in India, Ethics: Its Meaning in Indian Tradition II. Ethics in Vedic Period, Ethics in Dharmasastras and Itihasas III. Way of Righteousness in the Gita, Ethical Concepts of Hindu Tradition IV. Ethics in Buddhism, Jaina Ethics		
Unit VI	**Western Ethics**	**(5 Hrs)**
I. Aristotle, Thomas Aquinas II. William of Ockham, Thomas Hobbes III. Jeremy Bentham, Immanuel Kant IV. John Stuart Mill V. Emile Durkheim		

Learning Resources
Textbook: 1. Bates. A. P and Jullian J “Sociology: Understanding social Behaviour”, Houghton Mifflin, 1975.
Reference Book: 1. J William Pfeiffer (ed) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996); Pfeiffer and company. 2. William Frankena K, Ethics, Prentice-Hall, Inc., 1973 https://dorshon.com/wp-content/uploads/2018/03/Ethics.pdf
MOOC / NPTEL Course: 1. NPTEL Course: “https://onlinecourses.nptel.ac.in/noc20_hs28/preview”, Prof. Naveen Kashyap, IIT Guwahati **Other online material** Ethics notes IGNOU - https://egyankosh.ac.in/handle/123456789/4774

JSPM University Pune
S.Y. M.Tech. "Environment and Water Resource Engineering"
Semester- III

Course Type: SLC	**Lab Course Title:** Seminar	
Course Code: 250GEWM03_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P):** 4 **Experiential Learning (EL):**	**Oral (OR):** 100 Marks

Prerequisite Courses, if any: -

Objectives:

- To develop skills in literature survey, technical writing, and oral presentation.
- To enhance communication, organization, and time management skills in a professional setting.
- To encourage critical thinking, knowledge synthesis, and presentation on contemporary issues in Construction Management.
- To build confidence in presenting technical concepts and real-life project experiences to a professional audience.
- To create an opportunity to analyze and reflect on field training or internship outcomes.

Course Outcomes: On completion of the course, learner will be able to
CO1: Conduct a structured literature survey on a relevant topic or project.
CO2: Identify, define, and frame a technical problem or theme for presentation.
CO3: Prepare a comprehensive seminar report following academic standards.
CO4: Deliver an effective oral presentation with confidence and clarity.
CO5: Demonstrate analytical thinking and communication skills.
CO6: Incorporate feedback from faculty and peers to improve their work.

Seminar Guidelines:

- Each student will select a topic related to their internship/field project, or a current trend/challenge/innovation in Construction Management.
- Topics must be approved by the Seminar Coordinator.
- Students are expected to consult journal papers, industry reports, codes, standards, and project documentation.
- A seminar report (hard and soft copy) must be submitted in the prescribed format.

Seminar Report Format (Recommended):

1. Title Page
2. Certificate from Guide
3. Acknowledgement
4. Abstract (max 300 words)
5. Table of Contents
6. Introduction
7. Objectives of the Study
8. Literature Review / Background
9. Problem Statement / Case Study Description
10. Methodology / Techniques Used / Field Observations
11. Analysis, Results, and Discussion
12. Conclusions and Recommendations
13. References (APA / IEEE style)
14. Appendices (if any)

Seminar Evaluation Criteria

1. **Seminar Report**
   - Structure and formatting (Title page, index, references, etc.)
   - Clarity of objectives and problem statement
   - Quality and depth of literature review or background study
   - Methodology or approach followed
   - Analysis, observations, or findings from case studies
   - Conclusions, recommendations, and originality/innovation
2. **Oral Presentation**
   - Communication and presentation skills
   - Depth of subject knowledge
   - Use of visual aids (PowerPoint/other media)
   - Handling of questions and audience interaction
   - Confidence, fluency, and professionalism
   - Effective time management
3. **Overall Contribution and Conduct**
   - Regularity and punctuality in meetings and submissions
   - Active participation and coordination with the guide
   - Maintenance of logbook/diary
   - Feedback from seminar guide or external/internal supervisor

Instructions for Students:

- Submit the proposed seminar topic in Week 1 of the semester.
- Attend all review meetings with your assigned guide.
- Weekly progress must be recorded and presented to the guide.
- Final seminar presentations to be conducted in Weeks 14–16 before a departmental panel.
- No plagiarism; originality will be checked and penalized if found otherwise.

JSPM University Pune
S.Y. M.Tech. "Environment and Water Resource Engineering"
Semester- III

Course Type: IITP/FP/CEP	**Lab Course Title:** Field Project	
Course Code: 250GEWM01_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 6	**Lecture (L):** **Tutorial (T):** **Practical (P):** 4 **Experiential Learning (EL): 8**	**Practical (PR)-** 50 Marks **Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Objectives:

- To identify, investigate and work on real-world industry problems.
- To develop skills in problem formulation, literature survey, methodology design, data collection, and analysis.
- To encourage independent thinking, research aptitude, and professional project documentation.
- To apply academic learning to practical engineering and management challenges.

Course Outcomes: On completion of the course, learner will be able to
CO1: Identify and define a researchable or practical problem in construction management.
CO2: Conduct an in-depth literature survey related to the topic.
CO3: Design a suitable methodology for field/project investigation.
CO4: Initiate data collection, modeling, or analysis.
CO5: Present findings and future scope effectively through a structured report and seminar.
CO6: Demonstrate time management, documentation, and communication skills.

