

Course Title	HYDROLOGY AND IRRIGATION ENGINEERING	Semester	VI
Course Code	MVJ20CV61	CIE	50
Total No. of Contact Hours	50 L: T: P:: 3: 2: 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Explain the concept of hydrology and analyse hydrological data
- Measure the components of hydrological cycle.
- Analyse the flood hydrograph, unit hydrograph and S curve hydrograph.
- Demonstrate the system of irrigation.
- List and explain the Irrigation structures.

Module-1

L1, L2, L3

10 Hrs

Prerequisite: Knowledge on Water in earth, Water cycle, weather & climate

Hydrology: Introduction- Surface and Ground water Hydrology, Importance and Application of Hydrology in Engineering, Hydrologic cycle- Horton's representation, Engineering representation, Descriptive representation. Climate, Weather - Meteorological measurements

Precipitation: Forms and types of precipitation, measurement of precipitation (Simon's gauge & Syphon gauge only), and selection of rain gauge station. Adequacy of rain gauges, methods of computing average rainfall, interpolation of missing data, adjustment of missing data by double mass curve method, Hyetograph and mass curve of rainfall, Frequency analysis.

Laboratory Sessions/ Experimental learning: Determination of the average annual rain fall of the river basin by collecting the data

- Case study on the Precipitation data Analysis

Applications:

- Measuring the rainfall in the field
- Determining the missing rainfall data
- Presenting of rainfall data for Hydrological analysis

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/#>

Module-2

L1, L2, L3

10 Hrs

Prerequisite: precipitation and Runoff

Losses from precipitation: Evaporation: Definition, factors affecting, measurement (Class A pan). Estimation using empirical methods (Meyer's and Rohwer's equation),

evaporation control. Evapo-transpiration: Definition, factors affecting, measurement, estimation (Blaney criddle method)

Infiltration: Definition, factors affecting measurement (double ring infiltrometer), infiltration indices, Horton's equation of infiltration.

Runoff –Process, Estimation of runoff and Factor affecting runoff.

Laboratory Sessions/ Experimental learning: Measurement of evaporation rate of a reservoir and identification of evaporation control measures

- Case study on Evaporation control

Applications:

- Evaporation rate measurement the in the reservoir
- Measurement of infiltration rate for the different landscape
- Measuring the runoff in a river

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/#>

Module-3

L1, L2, L3

10 Hrs

Prerequisite: Flood & Drought,

Hydrographs: Definition, components of hydrographs, unit hydrograph and its derivation from simple storm hydrograph, base flow separation, Unit Hydrograph, S Hydrograph – Applications and numerical problems **Estimation of flood & flood**

routing: Definition of flood, methods of estimation of flood, Flood routing- Classification and introduction to Flood routing techniques, Flood control and management.

Laboratory Sessions/ Experimental learning:

- Plotting the hydrograph of a river basin by collecting the relevant data.
- Case study on Flood mitigation measures

Applications:

- Analyzation of runoff and Rainfall relationship
- Prediction of Flood
- Proposing the flood mitigation measures

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/>

Module-4

L1, L2, L3

10 Hrs

Prerequisite: Irrigation, Crops, and Crops seasons.

Irrigation Engineering: Introduction, need for irrigation, advantages and disadvantages of irrigation, Systems of irrigation: Gravity irrigation, lift irrigation, Flow irrigation, Furrow Irrigation, Strip Irrigation, Border Irrigation, Basin Irrigation, Micro Irrigation-Components- Advantages and disadvantages.

Water Requirement of Crops: Introduction, definitions, crop seasons of India, water requirement of a crop, duty, delta, base period. Consumptive use, Irrigation efficiencies, Assessment of irrigation water.

Laboratory Sessions/ Experimental learning:

- Identifying the suitable irrigation system in the particular field to improve the productivity
- Case study on Selection of irrigation methods

Applications:

- Increasing the water productivity
- Analyzing Effective Irrigation water management techniques
- Design the irrigation system

Video link / Additional online information:

- <https://nptel.ac.in/courses/10512159/>
- <https://nptel.ac.in/courses/105102159/>

Module-5	L1, L2, L3	10 Hrs
<p>Prerequisite: <i>Open channel flow</i></p> <p>Irrigation Structures: Definition, Irrigation water storage and water diversion structures, Dam- Components, types, functions, Tank- Components and Functions, Diversion head works, weir, River training works- Components.</p> <p>Canals: Definition, Types of canals, Alignment of canals, Design of canals by Kennedy's and Lacey's methods- Problems, Canal Fall and its types.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Identification of irrigation structure in a given region • Case study on canal design <p>Applications:</p> <ul style="list-style-type: none"> • Design of water storage structures, Design of canal • Rehabilitation of Irrigation structures <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105103096/ 		

Course Outcome	
CO1	Use the precipitation data for the hydrological research
CO2	Predict the components of Hydrological cycle
CO3	Use the hydrographs of the basin for runoff analysis
CO4	Illustrate the suitable irrigation system by calculating the water requirement of the crop
CO5	Explain the various irrigation structures

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses / Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1	K. Subramanya, "Engineering Hydrology", 4 th Edition Tata McGraw Hill Publishers, New Delhi, 2017
2	Punmia B C and Lal Pandey, "Irrigation and Water Power Engineering" Lakshmi Publishers, 2018

Reference Books:	
1.	Jayarami Reddy, "A Text Book of Hydrology", Lakshmi Publications, New Delhi, 2019
2	Te Chow, V., "Applied hydrology", Tata McGraw-Hill Education, 2010.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1	1				1		
CO2	2	1				1				1		
CO3	2	1		2	1					2		
CO4	2			2	1	1	2				1	
CO5	2	2			1		2	1		1		

High-3, Medium-2, Low

Course Title	DESIGN OF RC STRUCTURES	Semester	VI
Course Code	MVJ20CV62	CIE	50
Total No. of Contact Hours	50 L: T: P: 3: 2: 0	SEE	50
No. of Contact Hours/Week	5	Total	100
Credits	4	Exam Duration	3Hrs

Course objective is to:

- Identify, formulate, and solve engineering problems of RC elements subjected to different kinds of loading.
- Illustrate a procedural knowledge in designing various structural RC elements.
- Impart the culture of following the codes for strength, serviceability, and durability as an ethics.
- Provide knowledge in analysis and design of RC elements for the success in competitive examinations.

Module-1

L1,L2,L3

10 Hrs

Pre requisites: Basic knowledge of Structural Analysis

Introduction to Limit State Design and Serviceability: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short term deflection, long term deflection. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Calculation of deflection and cracking of singly reinforced beam only.

Laboratory Sessions/ Experimental learning: (Self Learning)

- To compare various components designed using older methods and limit state method.
- Comparison of components designed using older methods and limit state method

Applications: (Self Learning)

- To access the importance of strength and serviceability criteria in the design.

Video link:

- <https://nptel.ac.in/courses/105/105/105105105/>

Module-2

L1,L2,L3

10 Hrs

Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced, and flanged beams for flexure and shear.

Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Generate excel sheets for analysis of beams Applications: <ul style="list-style-type: none"> • In analyzing beams of single and multistoried buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-3	L1,L2,L3	10 Hrs
Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams for shear, design for combined bending and torsion as per IS-456. Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Generate excel sheets for design of beams/ develop 3D models in software to understand detailing. Applications: <ul style="list-style-type: none"> • In designing beams of single and multistoried buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-4	L1,L2,L3	10 Hrs
Limit State Design of Slabs and Stairs: Introduction to one way and two-way slabs, Design of cantilever, simply supported and one-way continuous slab. Design of two-way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length. Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Models of beams and slabs/ Site visits to understand the RC detailing of various components. Applications: <ul style="list-style-type: none"> • In designing slabs and stairs for single and multi-storied buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-5	L1,L2,L3	10 Hrs
Limit State Design of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and for axial load & moment.		

