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|---|----------------------------|-----------------|----------------|
| Course Title | DESIGN OF STEEL STRUCTURES | Semester | VII |
| Course Code | MVJ20CV71 | 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 |
| <p>Course objective is to: This course will enable students to</p> <ul style="list-style-type: none"> • Introduce steel structures and its basic components • Introduce structural steel fasteners like welding and bolting • Design tension members, compression members, beams and beam-column • Design column splices and bases | | | |
| Module-1 | | L1,L2,L3 | 10 Hrs. |
| <p>Introduction: Advantages and Disadvantages of Steel structures, Loads and Load combinations, Design considerations, Limit State Method (LSM) of design, Failure criteria for steel, Codes, Specifications, and section classification.</p> <p>Plastic Behavior of Structural Steel: Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis, Plastic analysis of continuous beams</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> • Developing animated videos to understand formation of plastic hinges <p>Applications:</p> <ul style="list-style-type: none"> • To select the type of member and to understand the plastic behavior of steel structures. <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105162/ | | | |
| Module-2 | | L1,L2,L3 | 10Hrs |
| <p>Bolted Connections: Introduction, Behavior of Bolted joints, Design strength of ordinary Black Bolts, Design strength of High Strength Friction Grip bolts (HSFG), Pin Connections, Simple Connections, Moment resistant connections, Beam to Beam connections, Beam and Column splices, Semi rigid connections.</p> <p>Welded Connections: Introduction, Welding process, Welding electrodes, Advantages of Welding, Types and Properties of Welds, Types of joints, Weld symbols, Weld specifications, Effective areas of welds, Design of welds, Simple joints, Moment resistant connections, Continuous Beam to Column connections, Continuous Beam to Beam connections, Beam Column splices, Tubular connections.</p> <p>Experimental learning:</p> | | | |

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| <ul style="list-style-type: none"> Develop 3D models using any modelling software to understand various connections. <p>Applications:</p> <ul style="list-style-type: none"> In developing connections between various elements of a steel structure. <p>Video link:</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105162/ | | |
| Module-3 | L1,L2,L3 | 10Hrs |
| <p>Design of Tension Members: Introduction, Types of tension members, Slenderness ratio, Behavior of tension members, Modes of failure, Factors affecting the strength of tension members, Angles under tension, Other sections, Design of tension member, Lug angles, Splices, Gussets. Design of splices and gussets</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> Field visit to understand various tension members. <p>Applications:</p> <ul style="list-style-type: none"> In designing trusses, purlins and beams of multistoreyed buildings. <p>Video link: https://nptel.ac.in/courses/105/105/105105162/</p> | | |
| Module-4 | L1,L2,L3 | 10Hrs. |
| <p>Design of Compression Members: Introduction, Failure modes, Behavior of compression members, Elastic buckling of slender compression members, Sections used for compression members, Effective length of compression members, Design of compression members, Built up compression members.</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> Field visit to understand various compression members <p>Applications:</p> <ul style="list-style-type: none"> In designing trusses and columns of multistoried buildings. <p>Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105162/ </p> | | |
| Module-5 | L1,L2,L3 | 10Hrs |
| <p>Design of Column Bases and Beams: Design of simple slab base and gusseted base. Introduction, Beam types, Lateral stability of beams, factors affecting lateral stability, Behavior of simple and built-up beams in bending(without vertical stiffeners), Design strength of laterally supported beams in Bending, Design strength of laterally unsupported beams, Shear strength of steel beams, Maximum deflection, Design of beams and purlins.</p> | | |

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| <p>Experimental learning:</p> <ul style="list-style-type: none"> Develop 3D models using any modelling software to understand behavior of beams. <p>Applications:</p> <ul style="list-style-type: none"> In designing columns and footings for multistoried buildings <p>Video link:</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105162/ |
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| Course outcomes: On completion of the course, students would be able to | |
| CO1 | Restate the basic elements of a steel structure |
| CO2 | Illustrate the fundamentals of structural steel fasteners |
| CO3 | Design basic elements of steel structure like tension members, compression members, beams and beam-columns |
| 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. |

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 |

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| Textbooks: | |
| 1. | Subramanian, -Design of Steel Structures , Oxford University Press, New Delhi, 2013. |
| 2. | Gambhir. M.L., -Fundamentals of Structural Steel Design , McGraw Hill Education India Pvt.Ltd., 2013 |

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| Reference Books: | |
| 1. | Shiyekar. M.R., -Limit State Design in Structural Steel , Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013. |
| 2. | Duggal. S.K, -Limit State Design of Steel Structures , Tata McGraw Hill Publishing Company, 2005. |
| 3. | Shah.V.L. and Veena Gore, -Limit State Design of Steel Structures , IS 800–2007 Structures Publications, 2009. |

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| 4. | IS 800:2007 GENERAL CONSTRUCTION IN STEEL – CODE OF PRACTICE |
| 5. | SP 6-1: ISI Handbook for Structural Engineers -Part- 1 Structural Steel Sections by Bureau of Indian Standards |

CO-PO Mapping

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

High-3, Medium-2, Low-1

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|----------------------------|---|----------------|--------|
| Course Title | DESIGN OF PRE-STRESSED CONCRETE ELEMENTS | Semester | VII |
| Course Code | MVJ20CV72 | 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 is to: This course will enable students to

- Use the basics of prestressing to concrete elements.
- Restate the basic principle of prestressing including losses.
- Interpret the deflections in a prestressed concrete member.
- Analyze the section for flexure, shear under limit state of serviceability and design the pre- stressed beam under permissible stress condition.
- Describe the design of anchorage zones.

Module-1

L2

10 Hrs.

Prerequisites: Concept of stress-strain characteristics of steel and concrete.

Introduction- High strength concrete and steel, stress-strain characteristics and properties, fundamentals, load balancing concept, stress concept, center of thrust. Pre-tensioning and post-tensioning systems, tensioning methods, and end anchorages (Online mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Experimental investigation to verify the efficiency and strength of post-tensioning systems.
- Industrial visit to witness pre-tensioning and post-tensioning methods and different types of end anchorages.

Applications: (Self Learning)

- Understanding of principles of prestressing concept.
- Find out the mechanism of the working of tensioning systems and various tools available to prestress the structures.

Video link / Additional online information: (Self Learning)

(Introduction to PSC, high strength concrete and steel, stress-strain characteristics and properties, pre-tensioning and post-tensioning systems, tensioning methods and end anchorages.)

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| <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ | | |
| Module-2 | L3 | 10 Hrs. |
| <p>Losses of Prestress: Stresses in concrete due to prestress and loads, stresses in steel due to loads, cable profiles, various losses encountered in pre-tensioning and post tensioning methods (Online Mode), determination of jacking force.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Calculation of losses in a prestressed concrete beam. • FE software analysis to study the effect of cable profiles in determining the stress distribution in post-tensioned member. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Estimating various losses of prestressing. • Find out the behaviour of prestressed concrete beam under different cable profiles. <p>Video link / Additional online information: (Self Learning) (Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ | | |
| Module-3 | L3 | 10 Hrs. |
| <p>Deflection of a pre-stressed member – Short term and long-term deflections, Elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343. Effect of creep on deflection, load verses deflection curve, methods of reducing deflection.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • FE software analysis to study the effect of cable profiles in determining the deflections in post- tensioned member. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge of deflection behavior of post-tensioned member under the loads and tendon profiles. • Understanding of long-term deformations due to creep in PSC. <p>Video link / Additional online information: (Self Learning) (Short term and long-term deflections, elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343).</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ | | |
| Module-4 | L3 & L4 | 10 Hrs. |
| <p>Prerequisites: Knowledge of Limit State of Strength & Serviceability.</p> <p>Flexure -Types of flexural failure, IS Code recommendations (Online Mode). Ultimate flexural strength of sections. Shear - IS Code recommendations (Online Mode), shear</p> | | |

resistance of sections, shear reinforcement. Limit state of serviceability – control of deflections and cracking.

Design of Beams: Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Analysis and design of simple prestressed concrete beams, encompassing bending and shear performance.
- Comparative analysis of behavior of PSC and RCC sections under flexure and shear.

Applications: (Self Learning)

- Gives in depth knowledge of performance of PSC beams under flexure and shear.

Video link / Additional online information: (Self Learning)

(Types of flexural failure, IS code recommendations, ultimate flexural strength of sections, IS Code recommendations, shear resistance of sections, shear reinforcement, control of deflections and cracking. Design of Beams.)

- <https://nptel.ac.in/courses/105/106/105106117/>

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| Module-5 | L3 & L4 | 10 Hrs. |
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Design of End block: Transmission of Prestress in pretension members, transmission length, Anchorage stress in post-tensioned members (Online Mode). Bearing stress and bursting tensile force stresses in end blocks- Methods, I.S. code provision for the design of end block reinforcement. **Laboratory Sessions/ Experimental learning: (Self Learning)**

- Software analysis of stress in anchorage zone in post-tensioned members.
- Case study on the effect of reinforcement on anchorage zone cracks in prestressed concrete members.

Applications: (Self Learning)

- Learn design of end zone reinforcement to check the bursting effect of the tensile stresses.

Video link / Additional online information: (Self Learning)

(Transmission of Prestress, Bearing stress and design of end block reinforcement).

