# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech. |
| **Course Code** | 6CV421 |
| **Course Name** | Sustainable and Energy Efficient Building Technologies |
| **Desired Requisites:** | Building Materials and Construction, Building Planning and Design |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives:** The course is designed to

| | |
|---|---|
| 1 | Introduce the class the scientific and engineering principles of energy and usstainable energy alternatives. |
| 2 | impress upon the integration of modern materials and traditional techniques to bring about cost effectiveness, energy efficiency and environmental friendly technologies in construction industry. |
| 3 | meet the objectives of green building concepts during the construction phase and operational phase. |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Perceive and explain concepts in the language of energy, and express the relevance of environment and energy efficiency in context to construction industry | Understand | 2 |
| CO2 | Calculate and assign the energy contribution of various materials and components in buildings. | Apply | 2 |
| CO3 | Ability to apply alternative/environmental friendly/ energy efficient building systems using conventional/modern/waste materials leading to better efficiency in context to embodied energy and thermal comfort. | Apply | 2 |
| CO4 | Apply the concept of heat exchange in buildings and adopt passive and active design strategies for human comfort in buildings. | Apply | 2 |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Module 1: Energy and Environment**<br>Energy, planning & urban form, Global warming, causes, energy considerations, energy conservation and energy efficiency, energy systems and spatial structures, Classification of energy, primary and secondary energy, commercial and non-commercial energy, renewable and non-renewable energy, Global primary energy reserves and consumption, energy distribution, Units of Energy with examples. | 5 |
| II | **Module 2: Energy and Environmental issues in Building Materials**<br>General facts, energy resources and their impacts on environment, energy in context to built environment, Sustainable buildings, Objectives of Green buildings, planning aspects of sustainable buildings, energy consumption and efficiency in buildings, Design strategies, Material strategies, Parametric assessment, Env. Issues related to buildings materials, Green Rating Standards (Griha and ECBC). | 6 |
| III | **Module 3: Conventional Materials and Techniques in Buildings**<br>Constraints in Choice of building systems, Pre & post construction performance, Properties of materials, Types of Physical, Mechanical, Chemical and Thermal characteristics, Introduction to structural and physical aspects of buildings, Conventional materials used in construction, Case studies of various building materials, Energy consumption in various building materials, Sustainability considerations. | 6 |

| | | |
|---|---|---|
| IV | **Module 4: Sustainable Materials and Techniques for Masonry**<br>Felt requirements and real objectives of Green towns, Energy scenario in pre and post independent India, Need and approach to sustainability, Green building materials, Design constraints,<br>Appropriate materials and techniques in construction: Relevance of building blocks, mortars. Stabilized mud blocks, FAL-G blocks, Hollow concrete blocks, Calcium silicate bricks, Hourdi blocks, Energy comparison in building blocks, Structural relevance of combination mortars for masonry, Building Materials from Agro and Industrial waste, Biomass resources, treated thatch, Industrial wastes, | *6* |
| V | **Module 5: Roofing concepts in Green Buildings**<br>Structural inefficiencies in Conventional roofing systems, Concepts in roofing alternatives, Thatch roofs, Filler slab roofs, Filler materials, Composite beam-panel roofs / floors, hollow hourdi/concrete block roofs / floors, Ferrocement roofing systems, Masonry Domes and Vaults, Comparison of Energy consumption in roofing systems, Energy Embodied energy in buildings. | *6* |
| VI | **Module 6: Energy systems in Building Maintenance**<br>Elements of climate, Factors influencing climate, Climate and human comfort, Orientation of buildings, Comfort criteria, Heat exchange in buildings, Design for heat loss and heat gain in buildings, Concepts of Active and Passive Energy systems in Buildings, Use of modern gadgets leading to energy efficiency, Influence of Building materials and components on thermal comfort, Green Cover, Introduction to Rain water harvesting. | *6* |

| **Text Books** | |
|---|---|
| 1 | Alternative Building materials and Technologies by K.S. Jagadish, B.V.Venkatarama Reddy, K. S. Nanjunda Rao, New Age International, 2017, 2nd Ed. |
| 2 | Manual of tropical Housing and Building- Climatic Design by Koenigsberger, Ingersoll, Mayhew, Szokolay, Universities Press (India) Pvt. Ltd., 2012 |
| 3 | Passive and Low Energy Building Design for Tropical Island Climates- by N. V. Baker, Published by Commonwealth Secretraiat Publications, copyright May 1987. |

| **References** | |
|---|---|
| 1 | Building with Earth, John Norton, Intermediate Technology Pub., 1997. |

| **Useful Links** | |
|---|---|
| 1 | |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSPO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | 2 | 2 | | | | 2 | | | 2 | | | | |
| **CO2** | 2 | 2 | 2 | | | | 2 | | | | | | | |
| **CO3** | | | 2 | | | | 2 | | | | | | 2 | |
| **CO4** | | | | | | 2 | 3 | | | | | | 2 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by Dr. K. S. Gumaste | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

## Course Information

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Sem VIII |
| **Course Code** | 6CV492 |
| **Course Name** | Project-II |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | - | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 30 | 40 | 100 |
| **Practical** | 12 Hrs/week | | | | |
| **Interaction** | - | **Credits: 6** | | | |

## Course Objectives

| | |
|---|---|
| 1 | To impart knowledge to the students to analyze the real-world problems and provide designs/solution. |
| 2 | To make students work in a team, follow professional ethics, and develop leadership and presentation skills. |

## Course Outcomes (CO)

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Conduct the necessary analytical/experimental work to provide a solution / develop parametric relation/ design, as per the designed objectives of the project. | Analyze/ Evaluate/ Create | 4/5/6 |
| CO2 | Develop expertise in using modern tools/laboratory instruments to produce experimental results for the defined objectives. | Analyze /Evaluate | 4//5 |
| CO3 | Exhibit adequate skills as an individual/team to analyze, evaluate and arrive at conclusions of the studies conducted, and communicate effectively. | Analyze/ Evaluate | 4/5 |
| CO4 | Work in a team to complete the objectives of the project work and present it to the evaluation committee. | Evaluate | 5 |
| CO5 | Preparation of a project report for the work done, including Problem Statement, Methodology, Results, Discussions and Conclusions. | Create | 6 |

## Module Contents

1. The students shall conduct experimental/analytical work in the institute or outside depending on the topic of their study.
2. The project work shall be carried out in the respective laboratories using the equipment necessary for the execution of the defined objectives of the work.
3. The results obtained shall be analyzed through the appropriate mathematical and statistical tools and techniques, and the results shall be compared with the literature.
4. The appropriate discussions on the obtained results and conclusions shall be documented in the report.
5. The students shall give Presentations on their project work to the internal and external evaluation committee and submit of the detailed project report of the work done.