Laboratory Sessions/ Experimental learning: (Self Learning)	
<ul style="list-style-type: none"> • Generate excel sheets for design / develop 3D models in software to understand detailing. 	
Applications:	
<ul style="list-style-type: none"> • In designing columns and footings for single and multistoried buildings 	
Video link:	
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 	
Course outcomes: On completion of the course, students would be able to	
CO1	Restate the design philosophy and principles.
CO2	Solve engineering problems of RC elements subjected to flexure, shear and torsion.
CO3	Illustrate on the procedural knowledge in designs of RC structural elements such as slabs, columns and footings
CO4	Identify the different failure modes of steel tension and compression members and beams and compute their design strengths.
CO5	Design column splices and bases as per the Indian Standards

Text Books:	
1.	Unnikrishnan Pillai and Devdas Menon, "Reinforced Concrete Design", McGraw Hill, New Delhi, 2017
2.	Subramanian, "Design of Concrete Structures", Oxford university Press, 2013

Reference Books:	
1.	H J Sah, "Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)", Charotar Publishing House Pvt. Ltd. 2014
2.	P C Varghese, "Limit State design of reinforced concrete", PHI, New Delhi, 2013
3.	W H Mosley, R Husle, J H Bungey, "Reinforced Concrete Design", MacMillan Education, Palgrave publishers, 1999
4.	IS: 456-2000, "Indian Standard Code Of Practice For Plain And Reinforced Concrete"
5.	SP 16 (1978): Design Aids for Reinforced Concrete to IS 456:1978

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses / Assignment		8

Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	-	1	-	-	1	-	1	1
CO2	1	1	3	2	-	1	-	-	1	-	1	1
CO3	2	2	1	3	-	1	-	-	2	-	1	1
CO4	1	1	2	2	-	1	-	-	2	-	1	1
CO5	1	1	2	3	-	1	-	-	2	-	1	1

High-3, Medium-2, Low-1

Course Title	AIR QUALITY MANAGEMENT	Semester	VI
Course Code	MVJ20CV631	CIE	50
Total No. of Contact Hours	40 L: T:: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective: Students should be able to,

- Classify the sources and effects of air pollution.
- Outline the meteorological factors influencing air pollution.
- Analyse air pollutant dispersion models.
- Illustrate particulate and gaseous pollution control methods.
- Predict vehicular pollution and control methods.

Prerequisites: *Environmental Studies, chemistry, Introduction to Environmental engineering.*

Module-1

L1, L2, L3

08 Hrs

Introduction: Sources and effects of air pollution

Definition, Sources, classification, and characterization of air pollutants.

Effects of air pollution on health, vegetation & materials. photochemical smog and coal induced smog. Global Environmental episodes.

Laboratory Sessions:

- Model making of classifying pollutants.
- Study of recent case study on air pollution episodes.

Applications: (Self Learning)

- Identification of various sources, classification, and characterization of pollutants.
- Effects of air pollutants on human beings and environment.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089>
- <https://nptel.ac.in/courses/105102089/8>

Module-2

L1, L2, L3

08 Hrs

Meteorology:

Temperature lapse rate & stability, Types of inversion wind velocity & turbulence, plume behaviour, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths.

Development of air quality models-Gaussian dispersion model, Applications.

Laboratory Sessions:

- Model making of various types of wind roses.

Applications: (Self Learning)

- Collection of data and development of air quality models.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/>
- <https://nptel.ac.in/courses/105102089/8>

Module-3

L1, L2, L3

08 Hrs

Sampling and Analysis: Basic Principles of Sampling – Source and ambient sampling, sampling Principles - Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution).

Monitoring and analysis of air pollutants (PM_{2.5}, PM₁₀, SOX, NOX, and CO), preservation techniques.

Laboratory Sessions:

- Sample collection to identify and analyze indoor and ambient pollutants.

Applications: (Self-Learning)

- Sample collection procedures and analysis.
- Preservation techniques for different particulates.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>

Module-4

L1, L2, L3

08 Hrs

Control Techniques

Control of particulates, Control at Sources, Process Changes, Equipment modifications, Design and operation of control. Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators. Selection criteria for equipment.

Gaseous pollutant control by adsorption & absorption, condensation, combustion – Pollution control for specific major industries.

Laboratory Sessions:

- Model making of particulate control equipment's like scrubber, filter, etc.

Applications: (Self Learning)

- Selection criteria for different equipment's suitable for control of pollutants.

- Understanding the procedures of air pollution control for specific industries.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104099/35>
- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>

Module-5

L1, L2, L3

08 Hrs

Air and Noise Pollution:

Air pollution due to automobiles, standards, and control methods.

Noise pollution causes, effects and control, noise standards.

Environmental issues, laws, acts, protocols, Legislation, and enforcement –

Environmental Impact Assessment – Methods.

Laboratory Sessions:

- Poster Presentation on various environmental laws and protocols
- Experimental checking of indoor air quality levels using handy air sampler.

Applications: (Self Learning)

- To understand various environmental laws and protocols.
- To gain knowledge about noise pollution and its effects on human beings.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>
- <https://nptel.ac.in/courses/105104099/35>

Course outcomes: On completion of the course, students would be able to

CO1	Identify the major sources of air pollution and understand their effects on health and environment.
CO2	Analyze the dispersion of air pollutants in the atmosphere and to develop air quality models.
CO3	Examine the sampling techniques for atmospheric and stack pollutants.
CO4	Outline and use the control techniques for particulate and gaseous emissions
CO5	Identify the sources of automobile pollution and understand their effects on health and environment and their control methods.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30		30

Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		10 0

Text Books:

1.	Rao C.S. (2006) Environmental Pollution Control Engineering, 2nd edition, New Age International, New Delhi.
2	Anjaneyulu Y, "Textbook of Air Pollution and Control Technologies", Allied Publishers

Reference Books:

1.	W.L. Heumann (1997), Industrial Air Pollution Control Systems, McGraw Hill, New York
2	Rao M.N., & Rao H V N. (1996), Air Pollution Control, Tata-McGraw Hill, New Delhi.
3	H. C. Perkins, "Air pollution". Tata McGraw Hill Publication
4	Mackenzie Davis and David Cornwell, "Introduction to Environmental Engineering" McGraw-Hill Co.
5	Noel De Nevers, "Air Pollution Control Engineering", Waveland Pr Inc.

CO-PO Mapping

CO/P O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1				1	2	2		1		
CO2	2	3	1	1			2					
CO3	2	1		2	1					2		
CO4	2	1		1	1	1				1		
CO5	2	1				1	2	2				

High-3, Medium-2, Low-1

Course Title	MUNICIPAL WASTEWATER MANAGEMENT	Semester	VI
Course Code	MVJ20CV632	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective: Students should be able to,

- Describe the concepts about sewerage systems and sewer appurtenances.
- Outline different unit operations and unit process involved in wastewater treatment process.
- Explain the concept and design of various physicochemical treatment units.
- Illustrate the concept and design of various biological treatment units.
- Examine the concept of tertiary wastewater treatment methods

Prerequisites: *Introduction to Environmental engineering, Basic knowledge of hydraulics is necessary.*

Module-1

L1, L2, L3

8 Hrs

Introduction: Wastewater Engineering

Introduction: need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm flow, time of concentration flow, material of sewers, shape of sewers, laying of sewers, joints and testing of sewers, ventilation of sewers.

Sewer appurtenances, manholes, catch basins, flushing tanks, traps, basic principles of house drainage, typical layout plan showing house drainage connections, maintenance of house drainage.

Laboratory Sessions:

- Model making of different types of sewers.
- Study of various shapes of sewers and its model making.