- <https://nptel.ac.in/courses/105/106/105106117/>

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| Course outcomes: On completion of the course, students would be able to | |
| CO1 | Restate the basic concept of pre-stressing and understand the requirement of PSC members for present scenario. |
| CO2 | Examine the stresses encountered in PSC element during transfer and at working. |
| CO3 | Interpret the effectiveness of the design of PSC after studying losses. |
| CO4 | Investigating the PSC element and finding its efficiency and design PSC beam for different requirements. |
| CO5 | Design the end blocks in PSC using codal provisions. |

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 |

| Textbooks: | |
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| 1. | Prestressed Concrete- N. Krishna Raju - Tata McGraw Hill Publishers- Sixth Edition, 2018. |
| 2. | Fundamentals of Prestressed Concrete- Dr. N C Sinha & Dr. S K Roy- S Chand Publishing-Third Edition- 2011. |

| Reference Books: | |
|------------------|---|
| 1. | Prestressed Concrete- Problems and Solutions- N. Krishna Raju- CBS Publishers & Distributors Pvt Ltd – Third Edition, 2018. |
| 2. | Pre-stressed Concrete- N. Rajagopalan- Narosa Publishing House- Second Edition, 2015. |
| 3. | Pre-stressed Concrete structures- P. Dayaratnam- Medtech Publishers- Seventh Edition, 2017. |
| 4. | K U Muthu - "Prestressed Concrete"- PHI Learning, 2016. |
| 5. | Design of Prestressed Concrete Structures- T.Y. Lin and Ned H. Burns - Wiley India Pvt Ltd- Third edition, 2010. |
| 6. | Leonhardt Fritz- "Prestressed Concrete-Design and Construction", Berlin, W. Ernst, 1964. |
| 7. | IS: 1343 - Indian Standard code for practice for prestressed concrete, BIS, New |

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

High-3, Medium-2, Low-1

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|----------------------------|--|----------------|-------|
| Course Title | DESIGN AND DRAWING OF HYDRAULIC STRUCTURES | Semester | VII |
| Course Code | MVJ20CV731 | 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: This course will enable students to

- State and explain the reservoir classifications and planning
- Explain the types of earth dams, gravity dams and their components and safety
- List and explain the types of spillways and energy dissipators in spillways
- Demonstrate different irrigation structures and their design criteria
- Demonstrate pipe network design and stormwater network design

Prerequisites: Knowledge on Water cycle in earth, different components and measurements of hydrological variables, hydrostatics, kinematics, and dynamics, and open channel flow.

Module-1

L1, L2, L3

8 Hrs

Prerequisites: Knowledge on Water cycle in earth, different components and measurements of hydrological variables, hydrostatics, Darcy law.

Reservoir Planning: Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, Numerical problems on storage capacity of reservoirs, density currents, Trap efficiency, Reservoir sedimentation, life of a reservoir, economic height of a dam and problems, environmental effects of reservoirs.

Earth Dams: Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria, problems, control of seepage through earth dams, Safety measures.

Laboratory Sessions: (Self Learning)

- Determination of reservoir storage by collecting data

Applications: (Self Learning)

- Reservoir planning
- Fixing the capacity of the reservoirs
- Determination of sediment load and different storage volumes of reservoir
- Design of Earth dams

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| Video link / Additional online information: (Self Learning) | | |
| <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/108/105108130/ | | |
| Module-2 | L1, L2, L3 | 8 Hrs |
| <p><i>Prerequisites: Basics of concrete technology</i></p> <p>Gravity Dams: Introduction, forces on a gravity dam, Numerical problems on stress analysis, combination of forces for design. Elementary & practical profiles of a gravity dam, stability analysis (without earthquake forces), problems, galleries in gravity dams.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> • Analyzing the forces acting on an existing gravity dam <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Dam safety analysis of different failures • Design of gravity dam storage and different forces <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105108130/ | | |
| Module-3 | L1, L2, L3 | 8 Hrs |
| <p><i>Prerequisites: Notches, weirs, and hydraulic jump</i></p> <p>Spillways: Introduction, essentials of a spillway, spillway components, factors affecting types & design of spillways, Types of spillways, Ogee spillway, Numerical problems on Ogee spillway, Energy dissipation below spillways (hydraulic jump- No design), Numerical problems based on conjugate depth, Froude number and energy dissipation, Spillway crest gates, Outlet works.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> • Hydraulic jump experiment on energy dissipation using conjugate depths. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Design of Ogee spillway <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/126/105/126105012/ | | |
| Module-4 | L1, L2, L3 | 8 Hrs |
| <p><i>Prerequisites: Notches, weirs, and basics of irrigation engineering</i></p> <p>Diversion Head Works: Components of diversion headworks, Design of impervious floors, Bligh's creep theory and limitations.</p> <p>Irrigation: Design of Surplus Weir, Canal gate sluice without tower head, Notch type canal fall, Cross drainage works, Canal cross regulator, Simple Aqueduct of Type III.</p> <p>Laboratory Sessions: (Self Learning)</p> | | |

- Measurement of discharge of flow over a weir

Applications: (Self Learning)

- Design of canal cross regulator

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/126/105/126105012/>

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| Module-5 | L1, L2, L3 | 8 Hrs |
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Hydraulic design in water supply: Losses in pipes, Moody diagram, Equivalent length of pipes in parallel and series, Water distribution network design, Numerical problems on Hardy-Cross method, Introduction to EPANET and demo.

Hydraulic design in stormwater management: Manning’s equation, Hazen-Williams equation, Darcy-Weisbach equation, Introduction to SWMM for a simple storm water network and demo.

Laboratory Sessions: (Self Learning)

- Design of pipe network for a simple distribution network

Applications: (Self Learning)

- Design of pipe network
- Design of storm water network

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106119/>

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

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| CO1 | Identify reservoir types and apply of reservoir storage capacity estimation methods |
| CO2 | Develop of Earth dams and Gravity dams designs and stability analysis |
| CO3 | Make use of design methods of Ogee spillway and selection of spillway type |
| CO4 | Select cross drainage works and design |
| CO5 | Model water distribution network and stormwater drainage network |

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 |

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| Semester End Examination | SEE (50) | 50 |
| Total | | 100 |

| Textbooks: | |
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| 1. | Punmia, B. C., et al. "Irrigation and Waterpower Engineering". Laxmi Publications, Ltd., 2009. |
| 2. | Garg, S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2006. |

| Reference Books: | |
|------------------|---|
| 1. | Murthy, C.S., "Water resources engineering: principles and practice". New Age International, 2002. |
| 2. | Sen, D., "Water Resources Engineering", NPTEL Website, https://nptel.ac.in/courses/105/105/105105110/# , 2009, December 31. |

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

High-3, Medium-2, Low-1

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|----------------------------|--------------------------------------|----------------|-------|
| Course Title | WATER RESOURCE MANAGEMENT | Semester | VII |
| Course Code | MVJ20CV732 | 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: This course will enable students to

- Judge surface and ground water resources.
- Address the issues of water resources management.
- Explain the principles of integrated water resources management.
- Apply the legal framework of water policy.
- Suggest the different methods of water harvesting.

Module-1

L1, L2

8 Hrs

Prerequisites: Knowledge on Water cycle in earth, form of water available in earth

Water Resources: Hydrologic Cycle, Global water resources and Indian Water resources, Water Balance, Available Renewable Water Resources, Surface Water Resources, Groundwater Resources- Types of Aquifers, and Groundwater as a Storage Medium.

Water resources management: The Water Balance as a Result of Human Interference, Storm water management, Flood water management, Fresh water management, Ground water management, Wastewater management, Urban water management, Water pollution and water quality management. Water table- Factors affecting water table, Water Scarcity

Laboratory Sessions/ Experimental learning:

- Identification of water management system available in a region

Applications:

- Water quantity estimation
- Water quantity management
- Quantifying the water scarcity.

Video link / Additional online information:

- <https://nptel.ac.in/courses/114105044/>
- <https://nptel.ac.in/courses/114105044/>
- <https://nptel.ac.in/courses/114105044/>

Module-2

L1, L2

8 Hrs

Water Resources Planning and Management: Necessity, Planning and management issues, System components, planning scales, Approaches. Planning and management

aspects, Analysis, Models for impact prediction and evaluation, Adaptive Integrated Policies, Post Planning and management Issues. Meeting the Planning and Management Challenges.

Laboratory Sessions/ Experimental learning:

- Analyzing the alternate solutions for water quality problem in a given region

Applications:

- Preparing analytical framework of management system
- Model analysis for selecting the optimum solution
- Management of Water quality issues through system approach

Video link / Additional online information:

- <https://nptel.ac.in/courses/105108130/>

Module-3

L1, L2

8 Hrs

Prerequisites: Role of women in water management, Cost, and value of water

Integrated Water Resources Management: Definition of IWRM- Natural and human integration system, Principles- Water as a finite and vulnerable resource, Participatory approach, The important role of women in water management, Water as an economic good, Implementation of IWRM, Legislative and Organizational Framework.

Private sector Involvement: Types and Forms of Private Sector Involvement, Benefits of IWRM in different sector- Environmental sector, Food and agriculture sector, water supply and sanitation.

Laboratory Sessions/ Experimental learning:

- Identification of private sector participation in water supply for a given

Applications:

- Decision making for water quantity problems based on IWRM Concept
- Evaluation of value of water
- Monitoring Private sector involvement in water management

Video link / Additional online information:

- <http://www.digimat.in/nptel/courses/video/105101010/L08.html>
- <https://nptel.ac.in/courses/114105044/>

Module-4

L1, L2

8 Hrs

Water Governance: Definition, Necessity of water governance, Principles of effective governance- Approaches, performance and operation water governance challenges, water governance cycle **National Water Policy:** National water resource council, 1987 & 2002 Nation water policy Irrigation Management Transfer Policies and Activities , Legal Registration of ,WUAs , Legal Changes in Water Allocation, – Role of Local

Institutions – Community Based Organizations .