Field Project Scope:

- Selection of problems/topic (based on industrial challenge, societal need, or academic relevance).
- Review of literature, background study, and framing of research/problem statement.
- Defining objectives, scope, and methodology.
- Preliminary data collection or case studies (if applicable).
- Submission of Project Proposal Report and Mid-Term Review Presentation.

Evaluation Criteria (Semester III - 100 Marks):

1. **Problem Identification and Relevance**
2. **Literature Survey and Technical Understanding**
3. **Project Planning, Scope, and Methodology**
4. **Preliminary Work / Case Study / Field Work Progress**
5. **Regularity, Discipline, and Interaction with Guide**
6. **Mid-Semester and Final Presentation Skills**
7. **Documentation and Project Report**

Instructions for Students (Phase I):

1. Topic Selection
   - Select a relevant, practical, or innovative topic in consultation with your assigned guide.
   - The topic may be industrial, societal, research-based, or field-oriented.
2. Proposal Preparation
   - Submit a project proposal including: problem statement, objectives, scope, review of literature, and proposed methodology.
3. Weekly Progress
   - Maintain regular contact with your internal guide (at least once a week).
   - Submit progress updates in your project logbook.
4. Mid-Semester Review
   - Present your progress in a departmental review to receive constructive feedback.
5. Interim Report Submission
   - Prepare a structured report containing proposal details, literature survey, initial work, methodology, and proposed data sources.
6. Plagiarism
   - Ensure your work is original and properly referenced. Plagiarism will result in rejection of report.
7. Final Presentation
   - Present your Phase I work before an evaluation panel and receive approval to proceed to Phase II.

JSPM University Pune
S.Y. M.Tech. "Environment and Water Resource Engineering"
Semester- III

Course Type: MLC	**Course Title**: Structural Audit	
Course Code: 230GSEM29_03	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):**	**Theory (TH):** 50 marks

Prerequisite Courses, if any:
1.

Course Objectives:
- To explain the concept, purpose, and legal framework of structural audits for civil infrastructure.
- To familiarize students with Non-Destructive Testing (NDT) techniques, evaluation methods, and their interpretation.
- To develop skills in detailed structural assessment, condition rating, and residual life estimation.
- To understand different components of GIS and Learning about map projection and coordinate system.
- Enhance professional competency in preparing structural audit reports, managing audits, and adhering to ethical practices.

Course Outcomes: On completion of the course, learner will be able to
CO1: Describe the need, objectives, and legal provisions related to structural audits in civil engineering.
CO2: Identify and classify different types of structural distress and their probable causes in RCC, steel, and masonry structures.
CO3: Select appropriate NDT techniques, conduct tests, and interpret results for assessing structural health.
CO4: Perform detailed structural assessments, evaluate condition ratings, and estimate the residual life of structures.
CO5: Propose suitable repair and retrofitting methods based on the nature and extent of distress. **CO6:** Prepare comprehensive structural audit reports, incorporating technical findings, recommendations, and compliance with professional ethics.

Course Contents

Unit I	**Introduction to Structural Audit**	**(5 Hours)**

Concept & Importance of Structural Audit in civil infrastructure, Legal Provisions & Guidelines – National and International codes (IS 13311, IS 456, municipal requirements). Classification of Structures Requiring Audit – Residential, commercial, industrial, heritage. Stages of Structural Audit – Preliminary and detailed audit. Case examples of failures due to lack of timely audit.

Unit II	**Distress in Structures: Causes & Identification**	**(5 Hours)**
Types of structural distress – Cracks, corrosion, deflection, spalling, settlement, Causes – Material degradation, environmental effects, design faults, poor workmanship, overloading, Symptoms of Distress in RCC, steel, masonry structures, Visual inspection techniques – Checklist preparation Field photographs & video demonstrations.		
Unit III	**Non-Destructive Testing (NDT) & Evaluation Methods**	**(5 Hours)**
Types of structural distress – Cracks, corrosion, deflection, spalling, settlement, Causes – Material degradation, environmental effects, design faults, poor workmanship, overloading, Symptoms of Distress in RCC, steel, masonry structures, Visual inspection techniques – Checklist preparation, Field photographs & video demonstrations.		
Unit IV	**Detailed Structural Assessment & Condition Rating**	**(5 Hours)**
Preparation of structural drawings & documentation, Load assessment & design verification, Structural health grading & condition rating systems, Evaluation of residual life of structure, Reporting formats for structural audit.		
Unit V	**Repair & Retrofitting Techniques**	**(5 Hours)**
Principles of structural repair, Material selection – High performance concrete, FRP composites, polymer-modified mortars, strengthening methods – Jacketing, steel plate bonding, FRP wrapping, section enlargement, Foundation strengthening techniques, Waterproofing & corrosion protection, Standards & guidelines for repair execution.		
Unit VI	**Case Studies, Report Preparation & Audit Management**	**(5 Hours)**
Presentation of real-life structural audit case studies (RCC buildings, industrial sheds, bridges), Preparation of structural audit report – Executive summary, methodology, findings, recommendations, cost implications, Audit documentation for legal and municipal submission, Ethical considerations & professional responsibilities, Open discussion & Q&A session.		