**20CE3201– QUANTITY SURVEYING AND VALUATION**

**(Civil Engineering)**

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| **Course Category** | Professional Core | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 2 - 1- 0 |
| **Prerequisite** | Building Materials and Construction | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Prepare approximate and detailed estimates of simple buildings and road works. |
| CO2 | Gain thorough knowledge of specifications of various materials and items of building construction. |
| CO3 | Perform rate analysis for earthwork, various types of masonry, and flooring. |
| CO4 | Perform the rate analysis for roofing, plastering, pointing, woodworks of simple buildings, and road works. |
| CO5 | Evaluate contracts and tenders in construction practices. |
| CO6 | Calculate the value of tangible assets. |
| **Course Content** | **UNIT – I**  **INTRODUCTION:** General items of work in buildings – Standard units – Principles of working out quantities for detailed and abstract estimates– Approximate and detailed estimates of simple buildings and road works.  **UNIT – II**  **SPECIFICATIONS:** Types – Standard specifications for different materials and items of building construction– Sand– Lime–Cement– Kankar– Mortars – Earth work for foundations – Foundation concrete– Reinforced concrete– Brick work– Stone masonry–Mosaic Flooring– R.C.C. roof and G.I. sheet roof– Plastering– Pointing – Painting and wood works.  **UNIT – III**  **RATE ANALYSIS-I:**  Earthwork for foundations and basement of buildings.  Mortars: Lime mortar (1:1.5) and Cement Mortar (1:4).  Foundation Concrete: Lime concrete (1:2:4) and Cement Concrete (1:5:10).  Reinforced Concrete: Lintels, Slabs, Beams, and Columns (1:2:4).  Brickwork: Constructed with first-class bricks with L.M. (1:1.5) and C.M.(1:6)  Stone Masonry: C.R.S. – 1st sort constructed with C.M. (1:2) and  R.R.Masonry: Lime mortar (1:1.5) and C.M. (1:2).  Flooring:   1. With Cuddapah or Shahabad slabs. 2. Mosaic flooring.   **UNIT – IV**  **RATE ANALYSIS-II:**  Roofing: a) R.C.C. roof 10cm thick, two courses of flat tiles to top.  b) A.C. corrugated sheet roofing on steel purlins.  Plastering : a) With L.M. (1:1.5) 2 coats (20mm thick)  b) C.M. (1:4) 12mm thick.  Pointing: a) With C.M. (1:3) flush pointing to R.R. Masonry.  b) C.M. (1:3) for brick masonry.  Painting: a) Whitewashing and colour washing of walls: 2 coats.  b) Painting iron and woodwork: 3 coats.  Woodwork: Panelled doors and windows.  Road work: W.B.M. road with bituminous carpet 20mm thick.  **UNIT –V**  **CONTRACTS:**Essential requirements of a valid contract - Forms of contract-Types of contracts– Contract document– Conditions of contracts– Contract procedure– Termination of contracts– Specifications– Important conditions of contract – Arbitration of tenders.  **UNIT – VI**  **VALUATION:** Introduction–Technique of valuation–Elements of valuation and Factors affecting valuation–Methods of valuation of land property and building property– Rate of interest for sale– Purchase– Mortgage– Capital gain– Tax– Estate duty and death duty –Types of valuation – Valuation for renewal of lease– Extension of lease– Methods of Ascertaining standard rent– Easement rights– Preparation of feasibility reports– Valuation reports– Awards. | |
| **Textbooks and References** | **TEXTBOOKS:**   1. B.N. Dutta, *Estimating and Costing in Civil Engineering*, UBS Publishers' Distributors Ltd publications, 28th revised Edition, 2016. 2. G.S.Birdie,*A Textbook ofEstimating and Costing in Civil Engineering,*Dhanpat Rai Publishing Company Private Limited,6thEdition, 2014. 3. M.Chakraborti*, Estimation, costing, specifications and valuation in civil engineering*, Published by M. Chakraborthi, 29th revised Edition, 2006   **REFERENCEBOOKS:**   1. D.D.Kohli, Ar.R.C.Kohli, *A Text book of Estimating and Costing (Civil),* S. Chand Publications, 13th edition, 2013. 2. R. Ambalavanan, *Estimation and Costing in Civil Construction*, Ane Books Pvt. Ltd, 2021. 3. A.K. Upadhyay, Civil Estimating and Costing, S.K.Kataria& Sons, Revised Edition, 2014. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | 1 | - | - | - | - | 1 | - | 1 | - | 1 | 1 | - | 1 | - | 2 |
| **CO2** | 1 | - | - | - | - | 2 | - | - | - | 2 | - | 1 | - | - | - |
| **CO3** | 2 | - | - | - | - | 2 | - | 1 | - | - | 1 | - | 1 | - | 2 |
| **CO4** | 2 | - | - | - | - | 2 | - | 1 | - | - | 1 | - | 1 | 1 | 2 |
| **CO5** | - | - | - | - | - | 3 | - | 1 | 2 | 3 | 2 | 1 | - | 1 | 2 |
| **CO6** | 2 | - | - | - | - | 3 | - | 2 | - | 2 | 2 | 2 | - | - | 2 |

**20CE3202 – REMOTE SENSING & GIS**

**(Civil Engineering)**

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| **Course Category** | Professional Core | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sectional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand various terminologies and interaction of EMR with atmosphere and earth’s surface. |
| CO2 | Explain the different technical aspects of a remote sensing network with special emphasis on Indian remote sensing technology. |
| CO3 | Compare different types of data obtained from a remote sensing network with tools specifically designed for the purpose. |
| CO4 | Understand various corrections applied to the data collected and techniques of image classification. |
| CO5 | Apply remote sensing in earth resources management. |
| CO6 | Demonstrate the basic concepts of Geographical Information System. |
| **Course**  **Content** | **UNIT – I**  **FUNDAMENTAL CONCEPTS OF REMOTE SENSING:** Definition of Remote Sensing; History of Remote Sensing and Indian Space Program; Remote Sensing Process; Source of energy – Concept of energy, Electromagnetic radiation, Electromagnetic Spectrum; Interaction of electromagnetic radiation with atmosphere, Vegetation, soil and water – Absorption, Scattering, Refraction, Reflection; Spectral Reflectance Curve; Atmospheric windows; Advantages and Limitations of Remote Sensing.  **UNIT – II**  **REMOTE SENSING SYSTEM:** Introduction; Types of Remote Sensing -Classification Based on Platform, Energy Source, Imaging Media, Regions of Electromagnetic Spectrum, Number of Bands; Characteristics of Images; Orbital Characteristics of Satellite; Remote Sensing Satellites; Definitions – Swath, Nadir, path, row, Orbital calendar.  **SENSOR CHARACTERISTICS:** Resolutions- Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.  **UNIT – III**  **VISUAL IMAGE INTERPRETATION:** Introduction; Information Extraction by Human and Computer; Remote Sensing Data Products; Image Interpretation; Elements of Visual Image Interpretation -Location, Size, Shape, Shadow, Tone, Colour, Texture, Pattern, Height and Depth, Site, Situation and Association; Interpretation Keys.  **UNIT – IV**  **DIGITAL IMAGE PROCESSING:** Introduction; Categorization of Image Processing; Image Processing Systems; Data Formats of Digital Image; Pre-processing - Radiometric Correction of Remotely Sensed Data, Geometric Correction of Remotely Sensed Data, Miscellaneous Pre-processing; Image Enhancement - Image Reduction, Image Magnification, Colour Compositing, Transect Extraction, Contrast Enhancement; Filtering; Image Classification - Information Class and Spectral Class - Supervised Versus Unsupervised Classification; Decision Rules for Supervised Classification; Decision Rules for Unsupervised Classification; Accuracy Assessment.  **UNIT – V**  **APPLICATIONS OF REMOTE SENSING FOR EARTH RESOURCES MANAGEMENT:** Agriculture – crop production forecasting, agricultural drought assessment, precision farming; Forestry – Type and density mapping, forest cover change, forest status in India; Land cover/Land use mapping – Wastelands, Urban sprawl; Water Resources; Coastal Zone Management – Coastal zone ecosystem, Coastal regulation zone, integrated coastal zone management.  **UNIT – VI**  **GEOGRAPHICAL INFORMATION SYSTEM:**  Definition of GIS; Key components of GIS; Functions of GIS, Application areas of GIS, Advantages of GIS – Advantages over traditional map, mapping software, Conventional DBMS, Analysis-modeling-Presentation and decision making; Functional Requirements of GIS; Limitations of GIS; Spatial data models – raster data model, vector data model. | |

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| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. B. Bhatta, *Remote sensing and GIS*, Oxford University Press, 3rd edition, 2021. 2. George Joseph and C. Jeganathan, *Fundamentals of remote sensing*, Universities Press, 3nd Edition, 2018. 3. TsurgCharg, *Introduction to Geographic information system,* Tata McGraw-Hill Education Private Limited. 2nd edition, 2014.   **REFERENCES:**   1. John R.Jensen, *Remote sensing of the environment– An earth resources perspective,* Pearson Education, 2ndedition, 2014. 2. Peter ABurragh and Rachael McDonnnell, *Principals of Geo physical Information system*, Oxford Publications 2nd edition, 2004. 3. A. Kumar, *Basics of remote sensing & GIS,* Laxmi publications, 3rd edition, 2009. |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | 1 | - | - | 1 | - | - | 1 | - | - | - | - | 1 | - | 1 | - |
| **CO 2** | 1 | - | - | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - |
| **CO 3** | 2 | - | - | - | 1 | - | 1 | - | - | - | - | - | 2 | 1 | 2 |
| **CO 4** | 2 | - | - | 1 | 1 | - | 1 | - | - | - | - | - | 2 | - | 1 |
| **CO 5** | 1 | - | - | 1 | 1 | - | 1 | - | - | - | - | - | - | 2 | 3 |
| **CO 6** | 1 | - | - | 2 | 1 | 1 | 2 | - | - | - | 1 | 1 | 1 | 1 | 2 |