Laboratory Sessions/ Experimental learning:

- Verification of implementation of water policies in a given region. Applications: (Self Learning)
- Justification on water allocation
- Highlighting the water policies during the decision-making process in water management
- Evaluation of effective participation of WUA

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/114105044/>

Module-5

L1, L2

8 Hrs

Prerequisites: Rainwater Harvesting, Evaporation, Water conservation

Water conservation: Definition, Goals, Water conservation techniques- Conservation by surface water storage, Conservation of rain water, Ground water conservation (Online mode), Catchment area protection (CAP) - Inter-basin transfer of water- Adoption of drip sprinkler irrigation, Management of growing pattern of crops, Reducing evapotranspiration, Reducing evaporation from various water bodies- Recycling of water , Measures of water conservation, simple water saving methods.

Water Harvesting: Water Harvesting Techniques, Micro-catchments, Design of Small Water Harvesting Structures, Farm Ponds, Percolation Tanks, Yield from a Catchment, Rain water Harvesting-various techniques related to Rural and Urban area(Online mode).

Laboratory Sessions/ Experimental learning:

- Design Rainwater harvesting structure in a given region to conserve water.

Applications:

- Design of Rainwater harvesting system
- Evaluation of effective conservation of water.
- Implementation of micro irrigation system

Video link / Additional online information:

- <https://nptel.ac.in/courses/105101010/>

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

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|-----|---|
| CO1 | Discuss the potential of groundwater and surface water resources. |
| CO2 | Illustrate the issues related to planning and management of water resources |
| CO3 | Outline IWRM in different regions. |
| CO4 | List out the legal issues of water policy |
| CO5 | Predict the method for water harvesting based on the area. |

| Scheme of Evaluation (Theory) | | |
|---|----------|---------|
| 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 |

| Textbooks: | |
|------------------|---|
| 1. | K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi, 2017 |
| 2. | H.M. Raghunath, "Ground Water", Wiley Eastern Publication, New Delhi. ,2016 |
| Reference Books: | |
| 1. | Mollinga, P. et al, "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006. |
| 2. | Daniel P. Loucks and Eelco van Beek, "Water Resources Systems Planning and Management", UNESCO Publication,2005 |
| 3. | Water Resources Engineering, D A Chin (Indian Edition), Pearson Publications |
| 4. | Water Resources Engineering, L W Mays (Indian Edition), Wiley Publications |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|----------------------------|----------------|-------|
| Course Title | GROUND WATER HYDRAULICS | Semester | VII |
| Course Code | MVJ20CV733 | 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: This course will enable students to

- State the properties of aquifer with its influence on groundwater storage
- Analyze the steady and unsteady groundwater flow conditions
- Apply the model approach for groundwater management system
- Estimate the groundwater quality
- Propose the suitable remedial measures for the groundwater development system

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

Module-1

L1, L2, L3

8 Hrs

Introduction – Water bearing Properties of Rock – Type of aquifers – Aquifer properties – permeability, specific yield, transmissivity, and storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms, Global distribution of water, Role of groundwater in water resources system and their management.

Laboratory Sessions:

- Poster Presentation on types of aquifers.
- Study of various properties of Rock

Applications: (Self Learning)

- Groundwater table fluctuation.
- Understanding the scope of the subject.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

Module-2

L1, L2,L3

8 Hrs

Objectives of Groundwater hydraulics – Darcy's Law – Groundwater equation – steady state flow – Dupuit Forchheimer assumption – heterogeneity & anisotropy, Ground water flow rates & flow directions, general flow equations through porous media. Unsteady state flow – Theis method – Jacob method -Slug tests – Image well theory – Partial penetrations of wells.

Laboratory Sessions:

- Poster Presentation on Image well theory and Partial penetrations of wells.
- Study of slug test by preparing the charts

Applications: (Self Learning)

- Understanding the groundwater equation.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

Module-3

L1, L2, L3

8 Hrs

Need for Management Model, Database for groundwater management, groundwater balance study, Introduction to Mathematical model, Conjunctive use, Collector well, Infiltration gallery and introduction to MODFLOW.

Laboratory Sessions:

- Case Study on Groundwater balance study by using Mathematical model.
- Poster Presentation on Infiltration Gallery

Applications: (Self Learning)

- Study of Mathematical modelling.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
/
- <https://nptel.ac.in/courses/105/103/105103026/>
/

Module-4

L1,L2,L3

8 Hrs

Ground water chemistry – Origin, movement, and quality – Water quality standards – Health and aesthetic aspects of water quality – Saline intrusion.

Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, fresh-saline water relations on oceanic islands, Karst terrains.

Laboratory Sessions:

- Model making of self -purification of groundwater.
- Poster Presentation on Saline Intrusion.

Applications: (Self Learning)

- Understanding of impact of saline intrusion.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

| Module-5 | L1, L2, L3 | 8 Hrs |
|---|------------|-------|
| <p>Ground water conservation: Artificial recharge techniques, Ground water management studies, Protection zone delineation, Contamination source inventory, Ground water Pollution and legislation, Remediation measures for quality and quantity improvement, Remediation of Saline intrusion.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Groundwater Pollution and legislation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Understanding of groundwater management studies. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105042/ • https://nptel.ac.in/courses/105/103/105103026/ | | |

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

| | |
|-----|---|
| CO1 | Asses the properties of aquifer with its influence on groundwater storage |
| CO2 | Identify the steady and unsteady groundwater flow conditions |
| CO3 | Apply the model approach for groundwater management system |
| CO4 | Estimate the groundwater quality |
| CO5 | Suggest the suitable remedial measures for the groundwater development system |

Scheme of Evaluation (Theory)

| 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 |

Textbooks:

| | |
|----|---|
| 1. | Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010. |
| 2. | Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998. |

| Reference Books: | |
|------------------|--|
| 1. | Todd D.K and Mays L.W, "Ground Water Hydrology", 3 rd Edition, John Wiley and Sons, New York, 2004. |
| 2. | Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2013. |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|------------------------------|----------------|-------|
| Course Title | COMPUTATIONAL FLUID DYNAMICS | Semester | VII |
| Course Code | MVJ20CV734 | 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: This course will enable students to

- State the governing equations of fluid dynamics
- Formulate and solve Euler's equation of motion
- Represent the skills related to Functions on Computer
- Apply the finite difference method on linear stability analysis
- Solve computational problems related to fluid flows by finite volume method

Module-1

L3

8 Hrs.

Introduction to CFD and Governing Equations: Need of CFD as tool, role in R&D, continuum, material or substantial derivative or total derivative, gradient, divergence and curl operators, Linearity, Principle of Superposition. Derivation of Navier-Stokes equations in control volume (integral form) and partial differential form, Euler equations (governing inviscid equations). Mathematical classification of PDE (Hyperbolic, Parabolic, Elliptic). Method of characteristics, Introduction to Riemann Problem and Solution Techniques.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Surface mesh formation by boundary element method

Applications: (Self Learning)

- Solve transport equations for the Reynolds stresses

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/112/105/112105045/>
- <https://nptel.ac.in/courses/103/106/103106119/>

Module-2

L3

8 Hrs.

One-dimensional Euler's equation: Conservative, Non-conservative form and primitive variable forms of Governing equations. Systematic way to diagonalise Eigenvalues and Eigenvectors of Flux Jacobian. Decoupling of Governing equations, introduction of characteristic variables. Relation between the two non- conservative forms. Conditions for genuinely nonlinear characteristics of the flux Jacobian.

Introduction to Turbulence Modeling: Derivation of RANS equations and k-epsilon model.

| | | |
|--|-----------|---------------|
| <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Determination of Eigenvalues and Eigenvectors for matrix data <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Identify the pressure at the upper surface of an airfoil <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ | | |
| Module-3 | L3 | 8 Hrs. |
| <p>Representation of Functions on Computer: Need for representation of functions, Box Function, Hat Function, Representation of $\sin x$ using hat functions- Aliasing, high frequency, low frequency. Representation error as a global error. Derivatives of hat functions, Haar functions, Machine Epsilon. Using Taylor series for representation of Derivatives.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Taylor's formula to find the power series expansion of $\sin x$ <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Study the Global errors propagated in the numerical integration <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ | | |
| Module-4 | L3 | 8 Hrs. |
| <p>Finite Difference Method : Applied to Linear Convection equation, Laplace Equations, Convection Diffusion equations, Burgers equations, modified equations, Explicit methods and Implicit methods as applied to linear convection equation, Laplace equations, convection diffusion equation. FTCS, FTFS, FTBS, CTCS. Jacobi Method, Gauss-Siedel, Successive Over Relaxation Method, TDMA. Von-Neumann stability (linear stability) analysis. Upwind Method in Finite Difference method.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Predict the condition of Pandemic situation by Gauss-Siedel method <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Propagation in a Gaseous Medium <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ | | |
| Module-5 | L3 | 8 Hrs. |
| <p>Finite Volume Method: Finite volume method. Finding the flux at interface. Central schemes</p> | | |

- Lax- Friedrichs Method, Lax-Wendroff Method, Two-Step Lax-Wendroff Method and Mac Cormack Method Upwind Method in Finite Volume methods - Flux Splitting Method Steger and Warming, van Leer, Roe's Method and finding Roe's Averages.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of solution of hyperbolic partial differential equations

Applications: (Self Learning)

- Gravity wave-model equations

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/112/105/112105045/>
- <https://nptel.ac.in/courses/103/106/103106119/>