Applications: (Self – Learning)

- Identifying different sewer material properties.
- Knowledge about various sewer appurtenances and its practical use.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104102/>
- <https://nptel.ac.in/courses/105105048/>

Module-2	L1, L2, L3	8 Hrs
<p>Design of sewers: Hydraulic formula for velocity, effects of variation on velocity, self-cleansing and non-scouring velocities, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions. Reaction kinetics (zero order, 1st order, and 2nd order).</p> <p>Disposal of effluents by dilution, self-purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents, Streeter- Phelps equation.</p> <p>Laboratory Sessions: (Self – Learning)</p> <ul style="list-style-type: none"> • Study of journal papers on hydraulic elements and design of sewers under different flow conditions. • Experimental study of oxygen sag curve. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Knowledge about the hydraulic elements of sewers under different flow conditions. • Behavior of different types of streams due to disposal of effluents. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105048/ 		
Module-3	L1, L2, L3	8 Hrs
<p>Wastewater characteristics: Sampling, significance and techniques, physical, chemical, and biological characteristics, CNS cycles, flow diagram for municipal wastewater treatment, unit operations.</p> <p>Theoretical principles and design criteria and design of screens, equalization basin, grit chamber, skimming tanks, primary and secondary settling tanks.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Sampling and testing of wastewater samples to identify various physical, chemical, and biological characteristics of water. (Env.Lab experiments) • Model making of Municipal Wastewater treatment showing various treatment units. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Sample collection procedures and analysis. • Knowledge of BIS standards for various physical, chemical, and biological parameters. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ 		

<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105048/ 		
Module-4	L1, L2, L3	8 Hrs
<p>Working principles and design</p> <p>Suspended growth system - conventional activated sludge process and its modifications. Attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles and design of stabilization ponds. Sequential batch reactors, moving bed bio reactors.</p> <p>Sludge Processing: Separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Activated sludge process, F/M ratio and modifications of ASP.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Model making of suspended and attached growth systems. • Preparation of flow chart showing various waste treatment processes. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Understand the sludge processing techniques and its behavior in different feeding conditions. • Knowledge on varying F/M ratios and understand its applications for various modifications of ASP. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ • https://nptel.ac.in/courses/105105048/ 		
Module-5	L1, L2, L3	8 Hrs
<p>Tertiary Wastewater Treatment</p> <p>Anaerobic Sludge digestion, Sludge digestion tanks, Design of Sludge drying beds, Need and technologies used. Nitrification and Denitrification Processes, Phosphorous removal. Advance oxidation Processes (AOPs), Electro coagulation, Numerical Problems.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Experimental determination of coagulation process. • A visit to college STP to make them understand and give practical exposure about the various wastewater treatment procedures. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Understand the importance of denitrification and removal of phosphorous from the wastewater. • Behavior of digested sludge on drying and its practical use as a manure. <p>Video link / Additional online information:</p>		

- <https://nptel.ac.in/courses/105104102/>
- <https://nptel.ac.in/courses/105105048/>

Course outcomes: On completion of the course, students would be able to	
CO1	Illustrate to design sewer and Sewerage treatment plant.
CO2	Outline degree of treatment and type of treatment for disposal, reuse and recycle.
CO3	Identify waste streams and design the municipal wastewater treatment plant.
CO4	Predict sewage effluent issues.
CO5	Identify the technologies used in tertiary wastewater treatment.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. \sum (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Metcalf and Eddy, "Wastewater Engineering - Collection, Treatment, Disposal and Reuse", McGraw Hill Pub.Co., 2009.
2	Patwardhan A.D, "Industrial Wastewater Treatment", PHI Learning Private Limited- New Delhi

Reference Books:

1	Nelson Leonard Nemerow, "Industrial Waste Treatment", Butterworth-Heinemann, 2007.
2	Hammer, M.J. and Hammer, M.J., "Water and Wastewater Technology", 7th Ed., Prentice Hall of India
3	Manual on Wastewater Treatment: CPHEEO, Ministry of Urban Development, New Delhi.
4	Fair, Geyer and Okun , "Water and Wastewater Engineering" Vol-II, John Willey Publishers, New York.
5	Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co Ltd.

CO-PO Mapping

CO/P O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	1	1	1		1
CO2	2	1	2				1	1				1
CO3	2	1	2			1	1	1				1
CO4	2	1	2	1			1		1	1		1
CO5	1	1	2	1	1		1			1		1

High-3, Medium-2, Low-1

Course Title	SOLID WASTE MANAGEMENT	Semester	VI
Course Code	MVJ20CV633	CIE	50
Total No. of Contact Hours	40 L: T: P:: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective is to:

- Restate the different elements of solid waste management from generation of solid waste to disposal.
- Analyze different processing technologies.
- Evaluate landfill site and conversion of municipal solid waste to compost or biogas.
- Identify sources, collection, treatment, and disposal of various types of solid waste.
- Analyze the energy recovery techniques from solid waste.

Prerequisites: Environmental Sciences, Introduction to Environmental Engineering.

Module-1

L1, L2, L3

8 Hrs

Introduction:

Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. functional elements of solid waste management system Generation rate, Numerical Problems.

Collection: Collection of solid waste- services and systems, equipment's.

Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with 2016 amendments.

Laboratory Sessions:

- Poster Presentation on composition of Solid waste
- Collection of solid waste generation data of the campus

Applications: (Self Learning)

- Identification of various sources, collection and transportation of solid waste.
- Effects of mishandling of solid waste on human beings and environment.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

Module-2	L1, L2, L3	8 Hrs
<p>Processing techniques: Purpose of processing, Chemical volume reduction (incineration) - Process description, 3T's, principal components in the design of municipal incinerators, Air pollution control, Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Processing of Municipal Solid Waste <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Identification of different processing techniques of Solid waste. • Identification of factors responsible for the design of Incinerators. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/105/105/105105160/ • https://nptel.ac.in/courses/105/106/105106056/ 		
Module-3	L1, L2, L3	8 Hrs
<p>Composting Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems.</p> <p>Sanitary Landfilling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Design of Sanitary Landfills. • Checklist for Composting techniques. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Identification of factors responsible for site selection for a Sanitary Landfill. • Effects of mishandling Sanitary Landfill Site. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/105/105/105105160/ • https://nptel.ac.in/courses/105/106/105106056/ 		
Module-4	L1, L2, L3	8 Hrs
<p>Sources, collection, treatment and disposal of :- Biomedical waste, E-waste, Hazardous waste and Construction and Demolition waste</p>		

Laboratory Sessions:

- Collection of E-waste generation data of the campus.
- Poster Presentation on collection, transport, and processing of Construction waste.

Applications: (Self Learning)

- Segregation of Biomedical waste and its impact on Biomedical waste handling and processing.
- Identification of characteristics of Hazardous waste.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

Module-5

L1, L2, L3

8 Hrs

Waste management rules and its amendments- Plastic Waste, E-waste, Biomedical Waste and Hazardous Waste. Energy recovery technique from solid waste management

Laboratory Sessions:

- Poster Presentation on Energy recovery techniques from solid waste management

Applications: (Self Learning)

- Different energy recovery techniques and their implications.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

Course outcomes: On completion of the course, students would be able to

CO1	Evaluate different elements of solid waste management system
CO2	Design suitable processing system
CO3	Asses the disposal site for solid waste
CO4	Identify sources, collection, treatment, and disposal of various types of solid waste
CO5	Apply the energy recovery techniques utilizing solid waste

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks		30
each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	

Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
	Total	100

Text Books:	
1.	George Tchobanoglous, Hilary Theisen , Samuel A Vigil, "Integrated Solid Waste Management: Engineering principles and management issues", M/c Graw hill Education . Indian edition, 1993.
2.	Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co ltd, ISBN: 9789351340263, 9789351340263, 2017

Reference Books:	
1.	Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016.
2.	Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health And Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
3.	Handbook of Solid waste management, second edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -100071356231

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	1	1	2	-	-	-	1
CO2	2	2	1	-	-	1	-	-	-	-	-	-
CO3	2	2	-	-	-	1	-	-	-	-	-	-
CO4	2	2	-	-	-	1	1	2	-	-	-	-
CO5	2	2	-	-	-	1	1	2	-	-	-	1

High-3, Medium-2, Low-1

Course Title	AIR AND WATER QUALITY MODELLING	Semester	VI
Course Code	MVJ20CV634	CIE	50
Total No. of Contact Hours	40 L: T: P: : 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- To facilitate acquiring basic skills of sampling and analytical techniques in air quality monitoring.
- Understanding of the air quality modelling and simulation techniques.
- To facilitate understanding of water quality guidelines, criteria and standards, and water quality index.
- Understanding and implementation of water quality programs.
- to acquire knowledge of the water quality modelling, sampling and analysis; and
- to provide exposure to the conventionally used water quality models

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about importance of air quality in Environmental Engineering

Introduction: Overview of current air quality trends and challenges; Basic concepts; applications and importance of air quality Monitoring; Iso-kinetic sampling; Precision and accuracy of monitoring; Air Quality Guidelines and Standards.

Laboratory Sessions/ Experimental learning:

- Documentation on air quality guidelines and standards
- Mini project on air sampling technique

Module-2

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about importance of air quality monitoring

Air Quality Modelling: Basic Components of an Air Quality Simulation Model; Parameters of Air Pollution Meteorology; Steady-state; Non-Steady-state and Grid Meteorological Modelling; Dispersion and Receptor modelling techniques; Gaussian plume model; Pasquill's stability Classification.