**20CE3203 – ENVIRONMENTAL ENGINEERING**

**(Civil Engineering)**

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| **Course Category** | Professional Core | **Credits:** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Engineering Chemistry and Fluid Mechanics | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Identify the sources of water and wastewater and determine the quality. Forecast the population for water demand and estimate the wastewater flows. |
| CO2 | Identify the intake structures; Analyze and design pipe network system. |
| CO3 | Design circular sewers; Select materials and appurtenances for sewers. |
| CO4 | Understand the methods of water treatment |
| CO5 | Understand conventional wastewater treatment methods. |
| CO6 | Understand the sludge treatment methods; Select proper effluent disposal method and design a septic tank. |
| **Course**  **Content** | **UNIT I**  **SOURCES, QUALITY AND QUANTITY PERSPECTIVES OF WATER AND WASTEWATER:** Sources, Characteristics - physical, chemical and biological, water demands – types and factors affecting water demand, fluctuations in rate of water demand, design period, population forecasting methods, estimation of dry weather flow and wet weather flow.    **UNIT II**  **COLLECTION AND CONVEYANCE OF WATER:**Intakes, types of Intakes, factors governing selection of location for intakes.  **DISTRIBUTION SYSTEM:**Requirements of a good distribution system, methods of distribution, systems of supply of water, Distribution reservoirs, layout of distribution system, design and analysis of pipe networks of distribution system – Hardy cross method.  **UNIT III**  **HYDRAULIC DESIGN OF SEWERS:**Hydraulic formulae for design of circular sewers, minimum and maximum velocity of flow in sewers.  **SEWER MATERIALS AND APPURTENANCES:**Factors affecting the selection of material, materials for sewers, shapes of sewers, valves and joints, sewer appurtenances.  **UNIT IV**  **WATER TREATMENT METHODS:**General layout of water treatment plant, Aeration, Sedimentation, Sedimentation aided with Coagulation, Filtration – Rapid sand filters, Disinfection – methods, Chlorination – types and forms, Membrane processes, Ion exchange process.  **UNIT V**  **CONVENTIONAL WASTEWATER TREATMENT:**General layout of wastewater treatment plant,**Primary treatment of sewage:**Screening, Grit Chambers, Sedimentation, Sedimentation aided with coagulation.  **SECONDARY TREATMENT OF WASTEWATER:**Activated sludge process, Trickling filters, Oxidation Pond.  **UNIT VI**  **SLUDGE MANAGEMENT:**Sludge - Types, Sludge treatment – Thickening, Stabilization/Digestion, Conditioning, Dewatering – Drying/Incineration, Sludge disposal methods.  **EFFLUENT DISPOSAL:**Methods – Dilution, Marine disposal, Land disposal, Self-purification of water bodies, Oxygen Sag Curve, Sewage Sickness.  Design of septic tank, Septic tank effluent disposal methods. | | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**  1. S.K. Garg, *Water supply engineering – Environmental Engineering I),* Khanna Publishers,33rd edition, 2019.  2. B.C. Punmia, *Wastewater engineering – environmental engineering II*, laxmi publications, 2nd edition, 2016.  3. S.K. Garg, *Sewage Disposal and Air Pollution Engineering* – Environmental Engineering (Vol.II), Khanna Publishers, 37th edition, 2019.  **REFERENCES:**  1. Metcalf & Eddy, Inc., *Waste water Engineering Treatment and Reuse*, McGraw Hill education, 4rth edition, 2017.  2. Ruth F. Weiner and Robin A. Matthews, *Environmental Engineering*, Butterworth- Heineman. Publishers, 4th edition 2003.  3. B.C. Punmia, *Water supply engineering - Environmental engineering I*, laxmi publications, 2nd edition, 2016. | | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | - | 1 | - | - | 1 | 2 | 1 | 2 | - | 1 | - | 1 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | - | - | - | 1 | 2 | 1 | 1 | 1 | 1 | 1 | - |
| **CO3** | 2 | 2 | 2 | - | - | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | - |
| **CO4** | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | 1 | - | 1 | - |
| **CO5** | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | 1 | - | 1 | - |
| **CO6** | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | - | 1 | - | 1 | - |

**20CE32E1 –HYDROLOGY &WATER RESOURCES ENGINEERING**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3-0 - 0 |
| **Prerequisite** | Fluid Mechanics | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the theories and principles governing the hydrologic processes. |
| CO2 | Determine the loss due to evapotranspiration and infiltration. |
| CO3 | Determine the runoff due to precipitation and develop runoff hydrographs. |
| CO4 | Assess and analyze floods and flood control measures. |
| CO5 | Determine aquifer parameters and yield of wells. |
| CO6 | Explain the basic concepts of irrigation engineering. |
| **Course Content** | **UNIT – I**  **INTRODUCTION:** Definition and scope; Hydrologic cycle; Sources of hydrological data.  **PRECIPITATION:** Forms of precipitation; Measurement of precipitation; Rain gauge network;Preparation and presentation of rainfall data; Mean precipitation of rainfall data; Depth-Area-Duration relationship; Frequency of point rainfall Maximum Intensity/Depth-Duration-Frequency relationship; Probable maximum Precipitation (PMP). | |
| **UNIT – II**  **ABSTRACTIONS FROM PRECIPITATION:** Evaporation process; Evaporimeters; Empirical evaporation equations; Analytical methods - estimation of evaporation and transpiration.  **EVAPOTRANSPIRATION:** Measurement of evapotranspiration; Evapotranspiration equations – Potential evapotranspiration and Actual evapotranspiration; Infiltration; Factors affecting infiltration; Infiltration indices.  **UNIT – III**  **RUNOFF:** Runoff characteristics; Factors affecting runoff– Catchment characteristics; Flow-duration curve; Flow-mass curve.  **HYDROGRAPHS:** Components of hydrograph; Base flow separation; unit hydrograph– Derivation of unit hydrograph–Unit hydrograph of different durations – Uses and limitations of unit hydrograph– Duration of the unit hydrograph; S-curve hydrograph; Instantaneous unit hydrograph.  **UNIT – IV**  **FLOODS:** Introduction– Rational method– Empirical formulae–Unit hydrograph method; Flood frequency studies–Gumbel’s method– Log-Pearson type III distribution; Partial duration series; Regional flood;Frequency analysis; Data for frequency studies; Design flood– Design storm– Risk, reliability and safety factor; Flood routing-channel routing; Flood control – Classification of methods for flood control or management; Flood control reservoir; Channel improvement; Floodways.  **UNIT – V**  **GROUNDWATER:** Introduction– Forms of subsurface water; Saturated formation; Aquifer properties; Geologic formations as aquifers; Equation of motion; Wells– Steady flow into a well– Open wells;Unsteady flow in a confined aquifer; Well loss– Specific capacity;Sea-water intrusion– Recharge.  **UNIT – VI**  **IRRIGATION:** Necessity and importance– Principal crops and crop seasons– Types– Methods of application– Soil-water–Plant relationship–Soil moisture constants – Consumptive use– Estimation of consumptive use– Crop water requirement– Duty and delta– Factors affecting duty– Depth and frequency of irrigation– Irrigation efficiencies– Water logging and causes– Standards of quality for irrigation water – Crop rotation. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. K. Subramanya, *Engineering Hydrology*, Tata McGraw-Hill Education Pvt. Ltd, 5thedition, 2017. 2. P. Jayarami Reddy, *Engineering Hydrology*, Laxmi Publications Pvt. Ltd., 3rd edition, 2016. 3. P.N. Modi, *Irrigation water resources and water power engineering,* Standard Book House publication, 11th Edition, 2019.   **REFERENCES:**   1. K.N. Duggal and J.P. Soni, *Elements of water resources engineering*, New Age International Publishers, 2nd edition, 2005. 2. G.L.Asawa, *Irrigation Engineering*, NewAge International Publishers, 2nd edition, 2000. 3. S.K. Garg, *Irrigation Engineering and Hydraulic Structures,* Khanna Publishers, 36th edition, 2020. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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| **CO 1** | 2 | - | - | 2 | - | - | 1 | - | - | - | - | 1 | - | - | - |
| **CO 2** | 3 | 2 | - | 1 | 1 | - | 1 | - | 1 | - | - | 1 | - | 1 | 1 |
| **CO 3** | 2 | - | - | 2 | 1 | - | 1 | - | 1 | - | - | 2 | 1 | 3 | 2 |
| **CO 4** | 2 | - | - | 1 | 1 | - | 1 | - | - | - | - | 1 | 1 | 3 | 2 |
| **CO 5** | 2 | 2 | - | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | - | 1 |
| **CO 6** | 3 | - | 1 | - | - | 2 | - | - | 1 | - | 1 | 1 | - | 1 | - |