## Text Books

| | |
|---|---|
| 1 | Guide to Research Projects for Engineering Students: Planning, Writing, Presenting, Kenneth Keng Wee Ong, CRC Press, Taylor and Francis Publications. |

## References

| | |
|---|---|
| 1 | R.C. Kothari, Research Methodology, New Age Publications, 2nd Edition |
| 2 | Technical Journals and Conference proceedings etc. pertaining to area of the project. |
| 3 | Dissertations of B.Tech./ M.Tech. Project work of previous students of department/institute |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | 3 | | | | 3 | 2 | 1 | | | 3 | 2 | 3 | |
| **CO2** | | 1 | | 1 | 1 | | | | | | | 1 | 3 | |
| **CO3** | | | | | 1 | | | 3 | 3 | 2 | | 1 | 3 | |
| **CO4** | | 2 | | 3 | | | | | 3 | | | | | |
| **CO5** | | | | | | | | | | 3 | | 3 | | |
| The strength of mapping: - 1: Low, 2: Medium, 3: High | | | | | | | | | | | | | | |

| Assessment | | | | |
|---|---|---|---|---|
| The Project work will be evaluated in three stages LA1, LA2 and ESE as given below: | | | | |
| **Assessment** | **Activity Related to** | **Conducted by** | **Typical Schedule** | **Marks** |
| LA1 | CO1, CO2 | Guide and Internal panel | During Week 1 to Week 6<br>Marks Submission at the end of Week 6 | 30 |
| LA2 | CO2, CO3 | Guide and Internal panel | During Week 6 to Week 12<br>Marks Submission at the end of Week 12 | 30 |
| Lab ESE | CO1, CO2, CO3, CO4 and CO5 | Guide and External examiner | During Week 12 to Week 18<br>Marks Submission at the end of Week 18 | 40 |
| The assessment of the students will be done individually by the respective supervisor/guide and in a group by the panel using the defined rubrics. | | | | |

| Prepared by | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

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**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B. Tech., Semester VIII |
| **Course Code** | 6CV431 |
| **Course Name** | Professional Elective 5: Structural Health Monitoring |
| **Desired Requisites:** | Solid Mechanics, Concrete Technology, Structural Analysis |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To develop proficiency in the use of various SHM technologies and tools for assessing the condition and performance of structures. |
| 2 | To enhance skills in data collection, analysis, and interpretation for making informed decisions regarding structural integrity and maintenance. |
| 3 | To apply SHM techniques to real-world problems, ensuring the safety, reliability, and longevity of civil engineering structures. |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Demonstrate a comprehensive understanding of the principles and techniques of structural health monitoring (SHM) and their importance in civil engineering. | Applying | 3 |
| CO2 | Analyze the need and challenges of Structural Health Monitoring. | Applying | 3 |
| CO3 | Describe various methods of damage detection. | Analysing | 4 |
| CO4 | Apply the Structural Health Monitoring technique for the building. | Applying | 3 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to Structural Health Monitoring**<br>Concepts and Definitions: Understanding the need for SHM, key concepts, and terminology. | 6 |
| II | **Importance and Application**<br>Benefits and applications of SHM in civil engineering, including safety, maintenance, and lifecycle management.<br>Historical Perspective: Evolution of SHM techniques and technologies. | 6 |
| III | **SHM Techniques and Technologies**<br>Non-Destructive Testing (NDT): Overview of NDT methods such as ultrasonic testing, radiography, magnetic particle testing, and eddy current testing.<br>Sensors and Instrumentation: Types of sensors used in SHM (e.g., strain gauges, accelerometers, displacement sensors), sensor placement, and data acquisition systems. | 8 |
| IV | **Structural Health Assessment and Damage Detection**<br>Damage Identification Methods: Techniques for detecting and locating damage, including static and dynamic methods.<br>Health Index Development: Creating health indices for evaluating the condition of structures. | 7 |
| V | **Health Monitoring of Bridges:**<br>Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health<br>monitoring Techniques: Vibration signal analysis, Strain gage based Instrumentation, Destructive & Non-destructive testing, Load Test, etc | 6 |

| | | |
|---|---|---|
| VI | **Advanced SHM Techniques**<br>Fiber Optic Sensors: Principles and applications of fibre optic sensing in SHM.<br>Wireless Sensor Networks: Use of wireless sensor networks for distributed monitoring of structures. | 5 |

| | |
|---|---|
| **Text Books** | |
| 1 | Charles R Farrar, and Keith Worden, Structural Health Monitoring: A Machine Learning Perspective, John Wiley &Sons, first edition, 2012-2013. |
| 2 | Nagayama, T. and Spencer Jr, B.F., 2007, Structural health monitoring using smart sensors, Newmark Structural Engineering Laboratory. University of Illinois at Urbana-Champaign. |
| **References** | |
| 1 | Glisic, B. and Inaudi, D., 2008, Fibre optic methods for structural health monitoring, John Wiley &Sons |
| 2 | Do, R., 2014, Passive and active sensing technologies for structural health monitoring, University of California, San Diego. |
| **Useful Links** | |
| 1 | https://youtu.be/Y_-OrF8lmio?si=46zyTMiut68gWBWk |
| 2 | https://youtu.be/7mbejkAPbgg?si=fR20wkLqGtFMjQBS |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 1 | 2 | | 1 | | | | | | | | | 2 | |
| **CO2** | | 2 | | 1 | | | | | | | | | 1 | |
| **CO3** | | | | | 2 | 2 | | | | | | | 1 | |
| **CO4** | | | | | 2 | 2 | | | | | | | 1 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