Laboratory Sessions/ Experimental learning:

<ul style="list-style-type: none"> • Report on derivation of Gaussian plume model • Documentation on air pollution parameters 		
Module-3	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>Basic knowledge about importance of air quality monitoring</i></p> <p>Analytical Techniques: Preparation of samples for analysis; Gravimetry; titrimetry; potentiometry (including ion analyzers); Colorimetry (UV-visible spectrometry); Metals and heavy metal detection techniques; Interpretation of Data; Air Quality Assessment and Reporting.</p> <p>Water sampling and analysis techniques; Water quality index and use specific water quality index.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Practice on preparation of samples for analysis • Knowledge about calibration of analyser 		
Module-4	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>Basic knowledge about importance of water quality monitoring</i></p> <p>Introduction to water quality modelling; Modelling of Lakes and reservoirs; Rivers and streams; and Groundwater modelling; Modelling for common water quality parameters: DO; temperature; suspended solids; algae; nutrients; coliforms and toxics; Calibration; validation and use of water quality models (DO-BOD models; solute transport models; nutrients and eutrophication models; and toxic substances and sediments models).</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Documentation work on water quality and its monitoring • Mini project on eutrophication models 		
Module-5	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>: Basic knowledge about importance of water quality modelling</i></p> <p>Softwares</p> <p>Air Modelling softwares; Validation of Models; Applications of Modelling; Air Pollution Forecast Models.</p> <p>Air quality Model -ARMOD, CALPUFF. – UNAMAP- BLP-RAM-ISCMPTER-CRSTER-Surface water quality models -HSPF, QUAL2K,</p> <p>Conventional Water Quality Models: QUAL2E – QUAL2K; BASINS and WASP7.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Practice on usage of various software's related to modelling <p>Applications:</p> <ul style="list-style-type: none"> • SO_x analysis by West and Geake method; 		

- NOx analysis by Jacobs and Hochheiser method;
- Stack monitoring; Tail pipe emissions monitoring;
- Preparation and analysis of samples in AAS and IC;
- Measurement of indoor air quality;
- Noise monitoring; Air modelling softwares - ISCST3; AERMOD, CALROADS, CALPUFF, etc

Course outcomes: On completion of the course, students would be able to

CO1	Learning of the techniques employed in the monitoring of particulates and gaseous pollutants in ambient air and stack gas
CO2	Gaining knowledge about modelling of air quality through the use of different softwares.
CO3	To be able to use the knowledge of water quality guidelines, criteria and standards, and water quality index
CO4	To be able to use water sampling and analysis techniques, water quality data analysis and WQI calculations
CO5	To be able to understand of water quality modelling and exposure to some of the conventionally used water quality models.

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Borrego C and Ana IM, Air Pollution Modelling and its Application; Springer (2008).
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2.	Khare M, Air Pollution – Monitoring; Modelling; Health and Control; InTech Publishers (2012)
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Reference Books:	
1.	Tiwary A and Colls J, Air Pollution: Measurement; Modelling and Mitigation; Spon Press (2002).
2.	Zannetti P, Air Quality Modelling - Theories; Methodologies; Computational Techniques; and Available Databases and Software: Volume IV - Advances and Updates; EnviroComp Institute (2010).
3.	Bartram J (Ed.), Water quality monitoring: A practical guide to the design and implementation of freshwater quality studies and monitoring programs, Taylor & Francis (2012).
4	Manivanan R, Water quality modelling: rivers, streams and estuaries, New India Publishing Agency (2008).
5.	Chapra SC, Surface water quality modelling, Waveland press (2008).
6.	Thomann RV and Mueller JA, Principles of surface water quality modelling and control, Harper & Row (1987).

Web Link and Video Lectures:	
1.	https://nptel.ac.in/courses/105/104/105104099/
2.	https://nptel.ac.in/content/storage2/courses/105101010/downloads/Lecture29.pdf

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	--	2	--	--	--	2	2	--	--	--	3	1
CO2	--	2	--	--	--	2	2	--	--	--	3	1
CO3	2	3	2	2	2	3	1	--	2	3	--	1
CO4	--	2	--	--	3	2	2	--	2	2	3	1
CO5	2	3	2	2	--	2	--	3	2	1	1	1

High-3, Medium-2, Low-1

Course Title	HIGHWAY GEOMETRIC DESIGN	Semester	VI
Course Code	MVJ20CV641	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- State the size and shape of various elements of roads are designed according to standards prescribed by IRC.
- Explain on how horizontal and vertical curves are designed to meet the design speed on the various types of roads.
- Illustrate on how the roads are designed to achieve optimum speed with maximum safety economically.
- Describe on how the roads are designed to achieve safe speed and maximum safety in the region of valley and summit curves.
- Brief on intersections and its suitability for safe traffic movement and to provide drainage elements for sustainable road.

Module-1

L1, L2, L3

8 Hrs

Prerequisites: Knowledge of roads and its components.

Introduction:

Geometric Control factors like Topography – design speed – design vehicle – Traffic – Capacity – volume – environment and other factors as per IRC and AASHTO standards and specifications- PCU concept – factors controlling PCU for different design purpose

Cross sectional elements: Pavement surface characteristics – friction – skid resistance – pavement unevenness - light reflecting characteristics – camber – objectives – types of camber – methods of providing cambers in the field – problems.

Laboratory Sessions/ Experimental learning:

- Visit to the nearest road and exploring the things

Applications:

- Able to get a practical knowledge on road elements provides.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105101087/>

Module-2	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Knowledge of pedestrian facilities and driver visibility.</i></p> <p>Cross sectional elements and Sight Distance:</p> <p>Cross sectional elements: Carriage way – kerb – median – shoulder – foot path – parking lanes – service roads – cycle tracks – Driveways – Right of way – Factors influencing right of way – Design of Road humps as per latest IRC provisions.</p> <p>Sight distance: Important, types, Sight distance at uncontrolled intersection, derivation, factors affecting sight distance, IRC, AASHTO standards, problems on above.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Visit to the nearest road and exploring the things <p>Applications:</p> <ul style="list-style-type: none"> • Able to get a practical knowledge on road elements provides. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105101087/ 		
Module-3	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Knowledge of change in alignment in horizontal direction</i></p> <p>Horizontal alignment:</p> <p>Definition, Checking the stability of vehicle, while moving on horizontal curve, Super elevation, Ruling minimum and maximum radius, Assumptions – problems – method of providing super elevation for different curves – Extra widening of pavement on curves – objectives – Mechanical widening – psychological widening – Transition curve – objectives – Ideal requirements – Types of transition curve – Method of evaluating length of transition curve – Setting the transition curve in the field, set back distance on horizontal curve and problems on above.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Designing a horizontal curve and marking in the field. <p>Applications:</p> <ul style="list-style-type: none"> • The knowledge on transferring design to field will be achieved. 		
Module-4	L1, L2, L3	8 Hr
<p><i>Prerequisites: Knowledge on change in ground profile.</i></p> <p>Vertical Alignment and Intersection design:</p> <p>Vertical alignment: Gradient – Types of gradients – Design criteria of summit and valley curve – Design of vertical curves based on SSD – OSD – Night visibility considerations – Design standards for hilly roads – problems on the above.</p>		

Intersection design: Principle – At grade and Grade separated junctions – Types – channelization – Features of channelizing Island – median opening – Gap in median at junction.

Laboratory Sessions/ Experimental learning: Model making on intersections and channelization

Applications: Knowledge on intersections and its vehicular behavior

Module-5	L1, L2, L3	8 Hr
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Prerequisites: Knowledge on round about intersection and highway drainages

Rotary intersection and Highway drainage:

Elements – Advantages – Disadvantages – Design guidelines – problem on the above – Grade separated intersection – Three legged inter section – Diamond inter change – Half clover leaf – clover leaf- Advantages- Disadvantages only

Highway drainage: Importance – sub surface drainage –surface drainage – Design of roadside drives – Hydrological – Hydraulically considerations and design of filter media, problems on above.

Laboratory Sessions/ Experimental learning: Identifying and chart making on different drainage types.

Applications: Knowledge on importance of drainage and patterns of drainage.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Course outcomes: At the end of the course, the student will be able to

CO1	Find importance and design geometric elements.
CO2	Predict sight distances and the components of horizontal curves.
CO3	Illustrate components of vertical curves and to design.
CO4	Solve the design of intersections in a roadway.
CO5	Examine IRC recommendations for highway.