**20CE32E2 - URBAN TRANSPORTATION PLANNING**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Transportation Engineering | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the basic concepts of transportation planning along with method of traffic forecast analysis. | |
| CO2 | Able to conduct transportation surveys which are essential in urban transportation planning. | |
| CO3 | Apply the basic concepts, factors affecting Trip generation and also use multiple linear regression analysis in Trip generation calculations. | |
| CO4 | Understand different methods of trip distribution. | |
| CO5 | Understand the concept of model spilt analysis. | |
| CO6 | Perform evaluation of transportation plans and also prepare transportation plan for a small town. | |
| **Course**  **Content** | **UNIT – I**  **TRANSPORT PLANNING PROCESS:** Scope of the Subject – Interdependence of the land use and traffic – Systems approach to transport planning –stages in transport planning – Survey and analysis of existing conditions – Forecast analysis of future conditions and plan synthesis – Evaluation – Programme adoption and implementation – Continuing study – Citizen participation – Difficulties in the transport planning process.    **UNIT – II**  **TRANSPORTATION SURVEY:** Introduction – Definition of the study area – Zoning – Type of Surveys – Home interview surveys – Commercial vehicles surveys – Taxi surveys –Roadside interview surveys –Postcard questionnaire – Registration number plate surveys – tags on vehicles – Public transport surveys – Inventory of transport facilities – Inventory of land use and economic activities  **UNIT – III**  **TRIP GENERATION:** Introduction and definitions – Trip purpose – Factors governing Trip generation and Trip attraction rates – Multiple linear regression analysis – Category analysis – Trip based and activity based approach.  **UNIT – IV**  **TRIP DISTRIBUTION:**Introduction, Methods of trip distribution – Growth factor methods - Uniform (Constant) factor method – Average factor method – Synthetic methods – Gravity model.  **UNIT – V**  **TRAFFIC ASSIGNMENT**: Purpose of traffic assignment – General principles – assignment techniques – All-or-nothing assignment (free assignment or desire assignment) – Multiple route assignment – Capacity restraint assignment – Diversion curves.  **MODAL SPLIT**:Introduction – Factors affecting model split –Modal split in the transport planning process.  **UNIT – VI**  **EVALUATION**: Need for Evaluation – Several plans to be formulated – Testing – Considerations in evaluation – Economic evaluation.  **VEHICLE OPERATING COST**S: Theory of Vehicle operating cost (VOC) – Component, factors affecting VOC.  **TRANSPORT PLANNING FOR SMALL AND MEDIUM SIZED CITIES**: Introduction – Difficulties in transport planning for small and medium cities – Quick response techniques. | | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Khanna, S.K. Justo C.E.G & Veeraraghavulu, “*Highway Engineering*” Nem chand&bros,10th edition, 2018. 2. Dr. L.R.Kadiyali, “*Principles and Practice of Highway Engineering*” Khanna publishers, 7th edition, 2019. 3. C.Venkatramaiah “*Transportation Engineering Vol I*” Universities Press (India) Private Ltd, 1st edition, 2016.   **REFERENCE BOOKS:**   1. Dr.LR Kadiyali ”*Traffic engineering and Transport planning*” Khanna publishers, 9th edition, 2017. 2. Vazirani and Chandola “*Transportation Engineering”* Vol. I” Khanna publishers, 5th edition, 1998. 3. A. K. Jain, *“ Urban Transport Planning and Management”,* APH Publishing corporation, 2009. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | 2 |
| **CO2** | 1 | - | 2 | 2 | 2 | - | - | 1 | 1 | 3 | 1 | 1 | - | - | 2 |
| **CO3** | 2 | - | 1 | 2 | 1 | 2 | - | 1 | 2 | 3 | 1 | 1 | - | - | 1 |
| **CO4** | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | - | - | 2 |
| **CO5** | 3 | - | - | 1 | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | - | 2 |
| **CO6** | 1 | - | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 1 | 1 | - | 1 | 1 |

**20CE32E3 - FINITE ELEMENT ANALYSIS**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture-Tutorial-Practical** | 3-0-0 |
| **Prerequisite** | Structural Analysis | **Sessional Evaluation** | 40 |
| **External Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the basic principles of finite element method. |
| CO2 | Comprehend the concepts of finite element modelling and discretization,shape functions. |
| CO3 | Apply the finite element method in one dimensional elements. |
| CO4 | Utilize the finite element method in analyzing plane trusses. |
| CO5 | Make use of finite element formulation for beam elements and apply plane stress and plane strain concepts to plane elements. |
| CO6 | Apply the knowledge of isoperimetric elements for analysis. |
| **Course**  **Content** | **UNIT –I**  **INTRODUCTION:** Historical background - Functional approximation- weighted residual methods – Rayleigh ritz method -Basic steps in Finite element method– Advantages and disadvantages – Limitations.  **UNIT – II**  **FINITE ELEMENT MODELING AND DISCRETIZATION:** Finite element modeling and discretization – Interpolation and shape functions – Types of elements –Nodes and degrees of freedom- serendipity elements.  **UNIT – III**  **ONE DIMENSIONAL FINITE ELEMENTS:** Introduction – Bar element – Beam element – Bar and beam elements of arbitrary orientation ––Element stiffness matrices –Assembly of element stiffness matrices––Loads––Boundary conditions –– Applications.  **UNIT – IV**  **TWO DIMENSIONAL FINITE ELEMENTS:** Plane trusses – Local and global coordinate systems – Direction cosines – element stiffness matrix – Assembly of element stiffness matrices – Stress calculation - Temperature effects.  **UNIT – V**  **FINITE ELEMENT FORMULATION:** Introduction – Beam stiffness matrix– Assembly of beam stiffness matrices – Loads – Boundary conditions – temperature effects.  Plane stress analysis – Plane strain analysis.  **UNIT – VI**  **ISOPARAMETRIC ELEMENTS:** Introduction– coordinate transformation - shape functions for isoparametric elements - Mesh generation – Mesh refinement– Numerical integration – Application to plane stress problems –Introduction to analysis software (for practice purpose only). | |
| **Text**  **& Reference books** | **TEXT BOOKS:**   * 1. C.S. Krishnamoorthy, *Finite Element Analysis*, McGraw–HillEducation, 2nd Edition, 2017.   2. S. S. Bhavikatti, *Finite Element Analysis*, New age international publishers, 3rd Edition, 2015.   3. Tirupathi R. Chandrupatla & Ashok D. Belegundu, *Introduction to Finite Elementsin Engineering*, Pearson Education, 4th Edition, 2011.   **REFERENCE BOOKS:**   * + 1. O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, *The Finite Element Method: Its basics and Fundamentals*, Butterworth-Heinemann publishers, 7th Edition, 2013.     2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, John Wiley& Sons Publishers, 4th Edition, 2001.     3. Daryl L. Logan, *A First Course in the Finite Element Method*, CL Engineering, 5th Revised Edition, 2010. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 1 | - | - |
| **CO2** | 1 | 1 | - | - | - | - | - | - | - | - | - | 2 | 3 | 3 | 1 |
| **CO3** | 3 | 2 | - | 2 | 1 | - | - | - | - | - | - | 1 | 2 | 2 | 1 |
| **CO4** | 3 | 2 | - | 1 | 1 | - | - | - | - | - | - | 1 | 2 | 2 | 1 |
| **CO5** | 3 | 2 | - | 1 | 1 | - | - | - | - | - | - | 1 | 2 | 2 | 1 |
| **CO6** | 2 | 1 | 1 | 1 | 2 | - | - | - | - | - | - | 2 | 3 | 3 | - |

**20CE32E4 –ADVANCED REINFORCED CONCRETE DESIGN**

**(Civil Engineering)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3-0-0 |
| **Prerequisite** | Elemental design of Reinforced Concrete Structures | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Design combined rectangular footings, raft foundation and pile foundation. |
| CO2 | Design cantilever and counterfort retaining walls for different loadings. |
| CO3 | Design bunkers and silos |
| CO4 | Design liquid retaining structures resting on ground |
| CO5 | Designelevated liquid retaining structures. |
| CO6 | Analyze pre-stressedrectangular sections for losses and stresses. |
| **Course Content** | **UNIT – I**  **DESIGN OF FOUNDATIONS:** Design of combined rectangular footings– Design of raft foundation with continuous slab – Design of pile foundation.  **UNIT – II**  **DESIGN OF RETAINING WALLS:** Design of cantilever retaining walls with horizontal backfill and sloping back fill – Design of counter fort retaining walls.  **UNIT – III**  **BUNKERS AND SILOS:**  Bunkers–Design of square bunkers– Design of circular Bunkers– Design of silos.  **UNIT – IV**  **DESIGN OF WATER TANKS RESTING ON GROUND:** Review of working stress design method – joints in water tanks– IS code method of design of circular tank with flexible joint between floor and wall–Approximate design of circular tank with restrained base –Approximate design of rectangular water tanks resting on ground.  **UNIT – V**  **DESIGN OF ELEVATED WATER TANKS:** Nature of stresses in spherical and conical domes – Design of RC domes – Design of Intze tanks.  **UNIT – VI**  **PRESTRESSED CONCRETE:** Principles of prestressing – Materials used – Methods and Systems of prestressing– Analysis of rectangular sections for stresses – Losses of prestress. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Dr. B. C. Punmia, Ashok Kumar Jain &Arun Kumar Jain,  *RCC DESIGNS (Reinforced Concrete Structures),* Laxmi Publications, 11th edition, 2022. 2. S. Ramamrutham, *Design of Reinforced Concrete Structures*, DhanpatRai Publishing Company (P) Ltd., 1st edition, 2016. 3. N. Krishna Raju, *Pre-stressed Concrete*, McGraw Hill Education, 6thedition, 2018.   **REFERENCE BOOKS:**   1. S. R. Karve & V. L. Shah., *Limit State Theory and Design of Reinforced Concrete*, Structures publications, 7th edition, 2015. 2. C.K Wang, C.G. and J.A. Pincheira, *Reinforced Concrete Design*, Oxford university press, 8th edition, 2017. 3. N. Subramanian, *Design of Reinforced Concrete Structures*, Oxford university press, Illustrated edition, 2013. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 2 | - | 1 | 1 | - | 1 | - | - | 1 | 2 | - | 1 | - |
| **CO2** | 3 | 1 | 2 | - | 1 | 1 | - | 1 | - | - | 1 | 1 | - | 1 | - |
| **CO3** | 3 | 1 | 2 | - | 1 | 1 | - | 1 | - | - | 1 | 1 | - | 1 | - |
| **CO4** | 3 | 1 | 2 | - | 2 | 1 | - | 1 | - | - | 1 | 2 | - | 1 | - |
| **CO5** | 3 | 1 | 2 | - | 2 | 2 | - | 1 | - | - | 1 | 2 | - | 1 | - |
| **CO6** | 3 | 1 | 1 | - | 1 | 1 | - | 1 | - | - | 1 | 3 | - | 1 | 1 |