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

| | |
|-----|--|
| CO1 | Restate the mathematical characteristics of partial differential equations. |
| CO2 | Explain how to classify and computationally solve Euler and Navier-Stokes equations. |
| CO3 | Make use of the concepts like accuracy, stability, consistency of numerical methods for the governing equations. |
| CO4 | Identify and implement numerical techniques for space and time integration of partial differential equations. |

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 |

Textbooks:

| | |
|----|---|
| 1. | Pletcher, r. H., Tannehill, j. C., Anderson, d., Computational fluid mechanics and heat transfer, 3 rd ed., Crc press, 2011. |
| 2. | Moin, p., Fundamentals of engineering numerical analysis, 2nd ed., Cambridge university press, 2010. |

| Reference Books: | |
|------------------|---|
| 1. | Ferziger, j. H., Numerical methods for engineering application, 2nd ed., Wiley, 1998. |
| 2. | Ferziger, j. H., Peric, m., Computational methods for fluid dynamics, 3rd ed., Springer, 2002. |
| 3. | Leveque, r., Numerical methods for conservation laws, lectures in mathematics, eth Zurich, birkhauser,1999. |
| 4. | Riemann Solvers and Numerical methods for Fluid Dynamics – A Practical Introduction- Eleuterio F Toro, Springer Publications, 1997. |

| CO-PO Mapping | | | | | | | | | | | | |
|-------------------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|------|------|
| CO/PO | PO1 | PO2 | PO13 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 1 | 2 | 1 | - | 2 | - | 1 | - | 1 | - | 1 | 1 |
| CO2 | 1 | 2 | 1 | - | 2 | - | 1 | - | 1 | - | 1 | 1 |
| CO3 | 1 | 2 | 1 | - | 2 | - | 1 | - | 1 | - | 1 | 1 |
| CO4 | 1 | 2 | 1 | - | 2 | - | 1 | - | 1 | - | 1 | 1 |
| CO5 | 1 | 2 | 1 | - | 2 | - | 1 | - | 1 | - | 1 | 1 |
| High-3, Medium-2, Low-1 | | | | | | | | | | | | |

| | | | |
|----------------------------|--------------------------------------|----------------|-------|
| Course Title | EARTH AND EARTH RETAINING STRUCTURES | Semester | VII |
| Course Code | MVJ20CV741 | 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: This course will enable students to

- To recall lateral earth pressure theories and pressure theories and design of retaining walls.
- To analyze anchored bulkheads by different methods.
- To explain pressure envelopes and design of various components in braced cuts and cofferdams.
- To impart knowledge about different types of dams and their basic design requirements.

Module-1

L3

8 Hrs.

Prerequisites: Effective stress, Total stress, and Pore water pressure

Lateral Pressure: Basic concepts, Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures: Culmann's, Rebhan's, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earthquake, wave effect, stratification, type of backfill, wall friction and adhesion. Retaining walls: Uses, types, stability, and design principles of retaining walls, backfill drainage, settlement and tilting.

Video link / Additional online information: (Self Learning)

- <https://www.digimat.in/nptel/courses/video/105105185/L55.html>
- <https://nptel.ac.in/courses/105/105/105105168/>

Module-2

L3

8 Hrs.

Prerequisites: Effective stress, Total stress, and Pore water pressure

Anchored bulkheads: Classification of anchored bulkheads, free and fixed earth support methods. Rowe's theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods and dead man Braced cuts and Cofferdams: Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils.

| | | |
|---|---|---------------|
| Video link / Additional online information: (Self Learning) | | |
| <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ | | |
| Module-3 | L3 | 8 Hrs. |
| <p>Prerequisites: Slope stability</p> <p>Earth dams- Stability analysis: Classification, seepage control in embankments and foundations, seepage analysis, stability analysis: upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishop's method.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105101201/L22.html • https://nptel.ac.in/courses/105/105/105105168/ | | |
| Module-4 | L3 | 8 Hrs. |
| <p>Prerequisites: soil stabilization</p> <p>Earth dams -Protection & Construction: Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ | | |
| Module-5 | L3 | 8 Hrs. |
| <p>Prerequisites: stability analysis</p> <p>Rigid Retaining Structures: Rigid Retaining Structures, Types, Empirical methods and Stability analysis. Flexible Retaining Structures: Flexible Retaining Structures, Types, Material, Cantilever sheet piles, Anchored bulkheads, free earth method, fixed earth method, moment reduction factors, anchorage, Braced Excavation Types, Construction methods, Pressure distribution in sands and clays.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105168/ | | |
| Course outcomes: On completion of the course, students would be able to | | |
| CO1 | Examine earth pressures on retaining structures, | |
| CO2 | Design of braced excavation for deep cuts and excavation in ground. | |
| CO3 | Analyze retaining walls, anchored bulkheads, braced cuts, coffer dams and | |

| | |
|-----|--|
| | earth dams. |
| CO4 | Outline different types of dams, their basic design requirements and loads imposed. |
| CO5 | Design retaining structures considering both external and internal stability aspects |

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 |

Textbooks:

1. Basic & Applied soil mechanics – Gopal Ranjan & ASR Rao, New Age International Publishers, 2011
2. Engineering for Embankment Dams by B. Singh & R. S. Varshney, A A Balkema Publishers, 1995

Reference Books:

1. Embankment Dams by Sharma Hd, Publisher: India Book House (IBH) Limited, 1991
2. Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.
3. Earth and Rock-Fill Dams: General Design and Construction Considerations by United States Army Corps of Engineers, University Press of the Pacific, 2004

CO-PO Mapping

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|--|-----------------------|-------|
| Course Title | MATRIX METHODS OF STRUCTURAL ANALYSIS | Semester | VII |
| Course Code | MVJ20CV742 | 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: This course will enable the students to

- Use principles of structural analysis.
- Solve for forces and moments of indeterminate structures using principle of matrix method.
- Investigate the internal forces of various types of beams, frames & trusses.
- Examine the force and displacement parameters of the structures.

Module-1

L2,L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Fundamental concepts: Static and Kinematic indeterminacy, Concepts of stiffness and flexibility. Energy concepts. Principle of minimum potential energy and minimum complementary energy. Development of element flexibility and element stiffness matrices for truss, beam and grid elements.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Calculations of Forces & Moments due to external and unit load application
- To check the behavior of Beams, Trusses & Frames

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/content/storage2/courses/112108092/module4/lec27.pdf>
- <https://nptel.ac.in/courses/105/105/105105180/>

Module-2

L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Analysis using Flexibility method: Force transformation matrix using Flexibility method, Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6 flexibility matrix)

Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method (having not more than 3 coordinates – 3x3 flexibility matrix).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Development of global flexibility matrix for different structural elements
- Analyzing the behavior of Beams, Trusses & Frames using flexibility method

Video link / Additional online information: (Self Learning)

- <https://web.iitd.ac.in/~sbhalla/flexibility.pdf>
- <https://nptel.ac.in/content/storage2/courses/105105109/pdf/m2l7.pdf>

Module-3

L2,L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Analysis using Stiffness Method: Displacement transformation matrix using Stiffness Method, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6 stiffness matrix) Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates – 3x3 stiffness matrix)

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Development of global stiffness matrix for different structural elements
- Analyzing the behavior of Beams, Trusses & Frames using stiffness method

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/content/storage2/courses/105105109/pdf/m4l30.pdf>

Module-4

L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Temperature Stresses
Effects of temperature change and lack of fit: Related numerical problems by flexibility and stiffness method as in Module 2 and 3.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

| | | |
|--|---|---------------|
| Applications: (Self Learning) | | |
| <ul style="list-style-type: none"> Analyzing the behavior of structural elements subjected to temperature stresses Analyzing the behavior of Trusses due to Lack of fit | | |
| Video link / Additional online information: (Self Learning) | | |
| <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105180/ | | |
| Module-5 | L3 | 8 Hrs. |
| <i>Prerequisites: Matrix methods, Redundant Forces, Static & Kinematic Indeterminacies</i> | | |
| <p>Solution techniques: Solution techniques including numerical problems for simultaneous equations, Gauss elimination and Cholesky method. Bandwidth consideration.</p> | | |
| <i>Laboratory Sessions/ Experimental learning: (Self Learning)</i> | | |
| <ul style="list-style-type: none"> Computation of Forces & Displacements using structural software Computation of Forces & Displacements using EXCEL Sheet | | |
| Applications: (Self Learning) | | |
| <ul style="list-style-type: none"> Calculation of Forces & Displacements using matrix methods | | |
| Video link / Additional online information: (Self Learning) | | |
| <ul style="list-style-type: none"> https://www.stat.cmu.edu/~ryantibs/convexopt-S15/scribes/09-num-lin-alg-scribed.pdf https://atozmath.com/example/CONM/GaussEli.aspx?he=e&q=CD2 | | |
| <i>Course outcomes: On completion of the course, students would be able to</i> | | |
| CO1 | Illustrate problem solving skills | |
| CO2 | Examine the principles of Structural Analysis | |
| CO3 | Use analytical skills | |
| CO4 | Write the Solution techniques | |
| CO5 | Investigate the behavior of structure. | |

| 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 | | 30 |
| Quizzes | CIE(50) | 2x2 =4 |
| Activities / Experimentations related to courses/Assignment/Assignment | | 8 |
| Mini Projects / Case Studies | | 8 |

| | | |
|--------------------------|----------|-------|
| Semester End Examination | SEE (50) | 50 |
| | | Total |
| | | 100 |

| Textbooks: | |
|------------|--|
| 1. | Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001 |
| 2. | Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998. |

| Reference Books: | |
|------------------|--|
| 1. | Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986. |
| 2. | W.Weaver and J.H.Gere, "Matrix Analysis of Framed Structures", Van Nostrand, 1980. |
| 3. | A.K.Jain "Advanced Structural Analysis with Computer Application" Nemchand and Brothers, Roorkee, India. |
| 4. | M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice – Hall. |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|---------------------------------|----------------|------|
| Course Title | ADVANCED FOUNDATION ENGINEERING | Semester | VII |
| Course Code | MVJ20CV743 | 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 | 3hrs |

Course objective is to: This course will enable students to

- Discuss the knowledge in calculating the bearing capacity and settlement of soils
- Examine the advanced topics of foundation design and analyses, supplementing their comprehensive knowledge acquired in basic foundation engineering course
- Illustrate profound understanding of shallow and deep foundation analyses
- Classify the choice of foundation design parameters
- Relate the cause and effect of dynamic loads on foundation

Module-1

L1, L2 & L3

8Hrs.