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**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B. Tech., Semester VIII |
| **Course Code** | 6CV432 |
| **Course Name** | Professional Elective 5: Industrial Wastewater Treatment |
| **Desired Requisites:** | Sewerage and Sewage Treatment |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To Provide in-depth knowledge of manufacturing processes, wastewater generation and treatment. |
| 2 | To enhance the technical competency and apply the acquired knowledge for research and development, industry, and consultancy activities. |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | ***Explain*** classification of industries and concept related to common effluent treatment plant. | Understand | II |
| CO2 | ***Apply*** concepts of waste minimization for reduction, reuse and by-product recovery from industrial wastewater. | Apply | III |
| CO3 | ***Study*** and ***Recommend*** effluent treatment technologies for agro-based, chemical and engineering industries. | Analyze | IV |
| CO4 | ***Design*** units for treatment of industrial wastewater. | Create | VI |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Classification of Industries and Waste Minimization Techniques**<br>Classification of Industries as per Central Pollution Control Board (CPCB), Concept of waste minimization, Techniques of volume and strength reduction, Equalization: Process, Flow and quality, Location, Volume requirement, Design considerations, Reuse and recycling concepts, Objectives and Methods of Neutralization and Proportioning. | 6 |
| II | **Agro Based Industries – A**<br>Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction/Reclamation/By-product recovery, Utilization, Alternative methods of treatment and disposal for Agro-based industries: Sugar and Distillery. | 7 |
| III | **Agro Based Industries – B**<br>Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction/Reclamation/By-product recovery, Utilization, Alternative methods of treatment and disposal for Agro-based industries: Dairy, Pulp and paper mill and Textile. | 7 |
| IV | **Chemical Industries**<br>Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction/Reclamation/By-product recovery, Utilization, Alternative methods of treatment and disposal for Chemical industries: Pharmaceutical, Petroleum and refineries, Fertilizer and Tannery. | 8 |

| | | |
|---|---|---|
| V | **Engineering Industries**<br>Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction/Reclamation/By-product recovery, Utilization, Alternative methods of treatment and disposal for Engineering industries: Electroplating and Thermal power plants. | 6 |
| VI | **Common Effluent Treatment Plant**<br>Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance. | 5 |

| **Text Books** | |
|---|---|
| 1 | Rao M. N. and Datta, "Waste Water Treatment", Oxford & IBH Publication, 1st Edition, 1992. |
| 2 | Masters, G, M, "Introduction to Environmental Engineering and Science", Pearson Education, 2004. |

| **References** | |
|---|---|
| 1 | Nelson Nemerow, "Theories and Practices of Industrial Waste Treatment", Wiley Publication Company, 1st Edition, 1971. |
| 2 | "IS Standards for Treatment and Disposal of Effluents of Various Industries". |
| 3 | Eckenfelder, W. W., "Industrial Water Pollution Control", McGraw-Hill, 2000. |
| 4 | Nemerow, N. L and Dasgupta, A., "Industrial and Hazardous Waste Treatment", Van Nostrand Reinhold (New York), 1991. |

| **Useful Links** | |
|---|---|
| 1 | https://www.youtube.com/watch?v=in3GSRuooRs |
| 2 | https://www.youtube.com/watch?v=JBSP6ayaIjU |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSPO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | | | | | 2 | 2 | | | | | | | |
| **CO3** | | 2 | | | | 2 | 2 | | | | | | 3 | |
| **CO4** | | 3 | 3 | | | | 2 | | | | | | 3 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

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**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6CV433 |
| **Course Name** | Professional Elective 5: Geosynthetics and Reinforced Soil Structures |
| **Desired Requisites:** | Soil Mechanics, Foundation Engineering |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To familiarize with different ground improvement techniques. |
| 2 | To impart knowledge of types, functions and applications of geosynthtics. |
| 3 | To explain the philosophy for analysis and design of Reinforced Earth Retaining Walls. |

**Course Outcomes (CO)**

| CO | Description | Bloom's Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Realize the need and demand for the use of geosynthetic materials in the field of civil engineering. | Understanding | 2 |
| CO2 | Design the Geosynthetics for the functions of separation, reinforcement, stabilization,filtration, drainage and moisture barriers. | Applying | 3 |
| CO3 | Understand and describe various manufacturing methods and quality control tests for Geosynthetics. | Understanding | 2 |
| CO4 | Understand types, functions and applications of natural geotextiles | Understanding | 2 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Ground Improvement Techniques, Introduction to Geosynthetics - Basic description - Polymeric materials – Uses and Applications. Properties of Geotextiles, Geogrids Geomembranes, Geocomposites. | 7 |
| II | **Geotextiles, Geogrids and Gabions**<br>Geotextiles: Design criteria for Separation – Reinforcement – Stabilization - Filtration - Drainage and Moisture barriers. Geogrids: Designing for Reinforcement - Stabilization – Gabions: Design - Construction methods. | 6 |
| III | **Use of Geosynthetics in Roads**<br>Geosynthetics in road ways – applications - role of subgrade conditions - design criteria – survivability - application in paved roads. | 6 |
| IV | **Reinforced Earth Retaining Walls**<br>Components - External stability - Internal stability - Design of reinforced earth walls with strip, sheet and grid reinforcement. | 7 |
| V | **Geomembranes**<br>Pond Liners - Covers for Reservoirs - Canal Liners - Landfill Liners - Caps and closures, moisture barriers. Geocomposites: An added advantage - Geocomposites in Separation - Reinforcement - Filtration - Geocomposites as Geowebs and Geocells. | 7 |

| | | |
|---|---|---|
| VI | **Natural Geotextiles**<br>Natural fibres as geotextiles - factors governing the use - juts fibres - coir geotextiles - bamboo/timber - combination of geotextiles. | 6 |

| **Text Books** | |
|---|---|
| 1 | Shukla Sanjay Kumar (2016), *"An introduction to geosynthetic engineering",* CRC Press. |
| 2 | Shukla Sanjay Kumar (2002), *"Geosynthetics and their applications",* Thomas Telford |
| 3 | Peter G Nicholson (2015), *"Soil improvement and ground modification methods",* Butterworth-Heinemann, , Elsevier Inc. |

| **References** | |
|---|---|
| 1 | R. W. Sarsby (2006), *"Geosynthetics in Civil Engineering",* 1st Edition, Woodhead Publishing |
| 2 | Robert M Koerner (2005), "Designing with Geosynthetics", 5th Edition, Pearson Prentic Hall. |
| 3 | Wu Jonathan T. H. (2019) ,"Geosynthetic reinforced soil (GRS) walls ", Wiley. |
| 4 | FHWA-NHI-10-024 (2009), "*Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes -Volume I* ", NHI. |
| 5 | Jie Han (2015), " *Principles and Practices of Ground Improvement*", Wiley. |

| **Useful Links** | |
|---|---|
| 1 | https://archive.nptel.ac.in/courses/105/106/105106052/ ( IIT Madras) |
| 2 | https://igrip.iitgn.ac.in/geosynthetics-lectures/ (IIT Gandhinagar) |
| 3 | https://nptel.ac.in/courses/105101143 (IIT Bombay) |