Text Books:	
1.	Principle and practice of Highway Engineering- L R KADIYALI & N B LAL: Khanna publications, 2009
2.	Highway Engineering – Khanna S K & Justo, Nemchand & Bros. 2001
Reference Books:	
1	Highway Engineering by Srinivas Kumar, 2002
2	Relevant IRC Publications
3	Transportation Engineering and Planning- Papa Coastas and Prevendors PHI, New Delhi.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	1	-	-	-	1	-	1	1
CO2	2	1	2	2	1	-	-	-	1	-	1	1
CO3	2	1	2	2	1	-	-	-	1	-	1	1
CO4	2	1	2	2	1	-	-	-	1	-	1	1
CO5	2	1	2	2	1	-	-	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	PAVEMENT MATERIALS	Semester	VI
Course Code	MVJ20CV642	CIE	50
Total No. of Contact Hours	40 L: T: P:: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Explain the different types, properties and tests on soil sub grade.
- Explain the properties of aggregates and different test procedures and specifications.
- Explain the origin, properties, constituents and preparation of bitumen, tar, cutback bitumen and emulsions.
- Illustrate the bituminous mix design method.
- Explain in detail about HMA, WMA, CMA Explain types of cement, tests on cement, types of concrete, fillers, and sealers.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Knowledge on basics of Soil Mechanics

Soil Characterization:

Properties of sub grade layers; different types of soils, Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in - situ procedures for evaluating the mechanical properties of soils viz. SPT, CPT, CBR, Plate Load test, Field compaction and control.

Laboratory Sessions:

- Basic tests on soil.
- Soil Stability Test.

Applications:

- To find out the Physical requirements of Aggregates with respect to IRC specifications.
- To find out the Optimum Binder Content for Bituminous Mixes.

Video link / Additional online information:

- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-26.pdf>
- <https://www.youtube.com/watch?v=fqYK4JGIVJY>
- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-24.pdf>

Module-2	L3	8 Hrs.
<i>Prerequisites: Knowledge on basic Highway Engineering materials.</i>		
Bitumen:		
Bitumen and Tar: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements, Grades of bitumen i.e. Penetration Grade, Viscosity Grade, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Bituminous Emulsions and Cutbacks, Preparation, characteristics, uses and tests, Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion, Modified binders.		
Laboratory Sessions:		
<ul style="list-style-type: none"> • Basic tests on bitumen. 		
Applications:		
<ul style="list-style-type: none"> • To find out the Physical requirements of Bitumen with respect to IRC specifications. 		
Video link / Additional online information:		
<ul style="list-style-type: none"> • https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105106053/lec31.pdf • https://nptel.ac.in/courses/105105107/ 		
Module-3	L3	8 Hrs.
<i>Prerequisites: Knowledge on basic Highway Engineering materials.</i>		
Bituminous Mixes:		
Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties. Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short-term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV. Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Hubbard Field method of mix design, Hveem's method of mix design; Introduction to super pave mix design procedure, HMA, WMA, CMA.		
Laboratory Sessions/ Experimental learning:		
<ul style="list-style-type: none"> • Rutting test and Fatigue test • Marshall Mix Design 		
Applications:		
<ul style="list-style-type: none"> • To determine the stability of the mix • To Prepare the stable bituminous mix for the road construction 		
Module-4	L3	8 Hrs.
Pre requisites: Types of equipment		

Pavement construction.
 Road construction equipment – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice, productivity calculation. Problem on equipment usage charges Investment on equipment, depreciation. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Laboratory Sessions/ Experimental learning:

- Refer standard contract forms and identify important clauses.

Application:

- Equipment selection.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105103093/>,
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104161/lec12.pdf,
- <https://syedsohailuddin.files.wordpress.com/2018/07/is-1200-17.pdf>

Module-5	L3	8 Hrs.
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Prerequisites: Knowledge on basic Highway Engineering materials.

Quality control
 Sub grade: Preparation of sub grade- construction of embankments and cuts for roads; Quality control tests. Flexible Pavements: Specifications of materials, construction method and field control check for of flexible pavement layers –BM- DBM and BC Cement Concrete Pavements: – PQC-FRCC- Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.

Laboratory Sessions/ Experimental learning:

- Compaction Test(density)
- Quality tests of aggregate.
- Quality test on the Bituminous and cement concrete during the construction

Video link / Additional online information (related to module if any):

- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-19.pdf>

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8

Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Course outcomes: On completion of the course, students would be able to

CO1	Gain knowledge about aggregates, properties and tests.
CO2	Capable of doing mix design for different layers of pavement.
CO3	Gain the Knowledge Bituminous Mixes and its Properties.
CO4	Assess quality of materials.
CO5	Inspect and estimate the work of equipment

Text Books:

1.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee, 2014.
2.	Partha Chakroborty and Animesh Das, 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, 2011.

Reference Books:

1	Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, Prentice–Hall, 2002.
2	Freddy L Roberts, Prithvi S Kandhaletal, "Hot Mix Asphalt Materials, mixture design and construction" -(2ndEdition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA, 2009.
3.	Peurifoy.R.L., 'Construction Planning, Equipment and Methods', McGraw Hill Publishers, New York,2000.
4	S.C.Sharma, 'Construction Equipment and its Management', Khanna Publishers, New Delhi, 1988.
5.	IRC:16-2008, IRC: SP:20-2002, IRC:SP:72-2007, IRC: SP:62-2004, MoRTH and AASHTO Publications

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	-	-	1	-	2	1	-	1
CO2	2	2	1	3	-	1	1	-	2	1	1	1
CO3	2	2	2	1	-	1	-	-	2	1	-	1
CO4	2	2	3	3	-	1	1	-	2	1	-	1
CO5	2	2	3	2	2	2	1	-	2	1	1	1

High-3, Medium-2, Low-1

Course Title	RAILWAYS, HARBOURS, TUNNELING AND AIRPORTS	Semester	VI
Course Code	MVJ20CV643	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students should be able to,

- Illustrate the basic knowledge in railways
- Explain the basic concepts of the construction and management of railways
- Predict the development of Harbour and tunnelling
- Outline the design concepts of berthing structures
- State the basic knowledge of airport planning and design

Pre requisites: Elements of Transportation Engineering, Transportation modes, traffic engineering

Module-1	L1, L2, L3	8 Hrs.
<p>Railways: Introduction to rail transportation and its limitation, merits and demerits, (Online Mode) Railway track, concept of gauge, Advantages of uniform gauge and loading gauge Components of permanent way and its ideal requirement, Wheel and Axles, Coning of Wheels, Components of permanent way and its ideal requirement, Rail ,various type of rail cross section, length of rail, defects in rail and remedies to reduce the defects, Measure to reduce the wear of rails, Characteristics of an ideal rail joints ,Rail fastening and fixtures Purpose of welding of rail joints, Type, function and requirement of an ideal sleeper, Merits and demerits of various sleepers, Coning of wheels and its purposes(Online Mode) Stresses in Components of Track.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • HEADS Rail software (Alignment design for Railways, Metro Rail Tunnels, Mono Rails, MRT, LRT) • Poster preparation on components of rails <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Case study - Railway Reservation (https://www.oreilly.com/library/view/introduction-to-database/9788131731925/xhtml/casestudy002.xhtml) • Dynamic Effects of a Long-span Railway Continuous Beam Bridge 		
Module-2	L1, L2	8 Hrs.
<p>Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation</p>		

of Materials required for track laying – Construction and maintenance of tracks
Modern methods of construction & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways (Online Mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Ansys software introduction
- Kenpave software introduction

Applications: (Self Learning)

- ABS on the Rails
- Signal crossing prevention system

Module-3	L1, L2, L3	8 Hrs.
<p>Harbour Engineering: Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location (Online Mode).and Design Principles – Harbour Layout and Terminal Facilities, Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works.</p> <p>Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation. (Online Mode).</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Design load application in Numerical Modelling for Coastal Structures • Subsurface soil exploration tests <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Risk levels in coastal and river engineering Environmental impact of harbor activities 		
Module-4	L1, L2, L3	8 Hrs.
<p>Berthing structure: General aspects of selection and design for berthing structures, Piers, Wharf, Quay wall, Jetty, Dolphins, trestle, Moles and mooring accessories, Design and construction of Dock wall, classification of Break water and construction method of Break water wall, Necessity for Fenders, types of fenders and Mooring system, Importance of Navigation Aids, Type of Navigation, Requirements of Signals, Light house, Beacons, Beacon light, Floating Navigation aids, Range light and Radar Reflectors. Types of dredger, Necessary of dredging (Online Mode).</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Model making of berthing structures <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Navigational aids in harbors and port approaches 		