Prerequisites: basic geotechnical engineering, advanced geotechnical engineering, soil mechanics General bearing capacity equation-Terzaghi's, Brinch Hansen's and Meyerhof's analyses, bearing capacity of footings according to BIS, eccentrically loaded footing, footing on layered soil, Settlement of shallow Foundations: Immediate, consolidation, & differential settlements. (Online mode) Principles of design of footing, Proportioning of footings for equal settlement.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Standard penetration test
- Dynamic cone penetration test
- Vane shear test

Applications: (Self Learning)

- Model making of footings
- Case study of settlement of foundation

Module-2

L1, L2 & L3

8Hrs.

Design of combined footings by Rigid method, Combined footings (rectangular & trapezoidal), strap footings. Types of rafts, bearing capacity & settlements of raft foundation (online mode), Design of raft foundation-Conventional rigid method, Elastic methods, Coefficient of sub-grade reaction, IS code (IS- 2950) procedure.

Laboratory Sessions/ Experimental learning: (Self Learning)

| | | |
|--|------------------------|---------------|
| <ul style="list-style-type: none"> Design of raft foundation using software Applications: (Self Learning) <ul style="list-style-type: none"> Introduction to Ansys software | | |
| Module-3 | L1, L2 & L3 | 8 Hrs. |
| <p>Introduction Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests. Introduction, Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, laterally loaded piles and under reamed piles. (Online mode),</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Model making of pile foundation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Case studies related to pile foundation in clay and sand | | |
| Module-4 | L1, L2 & L3 | 8 Hrs. |
| <p>Well Foundations: Introduction, Different shapes, and characteristics of wells. Components of well foundation (online mode), Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. Drilled Piers & Caissons: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic, and floating caissons. Advantages and disadvantages of floating caissons. (Online mode),</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Poster preparation of well foundation and caissons <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Case studies related mitigation to sinking of well foundation | | |
| Module-5 | L1, L2 & L3 | 8 Hrs. |
| <p>Machine Foundations: Introduction, free and forced vibrations, Types of Machine foundations, degrees of freedom of a block foundation, (online mode), general criteria for design of machine foundation, vibration analysis of a machine foundation, determination of natural frequency, vibration isolation and control.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Poster preparation of machine foundation vibration analysis of a machine foundation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Case studies related to vibration isolation and control . | | |

| | |
|--|---|
| Course outcomes: On completion of the course, students would be able to | |
| CO1 | Find the settlement and bearing capacity of soil |
| CO2 | Describe the size of isolated and combined foundations to satisfy bearing capacity and settlement criteria. |
| CO3 | Identify the load carrying capacity and settlement of single piles and pile groups including laterally loaded piles |
| CO4 | Recall the basics of analysis and design principles of well foundation, drilled piers and caissons |
| CO5 | Use the design principles of machine foundations program |

| | | |
|---|----------|--------------|
| 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 |

| | |
|-------------------|---|
| Textbooks: | |
| 1 | Punmia B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Co., India |
| 2 | Murthy V.N.S., Advanced Foundation Engineering, CBS PUBLISHERS |

| | |
|-------------------------|---|
| Reference Books: | |
| 1. | Donald P. Coduto, Geotechnical Engineering Principles & Practices, Prenticehall of India Ltd, India |
| 2. | Bowles J.E., Foundation Analysis and Design, McGraw Hill Pub. Co. New York |
| 3. | Swami Saran, Analysis and Design of Substructures, Oxford & IBH Pub. Co. Pvt. Ltd., India |
| 4. | Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955. |

| CO-PO Mapping | | | | | | | | | | | | |
|---------------|-----|-----|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|
| CO/PO | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 |
| CO1 | 2 | 3 | 1 | - | - | 1 | - | - | 1 | - | - | - |
| CO2 | 2 | 3 | 1 | - | - | 1 | - | - | 1 | - | - | 1 |
| CO3 | 2 | 3 | 1 | - | - | 1 | - | - | 1 | - | - | 1 |
| CO4 | 2 | 3 | 1 | - | - | 1 | - | - | 1 | - | - | 1 |
| CO5 | 2 | 3 | 1 | - | - | 1 | - | - | 1 | - | - | 1 |

High-3, Medium-2, Low-1

| | | | |
|----------------------------|---------------------------|----------------|-------|
| Course Title | FINITE ELEMENT METHOD | Semester | VII |
| Course Code | MVJ20CV744 | 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,

- Outline Energy concepts in FEM problems
- Outline the concept of discretization in FEM and Various Co-ordinate system in FEM
- Predict shape function for higher order elements
- Examine the need of Iso, sub and super parametric elements in FEM.
- Use some of the software in FEM

Module-1

L1, L2, L3

08 Hr.

Pre-requisites: Basic Concepts of Strength of Materials, Mechanics of Deformable bodies, Equilibrium Concepts, Analysis of trusses.

Introduction to Finite Element method: Various Numerical methods, Difference between Finite element and Finite difference method. Advantages and Disadvantages of FEM. Theory of elasticity concepts, Energy principles, Rayleigh - Ritz Method, Galerkin method, Steps in finite element analysis, displacement approach, stiffness matrix for a Bar, Beam and Truss element. Problems on Bar element only.

Laboratory Sessions/ Experimental learning:

- Application of Energy principles to different structural elements.

Applications(Self learning)

- Solution to problems from Numerical methods.

Video link / Additional online

information:

- <https://nptel.ac.in/courses/105105108/>
- <https://nptel.ac.in/courses/105/102/105102090/>

Module-2

L1, L2, L3

08 Hr.

Discretization and Coordinate System: Finite representation of infinite bodies and discretization of very large bodies, Different types of Coordinate system in FEM, Shape functions, Polynomial, LaGrange and Serendipity , one dimensional formulation; Analysis of Beams and Trusses with numerical examples.

Laboratory Sessions/ Experimental learning:

| | | |
|---|----------------|----------------|
| <ul style="list-style-type: none"> Development of Shape function for Serendipity elements by Inspection. <p>Application:(Self learning)</p> <ul style="list-style-type: none"> Verification of Suitability of Shape function using Serendipity concepts. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ | | |
| Module-3 | L1,L2L3 | 08 Hrs. |
| <p>Shape functions: Convergence of Shape functions, Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses, Static Condensation of nodes, Degradation technique, Axi symmetric Elements</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Experimental study on Static Condensation of Nodes. <p>Application:(Self learning)</p> <ul style="list-style-type: none"> Solution to Axi-symmetric problems using FEM Techniques. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ | | |
| Module-4 | L1,L2L3 | 08 Hrs. |
| <p>Isoparametric Elements: Iso parametric, Sub parametric and Super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Iso parametric Elements, Numerical integration by Gaussian quadrature rule for one-, two- and three-dimensional problems</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Practical application of Quadrature rule for one-, two- and three-dimensional problems <p>Application: (Self Learning)</p> <ul style="list-style-type: none"> Numerical integration techniques in FEM. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ | | |

| Module-5 | L1, L2L3 | 08 Hrs. |
|--|----------|---------|
| <p>Application of FEM in Civil Engineering: Analysis of Trusses, Frames, Beams & Bars, Determination of stresses in Soil, dams, Stresses in different layers of a flexible pavement due to loading. Exposure to FEM software's.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Hands on exposure to Use of Ansys Software. <p>Application :</p> <ul style="list-style-type: none"> Solution to various structural engineering problems using FEM. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ | | |

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 | Use the basic Knowledge of Energy concepts in FEM method. |
| CO2 | Compose Shape functions for Different types of Elements |
| CO3 | Solve the Basic Structural Engineering problems using FEM analysis |
| CO4 | Design the concept of developing Shape functions for Higher order elements. |
| CO5 | Use the various FEM Software's. |

Textbooks:

| | |
|----|--|
| 1. | Krishnamoorthy C.S., "Finite Element analysis" -Tata McGraw Hill,1900 |
| 2. | Desai C & Abel J F., " Introduction to Finite element Method" , East West Press Pvt. Ltd.,1972 |

| Reference Books: | |
|------------------|---|
| 1. | Cook R D et.al., "Concepts and applications of Finite Element analysis ", John Wiley,1995 |
| 2. | S.S.Bhavikatti,"Finite Element Analysis, New age International Publishers, 2005. |
| 3. | Bathe K J - " Finite Element Procedures in Engineering analysis "- Prentice Hall,2003 |
| 4. | A First Course in the Finite Element Method D L Logan (Indian Edition) CL Engineering |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|--|----------------|-------|
| Course Title | ENVIRONMENTAL PROTECTION AND MANAGEMENT | Semester | VII |
| Course Code | MVJ20CV751 | 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: This course will enable students to

- Use the facts of environmental pollution and conservation of natural resources.
- Discuss the elements of corporate environmental management systems complying with international standards.
- Outline the issues of environmental assessment team and implement waste minimization options.
- Use the application of environmental management systems audit for various organizations.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: *Environmental Studies, Environmental management principles*

Introduction: Importance of Environmental protection and need for Environmental management

Environmental Management Standards: Unique Characteristics of Environmental Problems -

Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts

-Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers

- Evolution of Environmental Stewardship. Environmental Management Principles – National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection.