CO-PO Mapping

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | | | | | | 2 | 3 | | | | | | 3 | 2 |
| CO2 | | | 3 | | | | | | | | | | 3 | 2 |
| CO3 | 2 | | | | | | | | | | | | | 1 |
| CO4 | | | | | | | 2 | | | | | | | 2 |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

| Prepared by Dr D. S. Chavan | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech. |
| **Course Code** | 6CV434 |
| **Course Name** | Professional Elective 5: Advanced Structural Design |
| **Desired Requisites:** | Design of Concrete structures I & Design of Concrete structures II |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To provide details of analysis and design methods for structural elements viz deep beam, shear wall, flat slab, deep foundation and earth retaining structures |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Design shear walls, flat slabs, foundations and earth-retaining structures | Creating | 6 |
| CO2 | Analyze shear wall two-span continuous beam rafted deep foundations | Analyzing | 4 |
| CO3 | Solove problems pertaining to fixed beam propped cantilever and continuous beam | Applying | 3 |
| CO4 | Create the reinforcement detailing of the flat slab | Creating | 6 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Elevated rectangular water reservoir**<br>Design of elevated water reservoir rectangular RCC water tank with staging, Using Provisions of IS 3370. | 6 |
| II | **Elevated circular water reservoir**<br>Design of elevated water reservoir a) Circular Flat Bottom- flat Top, b) RCC water tank with staging, Using Provisions of IS 3370. | 6 |
| III | **Flat slabs**<br>Elements of flat slabs, Design of Flat Slabs using Direct Design Method - Equivalent Frame Method - Reinforcement detailing as per SP 34: 1987. | 7 |
| IV | **Design of two span continuous beams**<br>Analysis and Design of two span continuous beams by limit state method, with redistribution of moments by using elastic envelop method, problems of fixed beam, propped cantilever, two span continuous beam. | 7 |
| V | **Design of foundations**<br>Analysis and Design of raft foundations. Analysis and design of Deep foundations: pile foundations, pile cap. | 7 |
| VI | **Earth retaining Structures**<br>Analysis and Design Earth retaining Structures: RCC cantilever and counterfort retaining walls. | 6 |

**Text Books**

| | |
|---|---|
| 1 | N. Krishna Raju and R. N. Pranesh, “Reinforced concrete design” New Age International Publishers, New Delhi. 2003. |
| 2 | Devdas Menon and S. Pillai “Reinforced Concrete Design” - Third Edition McGraw Hill Education; 3rd edition (1 July 2017) |

| | |
|---|---|
| 3 | S N Sinha “Reinforced Concrete Design” Second Revised Edition McGraw-Hill Education (India) Pvt Limited, 2002 |
| | |
| **References** | |
| 1 | P.C. Varghese , “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi 2nd Edition, 2006. |
| 2 | N.C. Sinha & S.K. Roy, “Fundamentals of Reinforced Concrete” S. Chand Publishing, 2013. |
| 3 | “Handbook of Reinforced Concrete SP-34” |
| | |
| **Useful Links** | |
| 1 | https://www.youtube.com/watch?v=undsd92MM8w |
| 2 | https://www.youtube.com/watch?v=BNZp9121cms |
| 3 | https://www.youtube.com/watch?v=uyuPmBGX32g |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | 3 | | | | | | | | | 1 | 1 | |
| **CO2** | | | 3 | | | | | | | | | 1 | 1 | |
| **CO3** | | | 3 | | | | | | | | | 1 | 1 | |
| **CO4** | | | | | | | | | | 2 | | 1 | 1 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher’s assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6CV435 |
| **Course Name** | Professional Elective 5: Earthquake Engineering |
| **Desired Requisites:** | Strength of Materials, Soil Mechanics, Engineering Mathematics |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To make students aware of the mechanism involved in the generation of earthquake and its consequences. |
| 2 | To obtain the governing equations for the single degree of freedom systems. |
| 3 | To impart knowledge regarding computation of lateral load and earthquake resistant design of buildings. |

**Course Outcomes (CO)**

| CO | Description | Bloom's Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | Understand the mechanism involved in the generation of the earthquake. | Understanding | 2 |
| CO2 | Compute the response of the various single degree of freedom systems. | Applying | 3 |
| CO3 | Interpret/Understand the behavior of the structures during the earthquake. | Applying/ Understanding | 3/2 |
| CO4 | Study the earthquake resistant design and modern earthquake resistant techniques | Analysing/ Understanding | 4/2 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Seismology and Earthquakes**<br>Internal structure of the earth, plate tectonics, plate boundaries, Faults: Fault geometry, Fault movement, Elastic rebound theory, other sources of seismic activity, Location of earthquakes, Size of earthquakes: Earthquake Intensity, Earthquake Magnitude, Earthquake Energy, Seismographs, Ground motion Parameters: Amplitude parameters, frequency content parameters, duration. | 7 |
| II | **Dynamics of Discrete Systems**<br>Basic terminologies: period, cycle, frequency, natural frequency, forced vibrations, degree of freedom, resonance, principal modes of vibrations, Normal mode of vibrations; properties of harmonic motion, vibrating systems, single degree of freedom systems (SDOF), equation of motion for SDOF system, Response of Linear SDOF systems: undamped free vibrations, damped free vibrations, undamped forced vibrations, damped forced vibrations, damping. | 7 |
| III | **Response Spectrum**<br>Response spectrum concept, tripartite spectrum, construction of design response spectrum, effect of foundation soil and structural damping on design spectrum, evaluation of lateral loads due to earthquakes on multistorey building as per IS 1893-2016-part I. | 6 |

| | | |
|---|---|---|
| IV | **Behavior of Structures During Earthquakes**<br>Response of brick masonry structures: Walls, Box action effect, different types of bands; response of stone masonry structures, response of reinforced concrete structures: Reversal of Stresses, Importance of Beam Column Joints, Effect of Short Column, Effect of Soft Storey, Improper Detailing, Effect of Masonry Infill Walls, Effect of Eccentricity, Effect of Pounding, Effect of Floating Columns, Effect of Flexibility, Effects of Setbacks. | 8 |
| V | **Earthquake Resistant Design**<br>Earthquake resistant design philosophy, Planning aspects, load path, stiffness and strength distribution, ductility, ductile detailing of RCC beam column as per IS13920 | 6 |
| VI | **Earthquake Resistant Techniques**<br>Base Isolation: Elastomeric, Sliding, Combined; Dampers: Friction dampers, Tuned Mass Dampers, Visco-elastic dampers | 5 |