**20CE32P1 -ENVIRONMENTAL ENGINEERING LABORATORY**

**(Civil Engineering)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Category** | Professional Core | **Credits** | 1.5 |
| **Course Type** | Practical | **Lecture - Tutorial - Practical** | 0 - 0 - 3 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Determine color and turbidity of water |
| CO2 | Determine total, dissolved, suspended and settleable solids in water. |
| CO3 | Determine pH, acidity and alkalinity of water. |
| CO4 | Determine hardness of water and chlorides in water |
| CO5 | Determine BOD, COD and sulphates in water. |
| CO6 | Determine Optimum Coagulant Dose. |
| **Course Content** | **LIST OF EXPERIMENTS**  1. Determination of Residual chlorine  2. Determination of Turbidity  3. Determination of total solids, suspended solids and dissolved solids  4. Determination of Settleable solids  5. Determination of pH  6. Determination of Acidity  7. Determination of Alkalinity  8. Determination of Hardness  9. Determination of Chlorides  10. Determination of Sulphates using UV-Vis spectrophotometer.  11. Determination of COD  12. Determination of Optimum Coagulant Dose  13. Demonstration of BOD, Colour | |
| **Textbooks** | **TEXTBOOKS:**   1. Dr. Kotaiah and Dr. N. Kumara Swamy,*Environmental Laboratory Manual*, Charotar publishing house, 1994. 2. Indian standards for Analysis of water and Wastewater. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | - | 1 | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 |
| **CO2** | 2 | 2 | - | 1 | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 |
| **CO3** | 3 | 2 | - | 1 | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 |
| **CO4** | 3 | 2 | - | 1 | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 |
| **CO5** | 3 | 2 | - | 1 | 2 | - | 1 | - | - | - | 1 | 2 | - | - | 1 |
| **CO6** | 2 | 2 | - | 1 | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 |

**20CE32P2 –REMOTE SENSING & GIS LABORATORY**

**(Civil Engineering)**

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| --- | --- | --- | --- |
| **Course Category** | Professional core | **Credits** | 1.5 |
| **Course Type** | Practical | **Lecture - Tutorial - Practical** | 0 - 0 - 3 |
| **Prerequisite** | Remote sensing & GIS | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Interpret a satellite image |
| CO2 | Perform orientation of photographs |
| CO3 | Map earth surface features |
| CO4 | Compute geometric measurements |
| CO5 | Perform spatial analysis |
| CO6 | Integrate different geospatial layers |
| **Course**  **Content** | **LIST OF EXPERIMENTS**   1. Importing maps and layers from various sources 2. Spatial resolution of a satellite image 3. Image enhancement 4. Generation of map with legends 5. Georeferensing 6. Supervised classification of a satellite image 7. Unsupervised classification of a satellite image 8. Digitization of points, lines and polygons 9. Attribute data entry 10. Overlay analysis- intersection, union, erase, identity 11. Buffer analysis 12. Data interpolation-Inverse distance weighting method 13. Generation of contour map from point data 14. Generation of digital elevation model from point data | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | - | 1 | - | 1 | 3 | - | - | - | 2 | - | - | 1 | 3 | - | 2 |
| **CO 2** | - | - | - | - | 3 | - | - | - | 2 | - | - | 1 | 3 | - | 2 |
| **CO 3** | - | - | - | - | 3 | - | - | - | 2 | 1 | - | 1 | 3 | - | 2 |
| **CO 4** | 1 | 2 | - | 2 | 3 | - | - | - | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| **CO 5** | 1 | 2 | - | 2 | 3 | - | - | - | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| **CO 6** | 1 | 3 | - | 3 | 3 | 2 | - | - | 2 | 1 | 1 | 1 | 3 | 3 | 3 |

**20CE32P3 –STRUCTURAL ANALYSIS AND DESIGN LABORATORY**

**(Civil Engineering)**

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| **Course Category** | Professional core | **Credits** | 1.5 |
| **Course Type** | Practical | **Lecture – Tutorial –Practical** | 0-0-3 |
| **Prerequisite** | Strength of Materials, Structural Analysis, Elemental Design of RC Structures | **Sessional Evaluation** | 40 |
| **Semester End Exam. Evaluation** | 60 |
| **Total Marks** | 100 |

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| --- | --- | --- |
| **Course Outcomes** | CO1 | Carryout analysis of simple beam and frame |
| CO2 | Analyze and design of multi storey RCC building |
| CO3 | Carryout wind and seismic analysis of RCC buildings |
| CO4 | Analyze and design of footings |
| CO5 | Carryout analysis and design of industrial warehouse |
| CO6 | Carryout analysis and design of conventional center |
| **Course Content** | **LIST OF EXPERIMENTS**   1. Introduction to STAAD pro and STRAP 2. Analysis of simple beam and single storey frame. 3. Analysis and design of multi-storey frame 4. Analysis of multi-storeybuilding 5. Design of multi-storeybuilding 6. Wind load analysis on RCC building 7. Seismic analysis of RCC building 8. Analysis and design of steel truss 9. Analysis and design of isolated footing 10. Analysis of industrial warehouse 11. Design of industrial warehouse 12. Analysis and design of conventional center | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO5** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO6** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 2 |

**N.B.K.R. INSTITUTE OF SCIENCE & TECHNOLOGY:: VIDYANAGAR**

*(AUTONOMOUS)*

**CIVIL ENGINEERING**

**SCHEME OF INSTRUCTION AND EVALUATION**

(With effect from the batch admitted in the academic year 2020-2021)

**IV YEAR OF FOUR YEAR B.TECH. DEGREE COURSE – I SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| S.NO | Course  Code | Course Title | Contact Hours/  Week | | | Credits | Evaluation | | | | | | | | | | | | | | |
| Sessional  Test-I | | | | | Sessional  Test-II | | | | | Total Sessional Marks (Max. 40) | | Semester  End Examination | | Max.  Total Marks |
| **THEORY** | L | T | P | Test-I  (2 hrs.) | | Assignment-I | Max.  Marks | | Test-II  (2 hrs.) | | Assignment-II | | Max.  Marks | 0.8(Better of two sessional tests)  +  0.2(Other) | | Duration  In Hours | Max. Marks |
| 1 | 20CE41EX | **Professional Elective-III** | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 3 | 60 | 100 |
| 2 | 20CE41EX | **Professional Elective-IV** | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 3 | 60 | 100 |
| 3 | 20CE41EX | **Professional Elective-V** | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 3 | 60 | 100 |
|  | | **OPEN ELECTIVE COURSE/JOB ORIENTED COURSE** | | | | | | | | | | | | | | |  | | |
| 4 | 20XX4101 | Open Elective Course/Job Oriented Course | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 3 | 60 | 100 |
| 5 | 20XX4102 | Open Elective Course/Job Oriented Course | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 3 | 60 | 100 |
|  | | **HUMANITIES & SOCIAL SCIENCES ELECTIVE** | | | | | | | | | | | | | | |  | | |
| 6 | 20SH4101 | Managerial Sciences | 3 | 0 | 0 | 3 | 34 | | 6 | 40 | | 34 | | 6 | | 40 | 0.8(Better of two+  0.2(Other) | | 3 | 60 | 100 |
|  |  | **SKILL ADVANCEDCOURSE / SOFT SKILL COURSE** | | | | | | | | | | | | | | | | Day-to-day Evaluation and a test  (40 marks) |  | | |
| 1 | 20CE41SC | Comp. Design Lab | 0 | 0 | 4 | 2 | - | - | | | - | | - | | - | - | | 3 | 60 | 100 |
|  |  | **INTERNSHIP** | | | | | | | | | | | | | | | | | | | |
| 1 | 20CE41IS | Industrial/Research Internship | 0 | 0 | 0 | 3 | - | - | | | - | | - | | - | - | | 40marks | - | 60 | 100 |
|  |  | **TOTAL** |  |  |  | **23** |  | | | | | | | | | | | | | | |
| 1 | 20xx41xx | Honors/Minor course | 4 | 0 | 0 | 4 | The hours distribution can be 3-0-2 or 3-1-0 also | | | | | | | | | | | | | | |
| **Industrial/Research:** Internship (Mandatory) 2 months during summer vacation (to be evaluated during VII semester)  **Professional Elective-III:**  20CE41E1:Pavement Construction & Management; **20CE41E2:Solid Waste Management**.; 20CE41E3:Structural Health Monitoring; 20CE41E4:Advanced Structural Design | | | | | | | | | | | | | | | | | | | | | |
| **Professional Elective-IV:** 20CE41E5:Prestressed Concrete; 20CE41E6:Bridge Engineering.; **20CE41E7:Railway Airport & Harbour Engineering**; 20CE41E8:Integrated Watershed Management | | | | | | | | | | | | | | | | | | | | | |
| **Professional Elective-V:**20CE41E9:Repair &Rehabilitation of Structures;**20CE41EA:Construction Planning & Management**; 20CE41EB:Air& Noise pollution Control ; 20CE41EC:Ground Improvement Techniques | | | | | | | | | | | | | | | | | | | | | |

**20CE41E1 – PAVEMENT CONSTRUCTION AND MANAGEMENT**

**(Civil Engineering)**

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| --- | --- | --- | --- |
| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Transportation  Engineering | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the construction procedure of embankment, gravel road and WBM road. |
| CO2 | Able to explain the construction procedure of bituminous and cement concrete pavements. |
| CO3 | Understand different methods of soil stabilization. |
| CO4 | Acquire knowledge about utilization of various highway construction machinery. |
| CO5 | Understand the need and methods of maintenance of different types of pavements. |
| CO6 | Understand methods of evaluation of different types of existing pavements and also different techniques to strengthen them. |
| **Course**  **Content** | **UNIT – I**  **CONSTRUCTION OF EARTHEN ROADS AND W.B.M ROADS:** Typical components of highway on embankment and in cutting, steps for construction of new highway on embankments and in cutting, functions and design elements of embankment – construction of sub grade – materials, construction method and quality control check. Method of compaction of soil and equipment - construction of embankment – construction of gravel road and WBM road.  **UNIT – II**  **CONSTRUCTION OF BITUMINOUS AND CEMENT CONCRETE PAVEMENTS:** Construction of bituminous roads – Interface treatments, Bitumen surface dressing and penetration macadam – Built up spray grout – Premix methods construction of cement concrete pavements – Construction of joints in cement concrete pavements – Types of joints, arrangement of joints, joint filler and scalar.  **UNIT – III**  **SOIL STABILIZED PAVEMENT LAYERS:** Objectives, application of soil stabilization techniques, mechanics of stabilization and investigations for soil stabilized roads and soil stabilization methods. Mechanical soil stabilization properties of soil –Aggregate mixtures –Factors affecting mechanical stabilization – Minimum design in mechanical stabilization, construction procedure – Stabilization using soft aggregates – Mehras’s method of stabilization.  **UNIT – IV**  **HIGHWAY CONSTRUCTION EQUIPMENT**: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Paving equipment for bituminous and cement concrete pavement. Equipment for stabilized soil road construction.  **UNIT – V**  **HIGHWAY MAINTENANCE:** Need – Causes of pavement failures – Classification of maintenance works maintenance management system – Failures in flexible pavements – Failures in sub grade – Failures in sub base or base course – Typical flexible pavement failures – Failures in cement concrete pavement – Typical rigid pavement failures –Different types of maintenance for Bituminous surfaces – Special repairs in flexible pavements – Waves and corrugations – Skidding of pavement surfaces – Maintenance of cement concrete pavements.  **UNIT – VI**  **PAVEMENT EVALUATION:** Structural evaluation of pavements –need and application of structural evaluation studies- different methods- factors affecting pavement deflection, general principle deflection approach, principle of structural evaluation of flexible pavements - Evaluation of pavement surface condition – Strengthening of existing pavements -objectives– Flexible overlay over flexible pavement by conventional design method – Overlay design by Benkelman beam deflection studies- rigid overlay over rigid pavement – Flexible overlay over rigid pavement. | |