Laboratory Sessions/ Experimental learning:

- A study on prediction and assessment of Environmental impacts inclusive of air, water, land and noisy environment.
- Model making of impacts on environment (air, water, land, noise) due to a proposed project.

Applications:

- Assignment on fundamentals and relevance of Environmental standards and laws for water, air and land quality by Pollution Control board.
- Documentation of EIA reports for various industries such as textiles, thermal power plants, mining industries etc.

Video link / Additional online information:

| | | |
|--|-------------------|---------------|
| <ul style="list-style-type: none"> Principles of Environmental management, environmental concern, EIA process, https://nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf Fundamentals of environmental pollution and control, EIA, EMP, water pollutant, wastewater, https://nptel.ac.in/courses/123105001/ | | |
| Module-2 | L1, L2, L3 | 8 Hrs. |
| <p><i>Prerequisites: Environmental pollution and standards.</i></p> <p>Environmental quality: Objectives, Rationale of Environmental standards, Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking.</p> <p>Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and clean technology, closing the loops, zero discharge technologies</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Sampling and analysis of various parameters with respect to water, waste water, air and noise A study clean technology by considering a case study <p>Applications:</p> <ul style="list-style-type: none"> Awareness training program to motivate the students in maintaining and improving the quality of the environment and preventing and abating environment pollution. Performance study of an effluent treatment plant <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> Policy and legal aspects of EMS, Environmental management system standards, EIA documentation and process, https://nptel.ac.in/courses/120108004/ | | |
| Module-3 | L1, L2, L3 | 8 Hrs. |
| <p><i>Prerequisites: Environmental impact and management</i></p> <p>Environmental Management System: EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention – environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets.</p> <p>Environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> A study on the structure of environmental management programs by considering a case study | | |

- Preparation of a flowchart related to structure of EMS

Applications:

- Equip students with necessary engineering skills such as solving engineering problems in pollution control methodologies in process.
- Documentation of a detailed report on EMS

Video link / Additional online information:

- Environmental management system standards as per the requirement, Policy and legal aspects of EMS, <https://nptel.ac.in/courses/120108004/>
- Environmental management system as per requirement, techniques, <https://nptel.ac.in/courses/123105001/>

Module-4

L1, L2, L3

8 Hrs.

Prerequisites: Environmental management system audit

Environmental Audit: Environmental management system audits as per ISO 19011 – Roles and qualifications of auditors.

Environmental performance indicators and their evaluation – Non-conformance – Corrective and preventive actions – compliance audits – waste audits and waste minimization planning – Environmental statement (form - Due diligence audit

Laboratory Sessions/ Experimental learning:

- A detailed study on EMS audits in corporate sectors
- A detailed study on EMS audits in manufacturing/service industries

Applications:

- Documentation and submission of EMS audit report related to corporate sectors
- Documentation and submission of EMS audit report related to manufacturing/service industries

Video link / Additional online information:

- Environmental management system auditing, EMS techniques, Introduction to waste and safety audit, <https://nptel.ac.in/courses/120108004/>
- Effluent quality assurance program, waste audit and assessment, <https://nptel.ac.in/content/storage2/courses/116104045/lecture9.pdf>
- Objectives and scope of environmental auditing, structure, procedure, <https://pdfslide.net/documents/unit-5-environmental-auditing-answers-to-learning-nptelacincourses120108004module5.html>

| Module-5 | | L1, L2, L3 | 8 Hrs. |
|--|--|------------|--------|
| <p>Prerequisites: <i>Environmental management system (EMS) audits for industries</i></p> <p>Applications: Applications of EMS, Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Tanning industry, Dairy, Cement, Chemical industries, etc. Trans boundary movement, disposal, procedures, of hazardous wastes.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • A detailed study on EMS audit system implemented in E-waste recycling unit • A detailed study on EMS audit system pollution prevention technology in any one service-based industry <p>Applications:</p> <ul style="list-style-type: none"> • A mini project on safety audit • Preparation of a report on waste audit in E-waste recycling unit <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Environmental management system auditing, EMS techniques implementation in various industries, https://nptel.ac.in/courses/120108004/ • Effluent quality assurance program, waste audit and assessment, https://nptel.ac.in/content/storage2/courses/116104045/lecture9.pdf • Objectives and scope of environmental auditing, structure, procedure, Implementation in industries, https://pdfslide.net/documents/unit-5-environmental-auditing-answers-to-learning-nptelacincourses120108004module5.html • EMS: ISO 14001, sustainability, policy, https://www.youtube.com/watch?v=spjwQX-acnA | | | |
| Course outcomes: On completion of the course, students would be able to | | | |
| CO1 | Discuss the knowledge about environmental issues and an approach to corporate environmental management systems for conservation of resources and environmental protection. | | |
| CO2 | Use appropriately the elements of Corporate Environmental Management systems complying to international environmental management system standards | | |
| CO3 | Examine pollution prevention assessment team and implement waste minimization options | | |
| CO4 | Explain the knowledge about environmental management system audits | | |
| CO5 | Compare, Develop, Implement, maintain and Audit Environmental Management systems for industries | | |

| 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 |

| Reference Books: | |
|------------------|---|
| 1. | ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002 |
| 2. | Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – astep by step guide" Earthscan Publications Ltd, London, 1999. |
| 3. | Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001. |

| Text Books: | |
|-------------|--|
| 1. | ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organization for Standardization, 2004 |
| 2. | Paul L Bishop „Pollution Prevention: Fundamentals and Practice“, McGraw- Hill International, Boston,2000. |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|--|----------------|--------|
| Course Title | CONSTRUCTION METHODS, PLANNING & MANAGEMENT | Semester | VII |
| Course Code | MVJ20CV752 | 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: This course will enable students to

- Discuss project preparation, Planning and Analysis with its types, measures & tools for assessment.
- Illustrate various management techniques for successful completion of construction projects.
- Classify various types of equipment's used in construction projects.
- Explain the various safety concepts and requirements applied to construction projects.
- Examine materials management technique in construction

| | | |
|-----------------|-----------------|----------------|
| Module-1 | L1,L2,L3 | 08 Hrs. |
|-----------------|-----------------|----------------|

Prerequisites: *Building materials, Construction management*

Project Planning: Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. (Online mode). Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, estimating durations, sequence of activities, activity utility data. Application of MS-Project and Primavera for planning

Laboratory Sessions/ Experimental learning: (Self Learning)

- Scheduling a residential building with G+1 project using MS-Project
- Scheduling a residential building with G+1 project using Primavera Software

Applications: (Self Learning)

- Knowledge about MS-Project and Primavera software
- Able to access the real time project scheduling and planning

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>
- <https://nptel.ac.in/courses/105/103/105103093/>

| Module-2 | L1,L2, L3 | 08 Hrs. |
|--|-----------|---------|
| <p>Scheduling Procedures- Construction Scheduling, activity cost and time estimation in CPM, PERT, RPM (Repetitive Project Modeling) techniques. LOB technique, Mass haul diagrams.</p> <p>Project Controlling- Monitoring and Control, Crashing (Online mode), Resource Leveling, Updating.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Resource allocation and management using Primavera Software <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge about the network analysis • Identifying different methods of scheduling a project <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102199/ | | |
| Module-3 | L1,L2,L3 | 08 Hrs. |
| <p>Construction Equipment's and Management- Identification, Planning of equipment, Selection of Equipment, Equipment Management in Projects, Maintenance Management,(Online Mode). Equipment cost, Operating cost, Cost Control of Equipment, Depreciation Analysis, Replacement of Equipment, Replacement Analysis , Safety Management</p> <p>Equipment for Earthwork- Fundamentals of Earth Work Operations, Earth Moving Operations, Types of Earth Work Equipment- Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment (Online Mode)</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Case study on selection of construction equipment <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Behavior of different types of equipment used in construction • Knowledge about planning and selection of equipment in construction projects <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103206/ | | |
| Module-4 | L1,L2,L3 | 08 Hrs. |
| <p>Construction Quality, Safety and Human Values- Quality and Safety Concerns in Construction - Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management (Online Mode).</p> <p>HSE- Introduction to concepts of HSE as applicable to Construction. Importance of safety in</p> | | |

construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms /ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances.