**Text Books**

| | |
|---|---|
| 1 | Duggal S. K. (2013), *Earthquake Resistance Design of Structures*; Oxford University Press, New Delhi |
| 2 | Pankaj Agarwal & Manish Shrikhande (2011), *Earthquake Resistant Design of Structures*, PHI Publications |

**References**

| | |
|---|---|
| 1 | Chopra A K (2007); *Dynamics of Structures*, Pearson, New Delhi. |
| 2 | Kramer S L (1996), *Geotechnical Earthquake Engineering*, Prentice Hall, New Jersy. |
| 3 | IS: 1893 (Part-I) (2016), Criteria for Earthquake Resistant Design General Provision to Building. |
| 4 | IS: 13920 (2016), Code of Practice for Ductile Detailing of RC Structure. |
| 5 | ITK-BMTPC, Earthquake Tips "Learning Earthquake Design and Construction" by C.V.R.Murthy, Building Material and Technology Promotion Council. |

**Useful Links**

| | |
|---|---|
| 1 | https://archive.nptel.ac.in/courses/105/101/105101004/ IIT Bombay |
| 2 | https://archive.nptel.ac.in/courses/105/101/105101134/ IIT Bombay |

CO-PO Mapping

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 2 | 2 | | | | | 2 | | | | | | | 2 |
| CO2 | 3 | 3 | | | | | | | | | | | 2 | 2 |
| CO3 | | 2 | | | | 2 | | | | | | | 2 | 2 |
| CO4 | | | 2 | | | 2 | 2 | | | | | | | 2 |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

## Course Information

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Semester-II |
| **Course Code** | 6CV436 |
| **Course Name** | Professional Elective 6: Decentralized Water and Wastewater Treatment |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

## Course Objectives

| | |
|---|---|
| 1 | To Provide in-depth knowledge of treatment systems and their applications. |
| 2 | To introduce design concepts on the decentralized treatment system |

## Course Outcomes (CO)

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | ***Explain*** the concepts and types of decentralized treatment of water and wastewater. | Understanding | II |
| CO2 | ***Apply*** decentralized treatment for various cases | Applying | III |
| CO3 | ***Analyze*** and ***evaluate*** the physical, chemical and biological systems for the decentralized treatment of water and wastewater. | Analyzing<br>Evaluating | IV<br>V |
| CO4 | ***Design*** the decentralized water and wastewater treatment systems and systems for storm water storage and treatment | Creating | VI |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Introduction to Decentralized Water and Wastewater Treatment**<br>Review of basics of water and wastewater treatment systems, quantification and characterization, Need, Advantages and types of DeWATS, Concept of sustainability in water and wastewater treatment | 6 |
| II | **Decentralized Water Treatment**<br>Introduction to Point of Use (POU) water treatment systems, Types, Treatment units in POU water treatment systems, Design of POU water treatment systems for residential, commercial and industrial purpose, Operation and Maintenance of POU water treatment systems, Packaged water treatment systems, Types, Design philosophy | 7 |
| III | **Decentralized Wastewater Treatment Systems (DeWATS): Primary Treatment**<br>Primary Treatment alternatives, advantages and disadvantages, design of screens, Grit chamber, Septic Tank, Imhoff tank, Biogas settler and Anaerobic baffled reactor | 7 |
| IV | **DeWATS: Secondary and Tertiary Treatment**<br>Secondary treatment alternatives, advantages and disadvantages, design of Waste Stabilisation Ponds, Up-flow Anaerobic Sludge Blanket Reactor (UASB), Activated Sludge Treatment, Sequencing Batch Reactor, Membrane Bio-reactor, Constructed Wetland (horizontal and vertical flow), Bio-rack Wetland and Aerated Ponds<br>Tertiary treatment alternatives, chlorination and ozonation | 7 |

| | | |
|---|---|---|
| V | **DeWATS: On-site Containment and Treatment**<br>On-site treatment systems, Greywater treatment, Design of anaerobic upflow filter, Urine diversion and composting toilet, Deep row entrenchment and Soak pit | 6 |
| VI | **Decentralized Stormwater Storage and Treatment Systems**<br>Need of stormwater storage and treatments, Concept of low impact development (LID) techniques, Management of stormwater using decentralized storage systems, Design of green roofs, vegetated swales, pocket wetlands, cisterns, rain gardens | 6 |

| **Text Books** | |
|---|---|
| 1 | Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017. |
| 2 | Hammer M. J. and Hammer M. J., "Water and Wastewater Technology", PHI learning private limited, 6th Edition, 2008. |
| 3 | Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6th Reprint, 2003. |

| **References** | |
|---|---|
| 1 | Sincero A. P. and Sincero G. A., "Environmental Engineering A Design approach", PHI learning private limited, 2004. |
| 2 | Gutterer B., Sasse L., Panzerbieter T. and Reckerzügel T., "Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries: A Practical Guide," Water, Engineering and Development Centre (WEDC) UK, 2009. |

| **Useful Links** | |
|---|---|
| 1 | https://www.youtube.com/watch?v=courErfW-cs |
| 2 | https://www.youtube.com/watch?v=CCso1LgJ3yg |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | 3 | | | | | | | |
| **CO2** | | 3 | | | | | 3 | 2 | | | | | | |
| **CO3** | | | 3 | | | | 3 | 2 | | | | | 2 | |
| **CO4** | | | 3 | | | | 3 | 2 | | | | | 2 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Sem VIII |
| **Course Code** | 6CV437 |
| **Course Name** | Professional Elective 6: Geoenvironmental Engineering |
| **Desired Requisites:** | Soil Mechanics, Foundation Engineering, Environmental Engineering |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To introduce the concept of geoenvironmental engineering. |
| 2 | To impart knowledge of soil contamination and contaminant transport in soil. |
| 3 | To acquaint with different approaches of solid waste containment. |
| 4 | To make aware of possible geotechnical reuse of waste material. |