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| **Textbooks and Reference Books** | **TEXTBOOKS:**   1. S.K. Khanna and C.E.GJusto &Veeraraghavulu, *Highway Engineering*, Nemchand&bros, 10th edition, 2018. 2. Dr. L.R Kadiyali, *Principles and Practice of Highway Engineering,* Khanna publishers, 7th edition, 2019. 3. C.Venkatramaiah, *Transportation Engineering Vol. I,* Universities Press (India) Private Ltd, 1st edition, 2016.   **REFERENCE BOOKS:**   1. Dr. L.R Kadiyali, *Traffic Engineering and Transport Planning,* Khanna publishers, 9th edition, 2017. 2. AnimeshDas, Analysis of pavement structures, CRC Press, 2nd edition, 2014. |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO 3** |
| **CO1** | 1 | - | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | - | 1 | 3 |
| **CO2** | 1 | - | 2 | 1 | 2 | - | - | 1 | 1 | 3 | 1 | 1 | - | 1 | 3 |
| **CO3** | 2 | - | 1 | 1 | 1 | 2 | - | 1 | 2 | 3 | 1 | 1 | - | 3 | 1 |
| **CO4** | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | - | 2 | 1 |
| **CO5** | 3 | - | - | 1 | 1 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | 1 | - |
| **CO6** | 1 | - | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | - | 1 | - |

**20CE41E2 – SOLID WASTE MANAGEMENT**

**(Civil Engineering)**

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| --- | --- | --- | --- |
| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Know the impacts of solid waste generation |
| CO2 | Identify different sources of solid waste. |
| CO3 | Apply the onsite handling, processing techniques and transfer techniques. |
| CO4 | Apply processing techniques and recovery of products from solid waste. |
| CO5 | Know various disposal techniques and management options for solid waste. |
| CO6 | Identifies hazardous wastes and apply the disposal techniques. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION:** Goals and objectives of solid waste management – Impacts of solid waste generation in a technological society – Principle of solid waste management – Social and economic aspects – Public awareness – Quantities of solid wastes.  **UNIT –II**  **SOURCES AND TYPES OF MUNICIPAL SOLID WASTES:** Sources and types of solid wastes – Factors affecting generation of solid wastes – functional elements - Characteristics - Effects of improper disposal of solid wastes – Public health effects.  **UNIT – III**  **ONSITE HANDLING – STORAGE AND PROCESSING:** Onsite handling –Methods used at residential and commercial sources –Onsite storage dust bins –Community containers, container locations, onsite processing methods  **COLLECTION AND TRANSFER:** Methods of Collection – Types of vehicles – Manpower requirement – Collection routes –Transfer stations – Selection of location - Options under Indian conditions.  **UNIT – IV**  **PROCESSING TECHNIQUES AND EQUIPMENT:** Purpose of processing- sorting - shreddingand incineration and types of incinerators.  **RECOVERY OF PRODUCTS AND ENERGY:** Material processing and recovery systems –Recovery of chemical conversion products –Recovery of biological conversion products, recovery of energy from conversion products.  **UNIT – V**  **DISPOSAL OF SOLID WASTES:** Sanitary landfills – General considerations –Site selection – Operational management systems in land fill – Gas and leachate control – construction –Ocean disposal of solid wastes – Application of GIS in Land Fill.  **UNIT – VI**  **HAZARDOUS WASTES:** Special wastes - Hazardous wastes –Hospital wastes –Sewage sludge –Industrial solid wastes –Methodsof disposal. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Iqbal H Khan, NavedAhsan, *Textbook of Solid Wastes Management,*CBS publishers and distributors pvt ltd, 1st edition, 2017. 2. George Tchobanoglous& Hilary Theison,*Solid Waste: Engineering principles and management,* McGraw-Hill Publishers, 1993. 3. Bhide, A.D. and Sundaresam B.B, *Solid Waste Management in developing countries*, Indian National Scientific Documentation Centre, 2016.   **REFERENCE BOOKS:**   1. Datta.MParida&B S GuhaB.K.andSreekrishna. T. R, *Industrial Solid Waste Management & Land Filling Practice,* Narosa publishing house, 2001 2. K. Sasi kumar and SanoopGopi Krishna, *Solid Waste Management,* PHI publishers, 2013. 3. [RajaramVasudevan,](https://www.amazon.in/s/ref=dp_byline_sr_ebooks_1?ie=UTF8&field-author=Rajaram+Vasudevan+&text=Rajaram+Vasudevan+&sort=relevancerank&search-alias=digital-text)[Siddiqui Faisal Zia](https://www.amazon.in/s/ref=dp_byline_sr_ebooks_2?ie=UTF8&field-author=Siddiqui+Faisal+Zia&text=Siddiqui+Faisal+Zia&sort=relevancerank&search-alias=digital-text), [SanjeevAgrawal](https://www.amazon.in/s/ref=dp_byline_sr_ebooks_3?ie=UTF8&field-author=Sanjeev+Agrawal&text=Sanjeev+Agrawal&sort=relevancerank&search-alias=digital-text)&  Mohmmad Imran Khan, *Solid And Liquid Waste Management*, PHI publishers. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | 1 | - | - | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | - | - | - |
| **CO2** | - | 2 | 1 | - | - | 3 | 2 | 3 | 2 | 2 | 2 | 1 | - | - | 1 |
| **CO3** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | - | 2 | 2 |
| **CO4** | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | - | 2 | 2 |
| **CO5** | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 |
| **CO6** | 2 | 2 | - | - | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | - | - | 1 |

**20CE41E3 – STRUCTURAL HEALTH MONITERING**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Objectives** | 1. To understand basic concepts of structural health monitoring in civil engineering. 2. To interpret structural heath failure in bridge structure. 3. To overview the Non Destructive Test techniques for detecting the defects in concrete structures. 4. To understand the concept of condition survey. 5. Gain-in knowledge in quality control of concrete structures. 6. Gain-in knowledge of Rehabilitation of concrete structures. | |
| **Course Outcomes** | CO1 | Understand basic concepts of structural health monitoring and analyse between system of a man and a structure with structural health monitoring. |
| CO2 | List out structural failures in bridge structure. |
| CO3 | Overview the non-destructive test techniques and methods for concrete structures. |
| CO4 | Perform condition survey for evaluation of concrete structures. |
| CO5 | Evaluate the non-destructive test techniques of concrete structures and case studies. |
| CO6 | Develop sustainable maintenance and rehabilitation of concrete structures. |
| **Course Content** | **UNIT-I**  **INTRODUCTION TO STRUCTURAL HEALTH MONITORING (SHM):**Definition & motivation for SHM – SHM – A way for smart materials and structures – SHM and Biomimetic – Analog between the nervous system of a man and a structurewith SHM–SHM as a part of system management – Passive and Active SHM – NDE – SHM and NDECS – Basic components of SHM – Materials for sensor design.  **UNIT-II**  **APPLICATION OF SHM IN CIVIL ENGINEERING:** Introduction to capacitive methods – Capacitive probe for cover concrete – SHM of a bridge – Applications for external post tensioned cables – Monitoring historical buildings.  **UNIT-III**  **NON DESTRUCTIVE TESTING OF CONCRETE STRUCTURES:** Introduction to NDT – Situations andcontexts – where NDT is needed – Classification of NDT procedures –Visual Inspection – Half-Cell electrical potential methods – Schmidt Rebound Hammer Test – Resistivitymeasurement –Electromagnetic methods – Radiographic Testing – ultrasonic testing – Infrared thermography – Ground penetrating radar – Radio isotope gauges – Other methods.  **UNIT-IV**  **CONDITION SURVEY & NDE OF CONCRETE STRUCTURE:** Definition –Objective of condition survey – Stages of condition survey(Preliminary – Planning – Inspection and Testing stages)–Possible defects in concrete structures.  **UNIT-V**  **QUALITY CONTROL OF CONCRETE STRUCTURES**: Definition and need – Quality control applications in concrete structures – NDT asan option for Non-Destructive Evaluation (NDE) of Concrete structures – Case studies of a few NDT procedures on concrete structures.  **UNIT-VI**  **REHABILITATION AND RETROFITTING OF CONCRETE STRUCTURE:** Repair rehabilitation & retrofitting of structures –Damage assessment of concretestructures – Materials and methods for repairs and rehabilitation – Modeling of repaired composite structure –Structural analysis and design – Importance ofre-analysis –Execution of rehabilitation strategy – Case studies. | |