Module-5		L1, L2, L3	8 Hrs.
Airport Design: Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting			
Laboratory Sessions/ Experimental learning: (Self Learning) <ul style="list-style-type: none"> • Virtual Aerodrome Laboratory introduction • AVN 370 Airport Management and Finance 			
Applications: (Self Learning) <ul style="list-style-type: none"> • Sustainable Approach to Airport Design and Operations • Final Airport Eco Design 			
Scheme of Evaluation:			
Details			Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3		CIE(50)	30
Quizzes			2x2 = 4
Activities / Experimentations related to courses/Assignment			8
Mini Projects / Case Studies			8
Semester End Examination		SEE (50)	50
Total			100
Course outcomes: On completion of the course, students would be able to			
CO1	Predict the capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway		
CO2	Compare and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive		
CO3	Restate the layout plan of airport, harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same		
CO4	Apply the knowledge gained to conduct surveying, understand the tunneling activities		
CO5	Analyze the Change tunnels, harbors, dock and necessary navigational aids and various methods of tunneling and tunnel accessories		

Text Books:	
1.	Oza.H.P. and Oza.G.H., A course in Docks & Harbour Engineering. Charotar Publishing Co.2016
2.	C Venkatramaiah, Transportation Engineering, Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels, Universities Press, 2016

Reference books:	
1	Mundrey J.S. A course in Railway Track Engineering. Tata McGraw Hill, 2009
2	Srinivasan R. Harbour, Dock and Tunnel Engineering , 26th Edition 2013
3	Khanna S K, Arora M G and Jain S S, Airport Planning and Design, Nemchand and Brothers, Roorkee, 1994

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	1	-	-	1
CO2	3	3	1	1	-	-	-	-	1	1	-	1
CO3	3	2	1	1	-	-	-	-	1	-	-	1
CO4	3	3	1	2	1	-	-	-	1	1	-	1
CO5	3	2	1	2	1	-	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	ROAD SAFETY AND MANAGEMENT	Semester	VI
Course Code	MVJ20CV644	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objective: Students will be able to,

- Explain different parameters responsible for providing road safety in the construction of new roads.
- Describe road reconstruction principle and improvement of road considering the different components of road and intersections.
- Discuss road safety and maintenance measures for road in operation considering pedestrian, cyclists, and road furniture.
- Define road safety audit principle and procedure, various traffic management techniques and their effectiveness.

Module-1

L3

8 Hrs.

Prerequisites: Road accidents

Road accidents, Causes, Scientific Investigations and Data Collection: Accident Analysis considering different scenarios, Analysis of Individual accidents to arrive at Real Causes, Statistical Methods of Analysis of Accident Data.

Laboratory Sessions/ Experimental learning:

- Analyzing any accident at a nearby junction

Applications:

- Accident analysis and finding the speed of vehicles involved in the accident.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_42.pdf

Module-2

L3

8 Hrs.

Prerequisites: Road safety and design

Ensuring Traffic Safety in Designing New Roads: Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section and Objects on the Right-of-Way.

Laboratory Sessions/ Experimental learning:

- Surveying newly constructed road with respect to safety parameters stated in the module.

Applications:

- Understanding how different conditions affect safety on New roads.

Module-3

L3

8 Hrs.

Prerequisites: Road reconstruction.

Ensuring Traffic Safety in Road Reconstruction: Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads.

Applications:

- Analyzing the accident data for reconstruction of roads.

Module-4

L3

8 Hrs.

Prerequisites: Road safety ensuring

Ensuring Traffic Safety in Road Operation: Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines and Guideposts, Guardrails and Barriers and Road Lighting.

Laboratory Sessions/ Experimental learning:

- Conducting a pedestrian safety survey at Hope form junction and analyzing the results.

Module-5

L3

8 Hrs.

Prerequisites: Road safety management

Road Safety Audit and Traffic Management Techniques: Principles- Procedures and Practice, Code of Good Practice and Checklists. Road safety issues and engineering, education, enforcement measures for improving road safety. Local area management. Low-cost measures, area traffic control.

Laboratory Sessions/ Experimental learning:

- Analyzing the safety of road with respect to engineering parameters on a stretch of road nearby.

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Course outcomes: On completion of the course, students would be able to

CO1	Recognize the factors affecting the construction of new roads
CO2	Illustrate the factors affecting the reconstruction of existing roads
CO3	Summarize the factors affecting the operation condition of road
CO4	Remember and illustrate the process of road safety audit and the measures of improving road safety.
CO5	Recognize the factors affecting the construction of new roads

Text Books:

1.	Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
2.	Jotin Kishty and B. Kent Lall, 'Transportation Engineering-An Introduction', Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006

Reference Books:

1.	Babkov, V.F. 'Road conditions and Traffic Safety', MIR publications, Moscow - 1975.
2.	K.W. Ogden, 'Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3.	IRC SP 88-2010, RC:11-2015 IRC:103-2012

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	1	1	-	1	1	1	1	2
CO2	2	2	2	1	-	2	1	1	1	2	1	1
CO3	2	2	2	2	2	3	2	-	1	1	1	1
CO4	2	2	2	1	-	2	1	1	2	1	1	1
CO5	2	2	1	1	-	2	1	2	1	1	1	1

High-3, Medium-2, Low-1

Course Title	SUSTAINABILITY CONCEPTS IN ENGINEERING	Semester	V
Course Code	MVJ20CV651	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objective: Students will be able to,

- Describe about the principles, indicators, and general concept of sustainability.
- Apprehend the local, regional, and global impacts of unsustainable designs, products and processes.
- Student shall be able to apply the sustainability concepts in engineering
- Know built environment frameworks and their use.
- Analyse how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

Module-1

L1, L2, L3

8 Hr

Introduction:

Prerequisites: Knowledge on sustainable approach in engineering

Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Experimental learning:

- In-situ investigation of high strength sustainability materials

Applications:

- In construction of building

Video link:

- <https://nptel.ac.in/courses/127/105/127105018/>

Module-2

L1, L2, L3

8 Hr.

Global Environmental Issue:

Prerequisites: Knowledge on environmental impacts of modern engineering tool

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste – sources, impacts of solid waste, Zero waste concept. Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking

Experimental learning:

- In-situ determination of air pollution, water pollution and solid waste management.

Applications:

- In maintaining the good environment.

Video link:

- <https://nptel.ac.in/courses/110/105/110105073/>

Module-3

L1, L2, L3

8 Hrs.

Sustainable Design:

Prerequisites: Knowledge on sustainable building materials for civil engineering

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Experimental learning:

- laboratory strength determination of the green building materials

Applications:

- In application of green technology in the sustainability will reduce the pollution to the environment

Video link:

- <https://nptel.ac.in/courses/105/105/105105157/>

Module-4

L1, L2, L3

8 Hrs.

Clean Technology and Energy:

Prerequisites: Knowledge on using modern tool in engineering

Energy sources: Basic Concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.