**Course Outcomes (CO)**

| CO | Description | Bloom's Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | **Describe** and **differentiate** various engineering properties of soils, available geosynthetic materials, their properties and suitability. | Understanding/ Analyzing | 2/4 |
| CO2 | **Calculate** area requirement of landfill site. | Applying | 2 |
| CO3 | **Evaluate** compaction quality using field tests. | Evaluating | 5 |
| CO4 | **Analyze** stability of landfill embankments, liner and covers. | Analyzing | 4 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to Geoenvironmental Engineering**<br>Introduction, overview of pollution, control and remediation, case histories on geoenvironmental engineering, Soil: phased system, soil classification, various soils with important engineering properties and their suitability for intended purpose, clay mineralogy. | 7 |
| II | **Contaminant Transport in Soil**<br>Soil-water-contaminant interaction, contaminant transport, geotechnical attenuation and attenuation capacity of soils, zones of contaminant plume, introduction to detection of polluted zones and monitoring designed system. | 5 |
| III | **Introduction to Geosynthetic Materials**<br>Types of geosynthetic materials: geotextile, geomembrane, geonet, geogrid, geosynthetic clay liners, geocell, geofoam; applications of geosynthetic materials for various engineering functions, properties of geosynthetic materials, use of geosynthetics in waste containment, concerns about use. | 6 |
| IV | **Solid Waste Containment**<br>Site selection, typical cross sections of landfills, merits and demerits. Area calculation of landfill site, EPA (MOEF and CPCB) Guidelines.<br>CCL, GCL and composite liners, compaction quality control for CC liners. Stability analysis of landfills: conventional slope stability analysis by method of slices, stability number concept. Stability against sliding of geomembrane over clay (liner stability) and sliding of soil over geomembrane (cover stability). Assessment of anchorage requirement of GM. | 12 |

| | | |
|---|---|---|
| V | **Slurry Waste Containment**<br>*Slurry waste containment:* slurry transported wastes, pond layouts, components of pond, embankment construction, staged raising of embankment, design aspects, environmental impact and control.<br>*Vertical Barriers for Containment:* various types of cutoff walls, requirements of good vertical barriers, slurry trench walls using Bentonite and Cement-bentonite slurry, material and construction aspects. | 5 |
| VI | **Geotechnical Reuse of Waste Material**<br>Waste reduction, use of waste in geotechnical construction, waste characteristics for soil replacement, transport considerations and engineering properties of waste. | 5 |

| **Text Books** | |
|---|---|
| 1 | Sivakumar Babu G L (2006)," Soil Reinforcement and Geosynthetics", University Press (India) Pvt Ltd Hyderabad. |
| 2 | Reddi, L. N. and Inyang, H.I., "Geoenvironmental Engineering, Principles and Applications", Mracel Dekker Inc. New York, 2000. |
| 3 | Bagchi, A., " Design of landfills and integrated solid waste management " John Wiley & Sons, Inc. USA, 2004. |

| **References** | |
|---|---|
| 1 | Donald Coduto, (2002) " Geotechnical Engineering Principles and Practices", Prentice Hall of India Pvt Ltd., New Delhi. |
| 2 | Daniel, D. E., (1993) " Geotechnical Practice for Waste Disposal", Chapman and Hall. |
| 3 | Rowe R. K., " Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000. |

| **Useful Links** | |
|---|---|
| 1 | https://cpcb.nic.in/rules/ |
| 2 | https://nptel.ac.in/courses/105103025 |
| 3 | https://onlinecourses.nptel.ac.in/noc19_ce37/preview |
| 4 | https://archive.nptel.ac.in/courses/105/102/105102160/ |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | 2 | | | | | 1 | | | | | | 1 | 2 |
| **CO2** | | 2 | 2 | | | | | | | | | | | 1 |
| **CO3** | | | | 2 | | | | | | | | | | 1 |
| **CO4** | | | 3 | | | | | | | | | | | 1 |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Semester-II |
| **Course Code** | 6CV438 |
| **Course Name** | Professional Elective 6: Contract Management |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To introduce the concepts and principles of contract management of engineering projects. |
| 2 | To develop proficiency with methods for civil engineering contract and dispute resolution systems. |
| 3 | To acquaint the students to formulate different contract documents |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | ***Explain*** provisions of Indian Contract Act | Understanding | II |
| CO2 | ***Describe*** elements of Contract Management | Understanding | II |
| CO3 | ***Appraise*** the different alternatives types of contracts and dispute resolution methods for an engineering project. | Analyzing | IV |
| CO4 | ***Formulate*** conditions of contract and contract documents | Creating | VI |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Introduction to Contract Management**<br>Importance of contracts, Overview of contract management, Overview of activities in contract management, Scope of contract management, Professional ethics, Detailed project report and understanding nature, specification, scope, timeline, cost and other salient points of projects for contact drafting. | 6 |
| II | **Indian Contract Act 1872**<br>Objectives of the act, Definition of contact, Meanings of proposal, promise, reciprocal promise, consideration, valid contract, free consent, Essential requirements of legally valid contract, Offer, Acceptance, Lawful Consideration, Intention, Capacity, and Legality of subject matter, Void and voidable contracts, Breach of contract and its consequences, Damages, Mitigating the loss or damage. | 7 |
| III | **Types Civil Engineering Contracts**<br>Competitive bidding contracts, Negotiated contracts, Lump-sum contacts, Item rate contract, percentage rate contracts, cost plus types of contract, Turnkey contract, subcontract, annual maintenance contract, Supply and Installation Contracts, BOT, BOOT, BOLT, PPP, EPC, HAM, NCB, ICB etc. Pros and cons of each type. | 7 |
| IV | **Contract Formation**<br>Tender, types of tenders, Tender notice, Pretender conference, Contents of tender notice, E-tendering, Tender preparation, Tender documents, Methods of tender submission, Opening of tenders, Scrutiny of tenders, Contract award and letter, Contract documents, Contract agreement | 6 |

| | | |
|---|---|---|
| V | **Conditions of Contract**<br>Notice to proceed, Handing over the site to contractor, Rights and duties of various parties, notices to be given, Fairness of Conditions of Contract, Subjects of conditions- Bid Security, Performance Security, Contract Duration and Price, Performance parameters; Payment terms, Delays, Penalties and liquidated damages; Force majeure, Suspension and termination, Changes and variations, subcontracting etc. Important contents of each condition, Typical conditions for each subject. | 7 |
| VI | **Dispute Resolution and Integrity in Contract**<br>The "conventional" model of dispute resolution, Alternative Dispute Resolution methods (ADR), early neutral evaluation, negotiation, conciliation, mediation, and arbitration, Indian legislation for arbitration and conciliation, Integrity in Contract its significance and typical clauses. | 6 |