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| **Textbooks and References** | **TEXTBOOKS:**   1. Gandhi and Thompson,*Smart Materials and Structures*,Springer, 1992. 2. Fu Ko Chang,*Structural Health Monitoring: Current Status and Perspectives*,CRC Press 1st edition, 1998. 3. Ravi shankar.K and Krishnamoorthy.T.S, *Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures*, Allied Publishers, 2004.   **REFERENCES:**   1. Shetty M.S., *Concrete Technology – Theory and Practice*”, S.Chand and Company, 2008. 2. DovKominetzky.M.S., *Design and Construction Failures*, Galgotia Publications Pvt. Ltd., 2001. 3. CPWD and Indian Buildings Congress, Hand Book on Seismic Retrofit of Buildings, Narosa Publishers, 2008. |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | - | 2 | 1 | 2 | 2 | 2 |
| **CO2** | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | - | 2 | 1 | 2 | 2 | 2 |
| **CO3** | 2 | 1 | 1 | - | - | 2 | 1 | - | - | - | 2 | 1 | 2 | 1 | 3 |
| **CO4** | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | - | - | 2 | 1 | - | 1 | 2 |
| **CO5** | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 |
| **CO6** | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | 1 | 1 | 2 | 2 | 2 |

**20CE41E4 – ADVANCED STRUCTURAL DESIGN**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3-0- 0 |
| **Prerequisite** | Elemental Design of Reinforced Concrete Structures | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Design slender reinforced concrete columns, concrete walls and grid floors. |
| CO2 | Analyze multi storey building frames for seismic forces. |
| CO3 | Perform Plastic design of beams and columns. |
| CO4 | Perform Plastic design of frames according to BIS code of practices. |
| CO5 | Design pre-stressed concrete beams by using limit state design. |
| CO6 | Perform the design of prestressed concrete slabs, pressure pipes and railway sleepers. |
| **Course**  **Content** | **UNIT – I**  Design of slender columns - Concrete walls under vertical loads - Grid floors.  **UNIT – II**  Introduction to seismic analysis - Different methods of computing seismic forces on buildings –Analysis of multi-storey building frames - Ductility considerations in earthquake resistant design of RC buildings based on IS 13920.  **UNIT – III**  Plastic design of simply supported and continuous beams –Columns  **UNIT – IV**  Plastic design of frames– Steps/process to as per the most recent BIS code of practices~~-~~ Deign of purlins.  **UNIT – V**  Design of Pre- stressed beams for strength in limit state in flexure and shear – Limit state strength at transfer conditions – Limit state of deflection and cracking.  **UNIT – VI**  Design of reinforcement in anchor zones – Design of Pre- stressed rectangular slabs – Design of pressure pipes – Design of railway sleepers. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. P.C. Varghese, *Advanced Reinforced Concrete Design*, PHI Publisher, 2nd revised edition, 2011. 2. Dr. S. Ramchandra and V. Gehlot, *Design of Steel Structures Vol-2*, standard publishers distributors, 9th revised and enlarged edition, 2015. 3. N. Krishna Raju, *Prestressed Concrete*, McGraw hill education, 6thEdition, 2018.   **REFERENCES:**   1. G.S.Pandit & S.P.Gupta, *Prestressed Concrete*, CBS Publishers, and distributors Pvt. Ltd., 1st Edition, 2019. 2. N. Krishna Raju, *Advanced Reinforced Concrete Design*, CBS Publishers, and distributors Pvt. Ltd., 3rd Edition, 2016. 3. Pankaj Agarwal & Manish Shrikhande, *Earthquake Resistant Design of Structures*, Prentice Hall of India Pvt. Ltd, 2011. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 2 | - | 1 | 1 |
| **CO2** | 3 | 3 | 1 | - | 1 | - | - | - | - | - | - | 1 | - | 1 | 1 |
| **CO3** | 3 | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 2 | - | 1 | 1 |
| **CO4** | 3 | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 2 | - | 1 | 1 |
| **CO5** | 3 | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 3 | - | 1 | 1 |
| **CO6** | 3 | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 1 | - | 1 | 1 |

**20CE41E5 - PRESTRESSED CONCRETE**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 -0 - 0 |
| **Prerequisite** | Elemental Design of Reinforced Concrete structures | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Calculate the resultant stresses in rectangular prestressed concrete. |
| CO2 | Analyze the losses and design the prestressed concrete sections. |
| CO3 | Design Pre-tensioned concrete members. |
| CO4 | Analyze and design partially post-tensioned members. |
| CO5 | Analyze and design composite prestressed concrete members. |
| CO6 | Design prestressed concrete slabs. |
| **Course Content** | **UNIT – I**  **INTRODUCTION:** Basic concepts of prestressing – Historical development –Advantages of prestressed concrete – High strength concrete – High tensile steel.  **PRESTRESSING SYSTEM:** Introduction –Tensioning devices – Pretensioning and post tensioning systems –Thermo-electric and chemical prestressing.  **ANALYSIS OF PRESTRESSED CONCRETE SECTIONS:** Basic assumptions – Analysis of prestress –Resultant stress at a section – Pressure line – Concept of load balancing –Stress in tendons and cracking moment.  **UNIT – II**  **LOSSES OF PRESTRESS**: Nature of losses of prestress – Loss due to elastic deformation of concrete – Shrinkage of concrete – Creep of concrete – Relaxation of stress in steel – Friction and anchorage slip – Total losses.  **DESIGN OF PRESTRESSED CONCRETE SECTIONS:** Design of sections for Flexure, Axial tension, Compression bending and Shear– Design of members for bond and bearing.  **UNIT – III**  **DESIGN OF PRE-TENSIONED MEMBERS:** Dimensioning of flexural members – Estimation of self-weight of beams – Ultimate flexure strength –Ultimate shear strength – design of pre tensioned members.  **UNIT – IV**  **DESIGN OF POST-TENSIONED MEMBERS:** Ultimate moment and shear – Cross sectional dimensions – Moment and shear forces – Minimum section modules – Permissible tendon zone – Deflection and serviceability – Design of partially prestressed members.  **UNIT – V**  **COMPOSITE CONCRETE STRUCTURES:** Composite structural members – Types of composite construction – Analysis of stress – Differential shrinkage – Deflection of composite members –Flexural strength of composite sections and design of composite sections.  **UNIT – VI**  **PRESTRESSED CONCRETE SLABS**: Types of prestressed concrete floor slabs – Design of prestressed concrete one way slabs, Two way slabs and simple flat slabs. | |
| **Textbooks**  **& References** | **TEXTBOOKS:**   1. N. Krishna Raju, *Prestressed Concrete,* McGraw Hill Education, 6thEdition, 2018. 2. P. Dayaratham and P. Sarah,*Prestressed Concrete Structures*, Medtech Publishers, 7th Edition, 2017. 3. S. Ramamrutham, *Prestressed Concrete Structures*, Dhanpatrai publishing company, 6th Edition, 2018.   **REFERENCE BOOKS:**   1. N.C.Sinha and S.K.Roy, *Fundamentals of Prestressed Concrete*, SChand Publishing, 3rd Edition, 2011. 2. T.Y. Lin & N.H. Burns,*Design of Prestressed Concrete Structures*,Wiley India Private Limited, 3rd Edition, 2010. 3. Shrikan B.Yanakudre, Ashish A.Yoligar, *Prestressed Concrete,* Khanna Publishing, 1st edition, 2018. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | 3 | - | - | 1 | - | 3 | - | - | - | - | - | 3 | - | 1 | 1 |
| **CO2** | 3 | - | 1 | 1 | - | 2 | 2 | 1 | - | - | - | 3 | - | 1 | 1 |
| **CO3** | 3 | - | 1 | - | 2 | 1 | - | 1 | - | - | 1 | 2 | - | 2 | 1 |
| **CO4** | 3 | - | 1 | 1 | 1 | 1 | - | 1 | - | - | 1 | 2 | - | 1 | 1 |
| **CO5** | 3 | - | 1 | 1 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | - | 1 | 1 |
| **CO6** | 3 | - | 1 | - | 2 | 1 | 1 | 1 | - | - | 1 | 1 | - | 2 | 2 |

**20CE41E6 – BRIDGE ENGINEERING**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3-0- 0 |
| **Prerequisite** | Elemental Design of Reinforced Concrete Structures and Structural Analysis | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Classify bridge loading standards and be able to recommend suitable bridge type. |
| CO2 | Analyze and design box culvert and deck slab bridge. |
| CO3 | Design RC T- beam bridge using Pigeaud’s method. |
| CO4 | Design plate girder bridge and composite bridge. |
| CO5 | Analyze Piers and abutments for stability. |
| CO6 | Design bridge bearings and identify the types and importance joints in bridges. |
| **Course**  **Content** | **UNIT - I**  **INTRODUCTION:** General – Classification of bridges – Site selection - Importance of site investigation in bridge design - Choice of bridge type - Location of piers and abutments - Subsoil exploration – Economical span- Traffic projection – Scour depth.  **IRC LOADING STANDARDS:** Various loads on bridges - Highway bridge loading standards–Impact factor–Railway Bridge loading standards (Broad Gauge Main Line Bridge).  **UNIT – II**  **BOX CULVERT:** General aspects – Design loads, Design of Box culvert subjected to IRC class AA tracked vehicle only.  **DECK SLAB BRIDGE:** Introduction – Effective width method– Design of deck Slab Bridge (simply supported) subjected to IRC class AA tracked vehicle only.  **UNIT - III**  **BEAM AND SLAB BRIDGE (T-BEAM BRIDGE):** General features – Design of interior panel of slab – Pigeaud’s method – Design of a T-beam bridge subjected to IRC class AA tracked vehicle only.  **UNIT - IV**  **PLATE GIRDER BRIDGE:** Introduction – elements of a plate girder and their design - Design of a deck type welded plate girder bridge for single line broad gauge.  **COMPOSITE BRIDGES:** Introduction – Advantages – Design of composite bridges consisting of RCC slabs over steel girders including shear connectors.  **UNIT - V**  **PIERS AND ABUTMENTS:** General features – Bed block – Materials for piers andabutments–Types of piers – Forces acting on piers – Stability analysis of piers – General features of abutments – Forces acting on abutments – Stability analysis of abutments - Types of wing walls – Approaches – Types of bridge foundations (excluding design).  **UNIT - VI**  **BRIDGE BEARINGS:** General features – Types of bearings – Design principles of steel rocker and roller bearings – Design of a steel rocker bearing – Design of elastomeric pad bearing – Joints – Expansion joints- Parapets and railings for highway bridges. | |
| **Text**  **and**  **Reference books** | **TEXT BOOKS:**   1. N.KrishnaRaju, *Design of Bridges*, Oxford & IBH Publishing Company Pvt. Ltd., 5th Edition, 2018. 2. N.RajaGopalan, *Bridge superstructure*, Narosa Publishing House, 2006. 3. S. C. Rangwala, *Bridge engineering*, Charotar Publications, 16th Rev Edition, 2015.   **REFERENCE BOOKS:**   1. D.J.Victor, *Essentials of bridge engineering*, Oxford& IBH Publishing Company Pvt. Ltd., 4th Edition, 1994. 2. T. R. Jagadeesh and M. A. Jayaram, *Design of Bridge structures*, PHI Learning Pvt. Ltd., 2nd Edition, 2014. 3. PonnuSwamy, *Bridge Engineering*, Tata McGraw Hill Company, 3rd Edition, 2017. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 2 | - | 1 | - | 1 | 1 | - | - | 1 | 1 | - | - | 1 |
| **CO2** | 3 | - | 3 | - | 1 | - | 2 | - | - | - | 1 | - | - | 2 | 3 |
| **CO3** | 3 | - | 3 | - | 2 | - | 1 | - | - | - | 1 | - | - | 2 | 3 |
| **CO4** | 3 | - | 2 | - | 2 | - | 1 | - | - | - | 1 | - | - | 2 | 3 |
| **CO5** | 2 | - | 1 | - | - | - | - | - | - | - | - | 1 | - | 2 | 3 |
| **CO6** | 1 | - | 1 | - | 1 | - | - | - | - | - | 1 | - | - | - | 2 |