Experimental learning:

- laboratory investigation of energy sources

Applications: <ul style="list-style-type: none"> In utilizing the sustainability approaches will save the environment pollution Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/102/105102195/ 		
Module-5	L1, L2, L3	8 Hrs.
Green Engineering: Prerequisites: Knowledge on using eco-friendly materials Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis. Experimental learning: <ul style="list-style-type: none"> In-situ evaluation of properties for different building materials and pollution control devices Applications: <ul style="list-style-type: none"> In utilizing the sustainability approaches will save the environment pollution Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/102/105102195/ 		

Course outcomes: On completion of the course, students would be able to	
CO1	Learn the sustainability concepts, understand the role and responsibility of engineers in sustainable development
CO2	Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines
CO4	Application of engineering knowledge in utilization of natural resources for the production materials.
CO5	Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3	CIE (50)	30

Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2	Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional

Reference Books:

1	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage Learning
2	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication
3	Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers
4	Daniel A. Vallero and Chris Brasier, "Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	2	1	1	-	1	-	-	1
CO2	2	-	-	-	1	1	-	-	3	1	1	-
CO3	1	2	2	1	-	1	-	-	-	-	-	1
CO4	3	1	1	1	1	-	-	-	1	-	2	-
CO5	1	1	1	-	-	2	-	-	3	-	-	1

High-3, Medium-2, Low-1

Course Title	RESOURCE ALLOCATION AND MANAGEMENT	Semester	VI
Course Code	MVJ20CV652	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objectives: This course will enable students to

- State the different types of resources and planning
- Illustrate on characteristics of resources and labour Management
- Represent materials and equipment's required for construction activities
- Apply the time management strategies on effective planning
- Detail on Resource allocation and levelling

Prerequisites: Basic idea of Management and financial resources

Module-1

L1, L2, L3

8 Hr

Resource Planning: Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Develop the check list for Resource planning for construction activities

Applications: (Self Learning)

- Resource Planning for Residential Building

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>

Module-2

L1, L2, L3

8 Hr.

Labour Management: Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, Optimum use Labour.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Develop the check list for Classes of Labour for construction activities

Applications: (Self Learning)

- Labour Arrangement for Construction of slab for a residential building

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>

Module-3	L1, L2, L3	8 Hrs.
<p>Materials and Equipment: Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Selection of Equipment for the Shutting materials preparation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Preparation of column shuttering Material using cutting machine <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		
Module-4	L1, L2, L3	8 Hr
<p>Time Management: Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control..</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Planning for Time management of Footing Layout marking, shuttering and concreting <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Item of work and its cash flow control measures <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		
Module-5	L1, L2, L3	8 Hr
<p>Resource Allocation and Levelling: Time-cost trade off, Computer application – Resource leveling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Development of resource planning by MS Project <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Value management for an Apartment building (G+10) <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Course outcomes: On completion of the course, students would be able to	
CO1	Restate the different types of resource planning for a construction activities
CO2	Illustrate the required characteristics of resources and labour for the item of work
CO3	Explain the materials and equipment's required for a particular construction activity
CO4	Create the checklist for effective planning through time management
CO5	Explain on Resource allocation and leveling for a construction activities
Text Books:	
1.	Andrew,D., Szilagg, "Hand Book of Engineering Management", 2002.
2.	Harvey, A., Levine, "Project Management using Micro Computers", Osborne -McGraw Hill C.A.Publishing Co., Inc. 2005. Industry, Granda Publishing Ltd.,
Reference Books:	
1	James.A., Adrain, "Quantitative Methods in Construction Management", American Elsevier Publishing Co., Inc., 2002
2	Oxley Rand Poslcit, "Management Techniques applied to the Construction",2000

CO-PO Mapping												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	1	1	2	2	-	3	-	3	2
CO2	1	1	-	1	1	2	2	-	3	-	3	2
CO3	1	1	-	1	1	2	2	-	3	-	3	2
CO4	1	1	-	1	1	2	2	-	3	-	3	2
CO5	1	1	-	1	1	2	2	-	3	-	3	2

High-3, Medium-2, Low-1

Course Title	OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT	Semester	VI
Course Code	MVJ20CV653	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- To understand the concepts of global scenario of Health & safety.
- Students should be able to analyse and solve basic agronomical issues.
- To be efficient in the operation of industrial hygiene equipment.
- To illustrate the importance and need of Fire & Safety.
- Students should be able to know the basics of fire and its classification.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about various types of hazards

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.

Laboratory Sessions/ Experimental learning:

- Measurement of Sound/Noise Level at Various Location and Compare it with Standard Values

Applications:

- Documentation of the report on noise level in the working environment

Video link / Additional online information:

- <https://nptel.ac.in/courses/114106017/>

Module-2

L1, L2, L3

8 Hrs.

Ergonomics at Workplace: Ergonomics Task analysis, Preventing Ergonomic Hazards, Workspace Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations.

Laboratory Sessions/ Experimental learning:

- A study on analysis of occupational health hazards in a working place

Video link / Additional online information: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110105094/ 		
Module-3	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Basic knowledge about agronomical issues</p> <p>Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of Product safety.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Demonstration and training on the usage of personal protective equipments, breathing apparatus, Emergency evacuation drill etc. <p>Applications:</p> <ul style="list-style-type: none"> • Awareness program on the utilization of the facilities provided to maintain the health of workers in working places <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf 		
Module-4	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Importance and need of Fire & Safety</p> <p>Health Considerations at Workplace: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Identification rehearsals of Portable extinguishers, Filling of DCP powder in Portable Extinguisher and wearing Protective clothing, Mock drills <p>Applications:</p> <ul style="list-style-type: none"> • A detailed report on classification of fire extinguishers <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Fire protection: basic concept, fire resistance, introduction of combustion process, https://nptel.ac.in/courses/105102176/ 		
Module-5	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Basic Knowledge of Industrial Safety</p> <p>Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Roles and responsibilities of workers, managers, and supervisors.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • A performance study on responsibility of management for safety in industries, safe guarding the workers • A study on OSHAS by considering a case-study 		

Applications:

- Documentation on an effective safety management in a manufacturing industry from workers health point of view.

Video link / Additional online information:

- <https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf>
- <https://nptel.ac.in/courses/110105094/>

Course outcomes: On completion of the course, students would be able to

CO1	Gains the knowledge about the various types of hazards and their control measures
CO2	Gains the knowledge about the occupational health issues
CO3	Able to analyse and solve occupational health issues
CO4	Able to know the basics of fire and its precautions, active and passive fire protection system in building or other industries/ premises.
CO5	To render the concept of safety analysis and confined space

Scheme of Evaluation

Detail s		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Test Books:

1.	Fire Protection and Prevention By: Birendra Mohan San, Publishers: UBS Publishers & Distributors Pvt Ltd., Edition: First Edition, Year of Publication: 2008
2.	Industrial safety management By: L.M. Deshmukh, Publishers: Tata Megraw Hill, New Delhi, Year: 2006,First Edition

Reference Books:	
1.	Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, United Kingdom
2.	Handbook Of Fire Technology By: R.S. Gupta, Orient Longman Publishers, Second Edition, 2005
3.	Handbook Of Fire And Explosion Protection Engineering By: Dennis P Nolan, Crest Publishing House, First Edition, 2007
6.	Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao, Publishers: Khanna Publishers, Year: 2008, Edition: Second
7.	A Handbook on health, Safety and Environment, SC Bhatia
8.	S Rao, H L Saluja- Electrical Safety, Fire Safety Engineering and Safety Management

Web Link and Video Lectures:	
1.	https://nptel.ac.in/courses/120108004/
2.	https://nptel.ac.in/courses/114106017/
3.	https://nptel.ac.in/courses/103/106/103106162/
4.	https://nptel.ac.in/courses/103/106/103106162/
5.	https://nptel.ac.in/courses/114106039/

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	--	2	--	--	--	2	2	--	--	--	3	1
CO2	--	2	--	--	--	2	2	--	--	--	3	1
CO3	2	3	2	2	2	3	1	--	2	3	--	1
CO4	--	2	--	--	3	2	2	--	2	2	3	1
CO5	2	3	2	2	--	2	--	3	2	1	1	1

High-3, Medium-2, Low-1

Course Title	INDUSTRIAL SAFETY	Semester	VI
Course Code	MVJ20CV654	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objectives: This course will enable students to

- State the importance and necessity of Safety measures in Industry
- Illustrate on significance of Sign Boards on Fire safety
- Apply the Safety programs in Industry Activities
- Detail on Safety precautions against shocks
- Construct the procedure for checking on chemical safety.

Pre Requisites: Basic idea of Safety

Module-1	L1, L2	8 Hr.
<p>Introduction to Safety: Terms used: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), OSHA, WHO. Lockout and tag out procedures, Safe material handling and storage.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Preparation of Safety manual for a hazardous Construction activity <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Material handling in Library <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-2	L1, L2	8 Hr.
<p>Fire Safety: Introduction, Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Collection of Fire safety Industries in India and compare with the specifications <p>Applications: (Self Learning)</p>		

<ul style="list-style-type: none"> • Fire Safety Equipment and Management in Industry like New Age Fire Protection Industries Private Limited, Usha Fire Safety Equipments (P) Ltd etc., <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-3	L1, L2	8 Hr.