| **Text Books** | |
|---|---|
| 1 | Ramaswamy B. S., "Contracts and their Management," Lexis Nexis, 5th Edition, 2016 |
| 2 | Patil B. S., "Civil Engineering Contracts &Estimates", Orient Langman Ltd., 3rd Edition, 2006. |
| 3 | Gajria K., "Law relating to Building and Engineering Contracts in India," Butterworths India, 2000. |

| **References** | |
|---|---|
| 1 | Prasad L., "Managing Engineering and Construction Contracts: Some Perspectives," LAP Lambert Academic Publishing, 2010 |
| 2 | Murdoch J. and Hughes W., "Construction Contracts: Law and Management, Routledge Publications, 2015. |

| **Useful Links** | |
|---|---|
| 1 | https://www.youtube.com/watch?v=O2AWwn-_zmg |
| 2 | https://www.youtube.com/watch?v=LvC4riB409E |
| 3 | https://www.youtube.com/watch?v=wJ8HZ7hqUs8&list=PL64587F5505355819 |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSPO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | | 2 | | 1 | | | | | | |
| **CO2** | | | | | | | | 2 | | | 3 | | | |
| **CO3** | | | | | | 2 | | 1 | | 2 | | | 2 | |
| **CO4** | | | | | | | | | | 3 | 3 | | 2 | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by: B. R. Kavathekar | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Sem VIII |
| **Course Code** | 6CV439 |
| **Course Name** | Professional Elective 6: Finite Element Method |
| **Desired Requisites:** | Solid Mechanics, Structural Mechanics |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To provide knowledge of philosophy and principles of finite element method in structural engineering. |
| 2 | To impart knowledge of element stiffness matrix formulation for 1D, 2D and 3D elements. |
| 3 | To demonstrate the ability of finite element method to model and solve various continuum field problems. |

**Course Outcomes (CO)**

| CO | Description | Bloom's Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | **Determine** element stiffness matrix using finite element methodology. | Understanding | 2 |
| CO2 | **Solve** for nodal degrees of freedom, strains and stresses. | Analyzing | 4 |
| CO3 | **Apply** finite element methodology to obtain solutions for various field problems. | Applying | 3 |
| CO4 | **Choose** appropriate shape function for the given finite element. | Applying | 3 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **FEM in Skeleton Structures-I**<br>Basic concept of finite element analysis, Discretization, nodes, element connectivity, formulation of element stiffness matrices for spring, bar and plane truss elements. Solutions for unknown nodal displacements; Applications of method to spring, bar and plane truss problems. | 7 |
| II | **FEM in Skeleton Structures-II**<br>Formulation of element stiffness matrices for beam and plane portal frame element by direct method; Transformation of matrix from local to global system; Numbering of nodes; minimization of band width; force displacement relations; Solution for displacement unknowns; Applications of method to plane truss; Continuous beams and plane portal frames. | 7 |
| III | **Field Problems Idealization**<br>Elementary theory of Elasticity: Stress strain relation; Strain displacement, relations; plane stress and plane strain problems; Compatibility conditions; differential equations of equilibrium; equations for two dimensional and three dimensional problems. | 6 |
| IV | **FEM Principles and General Approach**<br>Principle of minimum potential energy; variational method; continuum problems; Two dimensional Elements; use of displacement functions; Pascal's triangle; triangular and rectangular elements; Formulation of element stiffness matrix.<br>Convergence requirements – Selection of the order of polynomial, conforming and non-conforming elements, Effect of element aspect ratio, finite representation of infinite bodies. | 7 |

| | | |
|---|---|---|
| V | **Isoparametric Formulation**<br>Shape function in Cartesian and natural co-ordinate system, Lagrange's interpolation formulae, concept of isoparametric element, relation between Cartesian and natural coordinate system, Jacobian matrix, one and two dimensional Isoparametric elements. | 6 |
| VI | **3D Elements Formulation**<br>Introduction to three-dimensional problem, various three-dimensional elements, Axisymmetric problems, formulation of stiffness matrix of three dimensional and axisymmetric elements. | 6 |

| **Text Books** | |
|---|---|
| 1 | P.N.Seshu "Finite Element Analysis", PHI learning private Lim. Delhi, 2013. |
| 2 | T. R. Chandrupatla and A.D. Belegundu,"Introduction to Finite Element in Engineering", Prentice Hall of India Private Limited, 3rd Edition, 2002. |
| 3 | C. S. Desai & J. F. Abel "Introduction to Finite Element Method", AEP, 1st Edition, 1972. |

| **References** | |
|---|---|
| 1 | Robert D. Cook, David S. Malkus, Michael E. Plesha,Robert J. Witt,"Concepts and Applications of Finite Element Analysis", 2003. |
| 2 | David. V. Hutton, " Fundamentals of finite element analysis", Tata McGraw-Hill Edition 2005. |
| 3 | J. N. Reddy. "An Introduction to the Finite Element Method" McGraw Hill, 3rd Edition, New York, 2006. |
| 4 | Zienkiewicz.O.C. &Taylor.R.L., "The Finite Element Method- Vol I &Vol II" Tata McGraw-Hill Publishing Company Limited, 6th Edition, 2005. |