**20CE41E7 - RAILWAY, AIRPORT & HARBOUR ENGINEERING**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Transportation Engineering | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Objectives** | 1. To illustrate permanent way and its components. 2. To demonstrate different types of stations, yards, points, crossings and turnouts. 3. To outline the basic concepts of airport transportation, aircraft characteristics and airport. 4. To analyze runway orientation by wind rose method. 5. To relate water and water transportation for providing various facilities required in harbour. 6. To elaborate facilities required in harbour with break waters and dredging. | |
| **Course Outcomes** | CO1 | Illustrate permanent way, its components and functions in railways. |
| CO2 | Identify functions, requirements and types of stations, yards, points and crossing, turnouts. |
| CO3 | Outline air transport features along with airport components. |
| CO4 | Understand basic concepts of airport planning and runway orientation. |
| CO5 | Summarize facilities required in harbour and port. |
| CO6 | Relate importance of break waters, docks and dredging in harbour and port. |
| **Course Content** | **UNIT - I**  **INTRODUCTION TO RAILWAY ENGINEERING:** comparison of railways and highways, milestones in Indian railways, classification of Indian railways **–** rail route classification, railway zones.  **PERMANENT WAY**: Requirements of ideal permanent way, gauges – selection of gauge- uniformity of gauges, Rails **-** functions, requirements of rails, types of rail sections, rail failures, coning of wheels, Sleepers **–** types of sleepers,functions and requirements, adzing of sleepers, spacing of sleepers and sleeper density- problems, Ballast- functions and requirements, types of ballast - (Theory only).  **UNIT – II**  **STATIONS AND YARDS:** Railway stations **-** Site selection for railway stations, requirements, classification **-** operational classification and functional classification, platforms **-** types, loops, sidings, Station yards – types, layouts, Points and crossings **–** turnouts **-** left hand turnout, right hand turnout, types of switches, types of crossings, sleepers at points and crossings (Theory only).  **UNIT – III**  **AIR TRANSPORT:** Introduction to air transportation, characteristics of air transport, development of national organizations for civil aviation, airport zoning and zoning laws, classification of airports, different kinds of flights, Air traffic control **-** forecasting air traffic potential (Basic concepts only).  **AIR CRAFT AND AIR PORT:** Air craft– types, components, basic structure of air craft, aircraft characteristics, Components of airports and functions **-** terminal area and landing area, planning concepts for terminal building, Parking area **-** patterns of parking, systems of aircraft parking, Aprons **-** loading aprons and holding aprons, hangers **-** T hangers, nose hangers and grouped hangers.  **UNIT - IV**  **AIRPORT PLANNING:** Airport planning – Master plan, regional plan, factors affecting site selection for an airport, characteristics of well-planned airport layout, typical airport layout patterns, blast considerations, blast fences.  **RUNWAY ORIENTATION**: Runway - patterns, types, Orientation - wind rose analysis in runway orientation **–** problems on runway orientation**,** Length of runway – Problems.  **UNIT - V**  **WATER TRANSPORTATION**: Salient features of water transportation in India **-** types of water transportation - inland and ocean transportation**,** Tides, Wind and waves – factors governing the characteristics of water waves, Currents, uses and effects of tides at harbour.  **HARBOUR AND PORT**: Classification of harbors and ports, site selection, requirements of good port, components of a harbour and port **-** loading and unloading facilities of harbor, quays & wharves, piers, dolphins, jetties, fenders, aprons, transit sheds, Docks – classification, shapes of docks , dry docks & wet docks, Different layouts of harbour.  **UNIT - VI**  **BREAK WATERS:** Breakwaters – types of break waters, details of energy dissipation in mound break water, characteristics of mound break water, rubble mound breakwater – rubble mound breakwater strengthened by concrete blocks, rubble mound breakwater strengthened by patented blocks.  **DREDGING:** Classification of dredging, Equipment **-** mechanical type, hydraulic or suction type dredgers, choice of dredger, navigation facilities – need- types- general lights and local lights – fixed light station types only- floating navigation aids types only. | |
| **Textbooks**  **and References** | **TEXTBOOKS:**   1. S.C.Saxena & S.P.Arora, *A text book of Railway Engineering*, Dhanpat Rai publications, 7th edition, 2015. 2. R. Srinivasan, *Docks and Harbour engineering*, Charotar publishing hose Pvt. Ltd, 29th edition, 2018. 3. C.Venkatramaiah, *Transportation Engineering II”,* Universities press (India) Private Limited, 2ndedition, 2016.   **REFERENCE BOOKS:**   1. SP Bindra, “*A Course in Docks and Harbour Engineering”,* Dhanpat Rai Publication, 8th edition, 2016. 2. S.C. Rangwala , “*A text book of Railway Engineering”*, Charotar publishing house, 26th edition, 2016. 3. K.P. Subramanian, “*Highway, railway, airport and harbour engineering”,*  SCITECH publishers, 2nd edition, 2015. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | - |
| **CO2** | 1 | - | 2 | 2 | 2 | - | - | 1 | 1 | 3 | 1 | 1 | - | 1 | - |
| **CO3** | 2 | - | 1 | 2 | 1 | 2 | - | 1 | 2 | 3 | 1 | 1 | - | 1 | 1 |
| **CO4** | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | - | 1 | 1 |
| **CO5** | 3 | - | - | 1 | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | - | 1 |
| **CO6** | 1 | - | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 1 | 1 | - | 1 | - |

**20CE41E8 – INTEGRATED WATERSHED MANAGEMENT**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0- 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Demonstrate the basic concepts of watershed management |
| CO2 | Identify and plan for sustainable utilization of available land resources in the watershed. |
| CO3 | Identify and plan for sustainable utilization of available water resources in the watershed. |
| CO4 | Identify various crops patterns, soil condition and water salinity in the watershed and suggest remedial measures. |
| CO5 | Identify various energy resources available in the watershed and plan for sustainable utilization. |
| CO6 | Apply modern technology for effective integrated watershed management. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION:**Place in Environment - Global Effects, Degradation Trends; Semi-arid Tropics; Status in India - Forests; Soils, Water, Droughts, Cultivation, Irrigation, Power, Food and Nutrition; Neglected Nodes -Social, Technical, Environment, Cooperation, Economy.  **WATERSHED CONCEPT:** Watershed; Need; Characteristics. Size, Shape, physiography, Slope, Climate, Drainage, Land Use, Vegetation, Geology and Soils, Hydrology, Management - Degradation Devils; Integrated Multi-Disciplinary Approach - Socioeconomics, Priorities, Tasks, Rural Technological Delivery Systems, Nodes, Economics.  **UNIT – II**  **LAND:** Survey Layout; Preparation and Development, Contour Demarcation, Bush Clearance, Uprooting, Stone Picking and Packing, Levelling, Shaping and Consolidation, Fencing, Ploughing; Soil and Soil Moisture Conservation - Soil Survey; Conservation Measures. Rainwater Management - Stream Head Cutting, River Bank Management, Flow Irrigation, Waterways; Reclamation of Saline Soils. Alkaline Soils, Saline Soils, Acidic Soils, Sulfide Soils.  **UNIT – III**  **WATER:** Investigation. Remote Sensing, Data and Analysis; Exploration, Evaluation and Exploitation; Surface Water. Utilization of Wasted Flows, Salvaging Flood Flows, National Waterway Grid, Dams and Irrigation, Rejected Recharge, Tidal Rivers, Tanks; Rainwater Harvesting. Catchment, Harvesting, Harvesting Structures; Groundwater. Exploitation of Canal Command Areas, Potential Areas, Harvesting; Desalinization of Coastal Saline Stretches, Artificial Recharge;  **UNIT – IV**  **GREENERY:**Agriculture -Crop Husbandry - Soil Enrichment, Inter, Mixed and Strip Cropping, Cropping Pattern; Sustainable Agriculture - Hybrid and Improved Seeds; Biomass Management - Crop Rotation, Legumes, Organic Fertilization, Spider Fanning; Dryland Agriculture - Runoff Agriculture, Micro-catchment Fanning, Irrigation with Saline Water, Reusing Water, Conserving Water, Sprinkler irrigation, Drip Irrigation, Pot Irrigation, Other Systems, Reducing Cropland Percolation Limes, Reducing Transpiration Losses, Selection of Water Use Efficiency Crops; irrigation - Water Losses, Control of Water Levels, Salinity Problem, Water Distribution.  **UNIT – V**  **ENERGY:** Renewable resources, Water Power, Solar Energy, Wind Power; Biomass. Firewood. Synthetic Fuels, Burning of Municipal Garbage; Alternative Strategies; Conservation.  **SOCIOECONOMICS:**Awareness, Participation, Response; State and Integrated Approach. Appreciation of the Concept, Training, Transfer of Technology, Research and Development, Agro industrial Infrastructure; Sustainable society - Livestock, Small animal fanning, Pisciculture, Sericulture, Health and Hygiene, Education, Transport, Cues; Economics - Per Hectare Provision, NGOs, International Agencies, Future, Economic Viability; Sustainable Society.  **UNIT – VI**  **TECHNOLOGY**: Farm Equipment; Contour Methods; Check Dams; Water Catchment and Harvesting. Kunds, Depression Harvesting, Harvesting Below Ground Level, Harvesting Below Stream Bed Level, Groundwater Harvesting; Low-Cost Technology. Water Conservation. Utilization of Wasted Natural Resources, Novelties; Rural Technological Delivery Systems.  **IMPACT:** Model Watershed; Government Projects. National Projects; World Bank Projects; NGOs Efforts. Society for Promotion of Wasteland Development; ICRISAT. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. J.V.S. Murthy, *Watershed Management*, New Age International Publishers, 2nd edition, 2004 2. V.V.N.Murthy, and M.K. Jha*Land and water management*, Kalyani Publishers, 3rd edition, 2015. 3. Madan Mohan Das and M.D. Saikia, *Watershed management*, Prentice Hall ofIndia, 2nd edition 2013.   **REFERENCE BOOKS:**   1. P.E. Black, *Watershed Hydrology*, Prentice Hall Englewood Cliffs, 2nd edition, 2001. 2. R. Suresh, *Watershed Hydrology*, Standard Publishers and Distributors, Delhi, 2nd edition, 2007. 3. A. Ranga Reddy, *Watershed Management for Sustainable Development*, A Mittal Publications, 2005. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | - | - | - | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - |
| **CO 2** | - | - | - | 1 | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 |
| **CO 3** | - | - | - | 1 | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 |
| **CO 4** | 2 | - | - | 1 | - | 1 | 1 | - | - | - | - | 1 | - | 2 | 1 |
| **CO 5** | 1 | - | - | 1 | 2 | - | 2 | 1 | - | - | - | 1 | - | 2 | 1 |
| **CO 6** | 1 | - | - | 2 | 1 | 1 | 2 | 1 | - | - | - | - | - | 1 | 1 |