Ethics- Morals, values and ethics, need of engineering ethics. (Online Mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Case study on construction safety
- Poster preparation on construction safety

Applications: (Self Learning)

- Understanding the quality and safety concerns in construction
- Knowledge about total quality management measures taken in construction

Video link / Additional online information: (Self Learning)

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

| Module-5 | L1,L2,L3 | 08 Hrs. |
|--|----------|---------|
| <p>Labor and Material Utilization- Historical Perspective, class of labour, Wages & statutory requirement, (Online Mode). Labor Productivity, Factors Affecting Job-Site Productivity, Labour Relations in Construction, Problems in Collective Bargaining,</p> <p>Materials Management - Material Procurement and Delivery, Inventory Control, Trade-offs of Costs in Materials Management</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Sample preparation of checklist for material procurement <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge in latest skills for managing supply chain, logistics, delivery, storage of materials and impart training for improving output <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106206 | | |

| | |
|--|--|
| Course outcomes: On completion of the course, students would be able to | |
| CO1 | Use relevant software packages for planning, scheduling, executing and controlling of construction projects. |
| CO2 | Predict the total time required to complete the job without delay and delay in the project |
| CO3 | Classify the type and capacity of construction equipment used in construction site. |
| CO4 | Illustrate safety manuals and practice safety in construction operations |
| CO5 | Examine the modern trends in project management |

| | | |
|---|--------------|--------------|
| 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 |

| | |
|-------------------|---|
| Textbooks: | |
| 1. | Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998. |
| 2. | Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988. |

| | |
|-------------------------|---|
| Reference Books: | |
| 1. | Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 1997 |
| 2. | Calin M. Popescu, Chotchai Charoenngam, "Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications", Wiley, New York, 1995. |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|---------------------------|----------------|-------|
| Course Title | REMOTE SENSING AND GIS | Semester | VII |
| Course Code | MVJ20CV753 | 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: This course will enable students to

- State the basic concepts of Remote Sensing.
- Identify the various Remote Sensing Platforms and its limitations
- Illustrate various international space programmes
- Brief various Geographical Information System (GIS) method
- Solve real time problem by the application of RS & GIS

Module-1

L1 & L2

8 Hrs.

Introduction to Remote Sensing:

Introduction: Introduction to Remote Sensing: Definition - History & Concepts - Electromagnetic Radiation (Source, Mode of Energy transfer, Radiation Principles, Black body radiation); Electro Magnetic Radiation (EMR): EMR Spectrum - EMR Interaction with Atmosphere (Absorption, Scattering & Atmospheric windows) - EMR Interaction with Earth surface (Absorption & reflection) - Spectral Response pattern - Energy budgeting in Remote Sensing.

Module-2

L1 & L2

8 Hrs.

Sensor and its characteristics:

Sensors and Platforms: Resolutions (Spectral, Spatial, Temporal, Radiometric) –Platforms Sensors - Scanning & Orbiting Mechanism of Satellites and Data Acquisition. Optical Remote Sensing: Basic concepts -Optical sensors and scanners.

Thermal & Microwave Remote Sensing: Thermal Remote Sensing: Basic concepts-Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basic concepts Microwave sensors and Radiometers - Geometric characters – Radar grammetry (SLAR/SAR)- LIDAR - Hyper spectral Remote Sensing: basic concepts.

Module-3

L1, L2

8 Hrs.

Remote Sensing Satellite Programme:

Remote Sensing Satellites: LANDSAT Series - IRS Series - IRS-P series -Cartosat - Spot Series - ASTER, MODIS - IKONOS - QUICKBIRD - ORBVIEW -ERS - Meteorological Satellites -Shuttle Mission - Developments of Remote Sensing in India - Future Remote Sensing Missions

Module-4

L1, L2

8 Hrs.

| | | |
|--|--|---------------|
| Introduction to Geographical Information System (GIS): Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. Data Structure: Data Structure in GIS - Types of Data (Points, Lines and Polygons) - Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion (Vector to Raster and Raster to Vector) | | |
| Module-5 | | L1, L2 |
| 8 Hrs. | | |
| Integrated Applications of Remote sensing and GIS: Applications in Land use Land cover analysis, change detection, Water Resources, Urban Planning, Environmental Planning, Natural Resource Management and Traffic Management. Location Based Services and its Applications | | |
| Course outcomes: On completion of the course, students would be able to | | |
| CO1 | Collect data and delineate various elements from the satellite imagery using their spectral signature | |
| CO2 | Identified various Remote Sensing Platforms and its limitations | |
| CO3 | Restate and apply sustainability concepts in various space programmes | |
| CO4 | Analyze different features of ground information to create raster or vector data. | |
| CO5 | Perform digital classification and create different thematic maps for solving specific problems & Make decision based on the GIS analysis on thematic maps. | |

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 |

Textbooks:

| | |
|---|---|
| 1 | Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008 |
| 2 | S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005 |

Reference Books:

| | |
|---|--|
| 1 | Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006 |
|---|--|

| | |
|---|--|
| 2 | John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2 nd edition – by Pearson Education 2007 |
| 3 | Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004 |

CO-PO Mapping

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|--|----------------|-------|
| Title | INTRODUCTION TO RESEARCH AND TECHNICAL WRITING | Semester | VII |
| Course Code | MVJ20CV754 | 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: This course will enable students to

- Contrast engineering research, research methodology and types of research
- Demonstrate the process of literature survey and measures of research impact
- Explain research plans and design for outcomes
- Illustrate survey research method and selection of survey method and respondents
- Construct research presentations and demonstrate different presentations

Prerequisites: *Basic knowledge of respective Engineering disciplines.*

Module-1

L1, L2

8 Hrs

Introduction to Engineering Research: Research definition, Next step research, research questions, engineering ethics, identifying proofs, Need for taking research projects

Research Methodology: Research Methods/Scientific methods vs Research Methodology, Research Process. Types of research, Research approaches, Research Problem, Defining the problem, Illustration.

Laboratory Sessions: (Self Learning)

- Read an Environmental Impact Assessment Report and make interpretations.

Applications: (Self Learning)

- Learning of purpose of research and different types of research

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/121/106/121106007/>

Module-2

L1, L2, L3

8 Hrs

Literature Search and Review: Archival literature, why should engineers be ethical? Types of Publications, Journal articles, Conference papers, Books, Standards, Patents, Theses, Trade magazines, Newspaper articles, Infomercials, Advertisements.

Measures of research impact: H-index, I-index, Scopus, Web of science (SCI index), Google scholar, Literature review process, Referencing styles, Keywords, Publication

| | | |
|--|-------------------|-------------|
| <p>cost, Plagiarism, retractions of journal articles.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Find the plagiarism percentage of any report using online plagiarism checker (Turnitin) <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Understanding the purpose of literature review <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/121/106/121106007/ | | |
| Module-3 | L1, L2, L3 | 8Hrs |
| <p>Research Plan: Research proposals, Finding a suitable research question, Elements of a research proposal, Project title, Research team, Project summary, Project outline, Budget, Research contracts, Conflict of interest.</p> <p>Design for outcomes: One-dimensional data, Two-dimensional data, N-dimensional data, Research tools, Experimental measurements, Numerical modelling, Theoretical derivations and calculations, Curve fitting.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Practice curve fitting for sample experimental data. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Understanding elements of research proposals and data analysis. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/121/106/121106007/ | | |
| Module-4 | L1, L2 | 8Hrs |
| <p>Survey Research Methods: Purpose of a survey (Why undertake a survey?), Ergonomics and human factors, Ethics approval, Survey statements, Survey delivery, Respondent selection, Survey timeline, Statistical analysis, Reporting.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Prepare a questionnaire for survey of a water supply project <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Discover the survey method, questionnaire and respondents for a research study <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/109/103/109103153/ | | |
| Module-5 | L1, L2, L3 | 8Hrs |

Research Presentation: Introduction, Standard terms, Paper title and keywords, Writing an abstract, Practicing abstract writing, Paper presentation and review, Conference presentations, Poster presentations.

Laboratory Sessions: (Self Learning)

- Prepare and present a poster from a research topic.

Applications: (Self Learning)

- Distinguish different formats of research presentation and choose appropriate one for the research work

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/110/105/110105091/>

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

| | |
|-----|---|
| CO1 | Identify different research types and research methodologies |
| CO2 | Discover and prepare literature survey and identify literature metrics needed for evaluation research impact |
| CO3 | Construct research plans for their projects and identify data analysis methods |
| CO4 | Identify different survey methods and design survey for research |
| CO5 | Prepare different research presentations |

| 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 |

Textbooks:

| | |
|----|--|
| 1. | Kothari, C. R., "Research Methodology: Methods and Techniques", New Age International, |
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| | |
|----|---|
| | Fourth edition, 2018. |
| 2. | Kumar, R., "Research methodology: A step-by-step guide for beginners", Sage Publishers, 2018. |

| | |
|-------------------------|---|
| Reference Books: | |
| 1. | Thiel, D.V., "Research methods for engineers", Cambridge University Press, 2014. |
| 2. | Research Methodology and Scientific Writing, Thomas, C. G. (2e), Indian Print, Anne Books Ane Books Pvt. Ltd. |

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

High-3, Medium-2, Low-1

| | | | |
|----------------------------|---|----------------|--------|
| Course Title | QUANTITY SURVEYING AND CONTRACTS MANAGEMENT | Semester | VII |
| Course Code | MVJ20CV76 | CIE | 50 |
| Total No. of Contact Hours | 30 L : T : P :: 1 : 2 : 0 | SEE | 50 |
| No. of Contact Hours/week | 3 | Total | 100 |
| Credits | 2 | Exam. Duration | 3 Hrs. |

Course objective is to: This course will enable students to

- Find the quantities of work, develop the bill of quantities, and arrive at the Cost of civil engineering Project
- Use the concept of Valuation for Properties
- Outline the Tender process and Contract document.

Module-1

L3

6 Hrs.

Prerequisites: Reading Drawings, Concept of measurements, Reinforcement details.

Quantity Estimation for Building: Study of various drawing attached with estimates, important terms, and units of measurements, abstract, Types of estimates - Approximate, detailed, supplementary and revised. Estimation of building - short wall and long wall method - center line method.