<p>Safety Programs: Human Factors in Construction Safety, Problem Areas in Construction Safety, Elements of an Effective Safety Programs, Job-Site Safety Assessment, Safety Meetings, Safety Incentives.</p> <p>Safety while handling Material, compressed gas cylinders, corrosive substance, waste drum and containers.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Assessment and report on Bhopal gas tragedy in 1984 <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • National Occupational Health and Safety <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-4	L1, L2	8 Hr.

<p>Electrical Safety: Introduction to electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Collection of Electrical Testers manufacturers <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Honeywell – Protect your workforce against electrical hazards <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-5	L1, L2	8 Hr.

<p>Chemical Safety and other Safety Checks: Introduction to Chemical safety, Labeling of chemicals, acid hoods. Handling of acids, eye washers and showers. Safety thinking, accident</p>		
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investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Prepare the check list to maintain the Chemical safety (pre and post assessment)

Applications: (Self Learning)

- Different ways to stay safe in Chemical Industry

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/110/105/110105094/>
- <https://nptel.ac.in/courses/105/102/105102206/>

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Course outcomes: On completion of the course, students would be able to

CO1	Identify the hazards around the work environment and industries
CO2	Use the safety measures while performing work in and around the work area of the available Laboratories
CO3	Write the case studies by sharing experience of the employees working in housekeeping, laboratories like workshops, electrical labs, machine shops, electronics and computer laboratories.
CO4	Recognize the sign boards and its application.
CO5	Apply the necessary precautions while using chemicals and other hazardous materials

Text Books:	
1.	Electrical Safety, fire safety and safety management by S.Rao, R K Jain and Saluja. Khanna Publishers, 1997
2.	Chemical process Industrial safety by K S N Raju by McGraw Hill Education (India) private Limited, 2014

Reference Books:	
1.	Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 2000
2.	Industrial Safety and Management by L M Deshmukh by McGraw Hill Education (India) private Limited, 2005
3.	Environmental engineering by Gerard Kiely by McGraw Hill Education (India) private Limited, 2006

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	2	1	2	-	-	3	-	3	2
CO2	1	1	-	2	1	2	-	-	3	-	3	2
CO3	1	2	-	2	1	2	-	-	3	-	3	2
CO4	1	1	-	2	1	2	-	-	3	-	3	2
CO5	1	2	-	2	1	2	-	-	3	-	3	2

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL ENGINEERING LABORATORY	Semester	VI
Course Code	MVJ20CVL66	CIE	50
Total No. of Contact Hours	L : T : P :: 0: 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hr
Course objective is to: This course will enable students to <ul style="list-style-type: none"> • Examine different methods of water & wastewater quality • Recommend the degree and type of treatment • Explain the environmental significance and application in environmental engineering practice 			
Prerequisites: Water supply and Treatment Engineering			
S.NO	Experiments	L3, L4	
1	Determination of pH, Conductivity, TDS and Turbidity.		
2	Determination of Acidity and Alkalinity.		
3	Determination of Calcium, Magnesium and Total Hardness.		
4	Determination of Dissolved Oxygen		
5	Determination of BOD.		
6	Determination of Chlorides		
7	Determination of percentage of % of available chlorine in bleaching powder sample and Residual Chlorine.		
8	Determination of Solids in Sewage: i) Total Solids, ii) Suspended Solids, iii) Dissolved Solids, iv) Volatile Solids, Fixed Solids v) Settleable Solids.		
9	Determination of optimum coagulant dosage using Jar test apparatus.		
10	Determination of Sulphates by spectrophotometer		
11	Determination Nitrates and Iron by spectrophotometer.		
12	Determination of Sodium and Potassium by flame photometer.		
13	Determination of COD(Demonstration)		
14	Air Quality Monitoring (Demonstration)		
Video link / Additional online information: (Self-Learning)			

- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_2/index.html
- <https://jecassam.ac.in/engineering/civil/laboratories/environmental-engineering-laboratory/>

Course outcomes: After studying this course, students will be able to

CO 1	Acquire capability to conduct experiments and estimate the concentration of different parameters.
CO 2	Compare the result with standards and discuss based on the purpose of analysis.
CO 3	Identify type of treatment, degree of treatment for water and wastewater.
CO 4	Identify the parameter to be analysed for the student project work in environmental stream.

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Test Books:

1.	AWWA, WEF, APHA, 1998, Standard Methods for the Examination of Water and Wastewater (Method: 5210B,5-day BOD).
2.	Sawyer, C.N., McCarty, P.L., and Parkin, G.F. 2000. Chemistry for Environmental Engineering 4th Edition. Tata McGraw-Hill Publishing Company Limited.

Reference Books:

1.	IS 3025 (Part 44)-1993: Method of Sampling and Test (Physical and Chemical) for Water and Wastewater, Biochemical Oxygen Demand, First Revision.
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CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	2	-	2	-	1	1
CO2	3	3	2	1	2	2	2	-	2	1	1	1
CO3	3	3	2	1	2	2	2	-	2	2	1	1
CO4	3	3	2	1	2	2	2	-	2	2	1	1

High-3, Medium-2, Low-1

Course Title	SOFTWARE APPLICATION LABORATORY	Semester	VI
Course Code	MVJ20CVL67	CIE	50
Total No. of Contact Hours	L : T : P :: 0: 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Use industry standard software in a professional set up.
- Understanding the elements of finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design.
- Develop customized automation tools.
- Effectively communicate the mechanical properties of materials.

Module -1

L3

Prerequisites: Theory of stress & strain

Use of Software: ETags, STAAD pro or any other related software.

1. Analysis of plane trusses, continuous beams, portal frames. (ANALYSIS OF STRUCTURES_ MVJ19CV42_ Module 3 & 4)
2. 3D analysis of multi storied frame structures.

Module – 2

L3

Prerequisites: Basics of Project management, Geodetic Information

Project Management- Exercise on Project planning and scheduling of a building project using any project management software:

1. Understanding basic features of Project management software
2. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software.
3. Identification of Predecessor and Successor activities with constrain
4. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and Other non-Critical paths, Project duration, Floats.
5. Study on various View options available
6. Basic understanding about Resource Creation and allocation
7. Understanding about Splitting the activity, linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project

GIS applications using open-source software:

1. To create shape files for point, line, and polygon features with a map as reference.

2. To create decision maps for specific purpose.

Module-3		L3
Prerequisites: Design of RC Structures, Curve Setting. Use of EXCEL spread sheets:		
<ol style="list-style-type: none"> 1. Design of singly reinforced and doubly reinforced rectangular beam.(DESIGN OF RC STRUCTURES_ MVJ19CV62_Module 2) 2. Design of one way and two-way slabs, computation of earthwork, (DESIGN OF RC STRUCTURES_ MVJ19CV62_Module 3) 3. Design of horizontal curve by offset method, Design of super elevation. (GEODETIC INFORMATION_ MVJ19CV34_Module 4) 		
Course outcomes: On completion of the course, students would be able to		
CO1	Compute the stresses developed due to different loading conditions on plane trusses, continuous beams and portal frame.	
CO2	Use of software skills in a professional set up to automate the work and thereby reduce cycle time for completion of the work	
CO3	Design Beams, Slabs in RC Structures, Setting out curve in highway.	

Text Books:

1.	Chang,K , "Introduction to Geographic Information Systems", Tata McGraw-Hill Publishing Co. Ltd, 2008
2	R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010
3	Unnikrishnan Pillai and Devdas Menon, " Reinforced Concrete Design" , McGraw Hill, New Delhi
4.	B.C. Punmia, "Surveying Vol.1 & 2", Laxmi Publications pvt. Ltd., New Delhi –2009.

Reference Books:

1	George Joseph, "Fundamentals of Remote Sensing", University Press, 2003
2	Training manuals and User manuals and Relevant course reference books

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	2	-	-	-	1	-	-	1
CO2	3	3	2	2	2	-	-	-	1	2	3	2
CO3	3	2	2	2	-	-	-	-	1	-	-	1
CO4	1	3	2	2	2	1	-	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	Mini-Project	Semester	VI
Course Code	MVJ20CVP68	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 6	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	-

Course Objective:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project: (i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department. **(ii) Interdisciplinary:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

Course outcomes: On completion of the course, students would be able to

CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
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CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2