| **Useful Links** | |
|---|---|
| 1 | https://onlinecourses.nptel.ac.in/noc22_me43/preview |
| 2 | https://archive.nptel.ac.in/courses/112/104/112104193/ |
| 3 | https://ocw.mit.edu/courses/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/download/ |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | | | 3 | | | | | | | | | | 2 |
| CO2 | 3 | 2 | | 2 | | | | | | | | | | 2 |
| CO3 | | | 2 | 2 | | | | | | | | | | 2 |
| CO4 | 2 | | | 2 | | | | | | | | | | 2 |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech. |
| **Course Code** | 6CV440 |
| **Course Name** | PE VI: Design of Concrete bridges |
| **Desired Requisites:** | Design of Concrete structures |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 30 | 40 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To provide knowledge of loads and analysis for different types of bridges. |
| 2 | To impart knowledge for design of different types of bridges including substructures with relevant codes. |
| 3 | To provide knowledge for construction, inspection, and maintenance of bridges. |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | To explain different types of concrete bridges and their components. | Understanding | 2 |
| CO2 | To interpret and apply the codal provision for the design of concrete bridges. | Applying | 2/3 |
| CO3 | To design the different component of concrete bridge. | Creating | 6 |
| CO4 | To explain the construction and maintenance techniques of concrete bridges. | Understanding | 2 |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Introduction to Concrete bridges:** History and significance of bridge engineering, Classification of bridges (types, materials, and spans), Basic components of a bridge, Drainage of bridges, Selection of Bridge Site | 6 |
| II | **Loads and Standards for Bridge design:** Design loads for bridges, IRC loading, Relevant codes and standards (IRC, AASHTO, Eurocode) for bridge design, Load factors and partial safety factors | 7 |
| III | **Design of Superstructure:** Design of R. C. deck slab, Design of Box culvert, Pipe Culvert and Composite Bridge | 7 |
| IV | **Design of Sub-structure:** Abutments, Piers, Approach slab, Pile and Well foundation, Pneumatic caissons | 7 |
| V | **Bearing and expansion joints:** Forces on bearings, Types of bearings, design of unreinforced & reinforced elastomeric bearings, expansion joints | 6 |
| VI | **Construction & maintenance of Bridges:** Short & long span concrete bridge, Form work and False work, Construction management, inspection, maintenance, innovative construction techniques, Lessons from bride failures | 6 |

**Text Books**

| | |
|---|---|
| 1 | Krishna Raju, "Design of Bridges," Oxford and IBH Publishing Co. Lt. New Delhi and Kolkata, 2001 |
| 2 | Jagdeesh T. R., Jayaram M. A. Design of Bridge Structures, Pentice hall of India pvt ltd., New Delhi 2003 |

| | |
|---|---|
| 3 | Johnson Victor, "Essentials of Bridge Engineering, Oxford and IBH Publishing Co. Ltd, 5th Edition 2001 |
| | |
| **References** | |
| 1 | Raina V. K. "Concrete Bridge practice" Construction, Maintenance and rehabilitation", Tata McGrew Hill Publishing Company, New Delhi |
| 2 | Raina V. K. "Concrete Bridge Practices" Analysis Design and economics", Tata McGrew Hill Publishing Company, New Delhi |
| | |
| **Useful Links** | |
| 1 | https://onlinecourses.nptel.ac.in/noc19_ce23/preview |
| 2 | https://www.classcentral.com/course/swayam-reinforced-concrete-road-bridges-14270 |
| 3 | https://www.youtube.com/playlist?list=PLYX9X4ZldqpYMaPURxSbY1i8vgfVsZfmQ |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | | | | 2 | | 3 | | |
| **CO2** | | | | | | | | | | 2 | | 3 | | |
| **CO3** | | | 3 | | | | | | | | | | 3 | |
| **CO4** | 3 | | | | | | | | | 2 | | | | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Civil Engineering) |
| **Class, Semester** | Final Year B.Tech., Semester-II |
| **Course Code** | 6HS401 |
| **Course Name** | Humanities 3: Accounting and Finance for Engineers |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 2 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| **Practical** | - | | | | |
| **Interaction** | - | **Credits: 2** | | | |

**Course Objectives**

| | |
|---|---|
| 1 | To familiarize engineering students with basic concepts in accounting and finance |

**Course Outcomes (CO)**

| CO | Description | Blooms Taxonomy | |
|---|---|---|---|
| | | Descriptor | Level |
| CO1 | ***Explain*** generally accepted accounting principles and concepts in finance | Understand | II |
| CO2 | ***Summarize*** systems of accounting | Understand | II |
| CO3 | ***Apply*** concepts related to financial leverage and ratios, time value of money | Apply | III |
| CO4 | ***Calculate*** accounting and internal rate of return, net present value of asset. | Evaluate | V |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Basic Accounting and concepts in finance; Book keeping: definitions, objectives, elements, journal and ledger. | 4 |
| II | **Accounting & Concepts in Finance I:**<br>Definitions, objectives, characteristics, limitations, basic terms; Generally Accepted Accounting Principles (GAAP) | 4 |
| III | **Accounting & Concepts in Finance II:**<br>Systems of accounting, cash book, bank book, depreciation; provisions, reserves, accounting equation, journal & ledger entries, trial balance, profit & loss; account, balance sheet, cash flow statement | 6 |
| IV | **Analysis of financial statements:**<br>Financial leverage, financial ratios, Significance and applications | 3 |
| V | **Financial planning including capital budgeting I:**<br>Definition, financial planning options and objectives, time value of money, Simple and compound interest, rule of 72, methods of capital budgeting - payback period | 5 |
| VI | **Financial planning including capital budgeting II:**<br>Accounting rate of return (ARR), net present value (NPV), internal rate of return (IRR) | 4 |

**Text Books**

| | |
|---|---|
| 1 | Theusen G.J. and Fabrycky W.J., "Engineering Economy," 9th Edition, Prentice-Hall, Inc., New Delhi, India, 2001. |
| 2 | Jha K.N., "Construction Project Management- Theory and practice," 2nd Edition, Pearson India Education Services Pvt. Ltd., 2015. |
| | |
| **References** | |
| 1 | Crundwell F.K., "Finance for Engineers-Evaluation and Funding of Capital Projects," Springer, London, UK, 2008. (ISBN 978-1-84800-032-2). |
| | |
| **Useful Links** | |
| 1 | https://www.youtube.com/watch?v=0Y74FXKTDvw&list=PLFW6lRTa1g82vN2IP78V9S32FiUaKU8X8 |
| 2 | https://www.youtube.com/playlist?list=PLqkMUh7RSUsX5S0GO8SRBa_gxHbFL_w1R |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSPO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | 3 | | | |
| **CO2** | 2 | | | | | | | | | | 3 | | | |
| **CO3** | 2 | | | | | | | | | | 3 | | | |
| **CO4** | | 2 | | | | | | | | | 3 | | | |

The strength of mapping: - 1: Low, 2: Medium, 3: High

**Assessment**

- The assessment is based on MSE, ISE, and ESE.
- MSE shall be typically on modules 1 to 3.
- ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

| Prepared by: B. R. Kavathekar | DAC/BoS Secretary | Head/BoS Chairman |
|---|---|---|