Estimate of R.C.C structures: Slab, beam, column, footings, with bar bending schedule.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Case Study - Incorporating Pre-construction Cost Estimating in Construction Engineering and Management Programs
- Computation of quantities and cost estimating using EXCEL Sheet

Applications: (Self Learning)

- Quantity Estimation of different buildings
- Estimation of cost for different buildings
- Use of different software's for quantity estimation

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/103/105103093/>

| Module-2 | L3 | 6 Hrs. |
|--|----|--------|
| <p><i>Prerequisites: Reading Drawings, Concept of measurements, Areas & Volume Calculations.</i></p> <p>Estimate of Roof, Sanitary & Water Supply Works: Steel truss, manhole and septic tanks.</p> <p>Quantity Estimation for Roads: Road estimation, earthwork fully in banking, cutting, partly cutting and partly Filling.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Computation of Quantities using Excel Sheet • Plotting of Earthwork for Roads using Excel Sheet <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Quantity Estimation of different structures • Estimation of cost for different structures • Use of different software for quantity estimation <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ | | |
| Module-3 | L2 | 6 Hrs. |
| <p><i>Prerequisites: Understanding class of labors, Concept of measurements, Construction stages & Rates of Materials & Labors as per current market.</i></p> <p>Specification for Civil Engineering Works: Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings.</p> <p>Analysis of Rates: Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Learning current rates and analyzing for different construction works. • Specifications of different constructional activities using different relevant software <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Handling projects for various construction activities • Computing the cost of materials, labours and any taxes applicable using Excel sheets <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ | | |

| Module-4 | L2 | 6 Hrs. |
|---|----|--------|
| <p><i>Prerequisites: Planning & Scheduling of Construction Works</i></p> <p>Contract Management-Tender and its Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: covering Award of contract, letter of intent, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC). Law of Contract as per Indian Contract act 1872 , Types of Contract, Entire contract, Lump sum contract, Item rate, % rate, Cost plus with Target, Labour, EPC and BOT, Sub Contracting. Contract Forms : FIDIC contract Forms , CPWD , NHAI , NTPC , NHEPC.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Law of Contract as per Indian Contract act 1872 • PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Bidding Process • Contract for public and private department works <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ | | |
| Module-5 | L2 | 6 Hrs. |
| <p><i>Prerequisites: Land & Rental demands, Contracts & Laws</i></p> <p>Contract Management-Post award: Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes & its resolution mechanism, Contract management and administration</p> <p>Valuation: Definitions of terms used in valuation process, Cost, Estimate, Value and its relationship, Capitalized value. Concept of supply and demand in respect to properties (land , building , facilities'), freehold and lease hold , sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process, and methods of valuation : Rent fixation, valuation for mortgage, valuation of land.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Case Study – Multiple Valuation Approaches of Projects For Different Construction Designs & Techniques • Develop Valuation report for buildings using Excel Sheet | | |

Applications: (Self Learning)

- Valuation of different property
- Managing the contracts and any disputes

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/103/105103093/>

| Course outcomes: On completion of the course, students would be able to | |
|---|--|
| CO1 | Solve for detailed estimate and abstract of Quantities for buildings. |
| CO2 | Solve for detailed and abstract estimates for roads, roofs, water supply & sanitary works. |
| CO3 | Outline specifications & analyzing rates for different construction works. |
| CO4 | Discuss Contract documents of domestic and international construction works. |
| CO5 | Solve for valuation reports of buildings. |

| 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 |

| Textbooks: | |
|------------|--|
| 1. | Datta B.N., "Estimating and costing", UBSPD Publishing House, New Delhi |
| 2. | B.S. Patil, " Civil Engineering Contracts and Estimates", Universities Press |

| Reference Books: | |
|------------------|---|
| 1 | M. Chakraborti; "Estimation, Costing and Specifications", Laxmi Publications |
| 2 | Duncan Cartlidge , "Quantity Surveyor's Pocket Book", Routledge Publishers, 2012. |
| 3 | Robert L Peurifoy , Garold D. Oberlender , " Estimating Construction Costs" – 5ed , Tata McGraw-Hill , New Delhi |
| 4 | David Pratt , " Fundamentals of Construction Estimating" – 3ed |
| 5 | PWD Data Book, CPWD Schedule of Rates (SoR). and NH SoR – Karnataka MORTH Specification for Roads and Bridge Works – IRC New Delhi |

CO-PO Mapping

| CO/PO | PO1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 |
|-------|-----|------|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 1 | 1 | 1 | - | - | - | - | 1 | - | - | 1 | 2 |
| CO2 | 2 | 2 | 2 | - | 1 | 1 | 1 | 2 | - | - | 2 | 2 |
| CO3 | 1 | 1 | 2 | - | - | 1 | 1 | 2 | 1 | - | 2 | 2 |
| CO4 | 1 | - | 2 | - | - | 2 | 1 | 1 | 1 | - | 1 | 1 |
| CO5 | 1 | - | 2 | - | - | 2 | 1 | 2 | 1 | - | 1 | 1 |

High-3, Medium-2, Low-1

| | | | |
|----------------------------|--|----------------|--------|
| Course Title | COMPUTER AIDED DETAILING OF STRUCTURES | Semester | VII |
| Course Code | MVJ20CVL77 | 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 is to: This course will enable students to

- Acquaint with graphic primitives and transformations.
- Be versed of the scale factors, sections of drawings.
- Draft the detailing of RC and Steel structural member.

Prerequisites: Knowledge on Design of RCC structures, SP-34- Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards.

| | | |
|--|---|-----------|
| S.NO | Module-1-Detailing of RCC Structures | L3 |
| The following drawings, detailing is to be prepared for the data given, using AUTOCAD. | | |
| 1 | Footing-Combined- Prepare the plan, cross-sectional elevation, and side view. | |
| 2 | Beams – Fixed and Continuous- Prepare the cross-sectional elevation and side view. | |
| 3 | Slab –One-way continuous- Prepare the plan, cross-sectional elevation, and side view. | |
| 4 | Staircase – Doglegged- Prepare the plan and cross-sectional elevation of all flights. | |
| 5 | Cantilever Retaining wall- Prepare the cross-sectional elevation and side view. | |
| 6 | Counter Fort Retaining wall- Prepare the plan and cross-sectional elevation. | |
| 7 | Circular Water Tank, Rectangular Water Tank- Prepare the plan, cross-sectional elevation front and side view. | |
| | Module-2-Detailing of Steel Structures | L3 |
| <i>Prerequisites: Knowledge on Design of Steel structures.</i> | | |
| The following drawings, detailing is to be prepared for the data given, using AUTOCAD. | | |
| 8 | Connections – Beam to beam, Beam to Column by Bolted and Welded Connections Prepare the front and side views. | |
| 9 | Built-up columns with lacings and battens- Prepare the plan and elevation. | |

| | |
|----|---|
| 10 | Column bases and Gusseted bases with bolted and welded connections- Prepare the plan and cross-sectional elevation and side view. |
| 11 | Roof Truss – Welded and Bolted- Prepare the elevation and enlarged view of joints and support. |
| 12 | Welded Plate girder- Prepare the plan, front and side views. |
| 13 | Gantry Girder- Prepare the plan, front and side views. |

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

| | |
|-----|--|
| CO1 | Utilize the drafting software. |
| CO2 | Prepare detailed working drawings. |
| CO3 | Discuss the drawings of prepared structures. |
| CO4 | Explain through documentation. |

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 |

Reference Books:

| | |
|----|--|
| 1. | N Krishna Raju, "Structural Design and Drawing of Reinforced Concrete and Steel", University Press-2019. |
| 2. | D Krishna Murthy, "Structural Design and Drawing, Volume-II – Concrete Structures", CBS Publishers, New Delhi-1 st Edition-2018. |
| 3. | SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards. |
| 4. | IS 13920, Ductile Design And Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice, Bureau of Indian Standards. |

CO-PO Mapping

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO 5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|------|------|
| CO1 | 1 | - | - | - | 3 | - | - | - | 1 | - | - | 3 |
| CO2 | 1 | - | - | 1 | 3 | - | - | - | 1 | - | - | 3 |
| CO3 | 1 | - | - | - | - | - | - | - | 1 | - | 2 | 3 |
| CO4 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |

High-3, Medium-2, Low-1

| | | | |
|----------------------------|------------------------|----------------|-----|
| Course Title | PROJECT PHASE – 1 | Semester | VII |
| Course Code | MVJ20CVP78 | CIE | 100 |
| Total No. of Contact Hours | L : T : P :: 0 : 0 : 4 | SEE | - |
| No. of Contact Hours/week | - | Total | 100 |
| Credits | 2 | Exam. Duration | - |

| | |
|---|--|
| <p>Course Objective:</p> <ul style="list-style-type: none"> • To support independent learning. • To develop interactive, communication, organization, time management, and presentation skills. • To impart flexibility and adaptability. • To expand intellectual capacity, credibility, judgment, intuition. • To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. | |
| <p>Project Work Phase - I: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.</p> | |
| <p>Course outcomes: At the end of the course the student will be able to:</p> | |
| CO1 | Describe the project and be able to defend it. |
| CO2 | Learn to use modern tools and techniques. |
| CO3 | Develop skills to work in a team to achieve common goal. Develop skills of project management and finance. |
| CO4 | Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it. |
| CO5 | Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs. |
| <p>Scheme of Evaluation :</p> <p>Internal Marks: The Internal marks (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.</p> | |

| 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 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| CO5 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |

High-3, Medium-2, Low-1