**20CE41E9 – REPAIR AND REHABILITATION OF STRUCTURES**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Concrete Technology | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Apply maintenance and repair strategies to evaluate damaged structures. |
| CO2 | Evaluate strength and durability characteristics of concrete. |
| CO3 | Identify various materials used for repair and their applications. |
| CO4 | Apply non-destructive testing techniques and protective methods to field problems. |
| CO5 | Recommend repair and demolition procedures of structures. |
| CO6 | Assess corrosion of embedded steel in concrete and suggest repair techniques. |
| **Course**  **Content** | **UNIT -I**  **MAINTENANCE AND REPAIR STRATEGIES:** Maintenance – Repair and rehabilitation – Facets of maintenance – Importance of maintenance – Various aspects of inspection – Assessment procedure for evaluating a damaged structure – Causes of deterioration.  **UNIT -II**  **STRENGTH AND DURABILITY OF CONCRETE:** Quality assurance for concrete – Strength – Durability and thermal properties of concrete – Cracks – Different types –Causes – Effects due to climate – Temperature – Sustained elevated temperature –Corrosion – Effects of cover thickness.  **UNIT -III**  **MATERIALS FOR REPAIR:**–Expansive cement- Ferro cement - Special elements for accelerated strength gain-Sulphur infiltrated concrete– Fibre reinforced concrete -Types of fiber reinforced concrete – High strength concrete–High performance concrete– Vacuum concrete–– Geopolymer concrete–Reactive powder concrete–Bacterial concrete.  **UNIT -IV**  **PROTECTION METHODS**: Non-Destructive Testing Techniques: Radioactive Method –Nuclear Method-Magnetic Method-Electrical Method. Epoxy Injection – Shoring – Underpinning – Corrosion Protection Techniques – Corrosion Inhibitors – Corrosion Resistant Steels – Coatings to Reinforcement – Cathodic Protection.  **UNIT- V**  **REPAIR AND DEMOLITION TECHNIQUES OF STRUCTURES**: Strengthening of Structural Elements – Repair of structures distressed due to corrosion – fire – Leakage and earthquake – Engineered demolition methods – Case studies.  **UNIT -VI**  **CORROSION OF EMBEDDED STEEL IN CONCRETE:** Corrosion of embedded steel in concrete – Mechanism – Stages of corrosion damage – Repair of various corrosion damaged structural elements (slabs, beams, and columns).  **JACKETING:** Jacketing – Column jacketing – Beam jacketing – Beam Column joint jacketing – Reinforced concrete jackets – Steel jacketing – FRP jacketing.  **STRENGTHENING**: Strengthening of beam: Shear strengthening and Flexural strengthening. | |
| **Text**  **and**  **Reference books** | **TEXTBOOKS:**   1. Poonam I. Modi and Chirag N. Patel, *Repair and Rehabilitation of Structures*, PHI learning Pvt. Ltd, Eastern Economy Edition, 2016. 2. Denison Campbell, Allen and Harold Roper, *Concrete Structures, MaterialsMaintenance and Repair*, Longman Scientific and Technical, Illustrated edition, 1991. 3. R.T. Allenand S.C Edwards, *Repair of Concrete Structures*, Blakie and Sons, 2nd edition, 1992.   **REFERENCES:**   1. M.S Dov Kominetzky, *Design and Construction Failures*, Galgotia Publications Pvt. Ltd., 2001. 2. K. Ravi Shankar and T.S KrishnaMoorthy, *Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures*, Allied Publishers, 2004. 3. M. L. Gambhir., *Concrete Technology*, McGraw Hill Publication, 5th edition 2013. | |

**CO-PO Mapping**: 3-High Mapping, 2- Moderate Mapping, 1-Low Mapping, -- Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | - | 1 | 2 | 1 | 2 | 1 | - | - | 2 | 1 | - | 1 | 1 |
| **CO2** | 2 | 1 | - | 1 | 2 | 1 | 2 | 1 | - | 1 | 2 | 1 | - | 1 | - |
| **CO3** | 1 | 1 | - | - | - | - | 1 | - | - | - | 1 | 1 | - | 1 | 1 |
| **CO4** | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | - | 2 | 2 |
| **CO5** | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | 3 | 2 |
| **CO6** | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | - | 3 | 2 |

# ****20CE41EA - CONSTRUCTION PLANNING & MANAGEMENT****

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Building materials and construction | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Demonstrate the basics of construction management. |
| CO2 | Schedule various components of project and utilize CPM and PERT techniques. |
| CO3 | Classify the working of various equipment in construction industry. |
| CO4 | Perform inspection for quality control, ethical audit and prepare audit statement. |
| CO5 | Illustrate the importance of safety and risk in construction and organizational structures and roles. |
| CO6 | Illustrate the importance of trade unions connected with the construction industry in India. |
| **Course Content** | **UNIT - I**  **INTRODUCTION:** Significance of construction management– Objectives and functions of construction management– Types of construction– Resources for construction industry–Stages of construction–Construction team– Engineering drawings.  **UNIT - II**  **CONSTRUCTION PLANNING:** Stage of planning– Scheduling– Preparation of material– Equipment– Labour and finance schedules– Bar charts– Milestone charts  **NETWORK TECHNIQUES IN CONSTRUCTION MANAGEMENT:** Critical Path Method (CPM) –Program Evaluation and Review Technique (PERT) – Network techniques breakdown structures– Classification of activities–Rules for developing networks– Network development–Network analysis– Critical activities and critical path – Cost optimization.  **UNIT - III**  **CONSTRUCTION EQUIPMENT AND MANAGEMENT:** Equipment requirement in construction industry– Heavy earth moving equipment: Bulldozer, scrapers, loaders, excavator, shovels, and cranes– Compaction equipment– Grading equipment– Aggregate production equipment– Asphalt mixing plant– Asphalt laying equipment– Hauling equipment– Concrete mixing equipment– Material handling devices– Pneumatic equipment–Bridge construction equipment– Drilling and blasting equipment– Pumping and dewatering equipment.  **UNIT – IV**  **INSPECTION:** Need for inspection and quality control– Principles of inspection–Enforcement of specifications –Stages of inspection and quality control.  **QUALITY CONTROL:** Ethical Audit: Introduction – Aspects of project realization – Ethical audit procedures – The decision makers – Variety of interests – Formulation of briefs –The audit statement– The audit reviews.  **UNIT – V**  **SAFETY AND RISK:** Introduction – Safety and risk – Concept and importance of safety – Types of risk – Safety and engineers – Safety measures in construction works – Design for safety – Risk benefit analysis – Accidents.  **ORGANISING CONSTRUCTION:** Principles of organization– Communication – Leadership and human relations– Types of organization– Organization for a construction firm– Temporary services– Job layout**.**  **UNIT – VI**  **CONSTRUCTION LABOUR**: Status of construction labour - Wages of construction workers – Trade unions connected with construction industry – Trade unions act, 1926 – Labour welfare fund act, 1965 – Payment of wages act – Minimum wages act, 1948 – Workmen’s compensation act, 1923 – Contract labour act, 1970. | |
| **Textbooks**  **and References** | **TEXTBOOKS:**   * + - 1. P.S. Gahlot and B.M. Dhir, *Construction Planning and Management*, New age International Publishers, 2nd edition, 2018.       2. S.C. Sharma, *Construction Equipment andManagement*, Khanna publishers, 3rd Edition, 2019.       3. B.L Gupta and Amit Gupta, *Construction Management and Machinery*,Standard Publishers Distributors, 2nd Edition, 2005.   **REFERENCE BOOKS:**   1. S.Seetharaman,*Construction Engineering and Management*, Umesh publications, 4th edition, 2008. 2. Haripal Singh,*Construction Management and Accounts*,Tata McGraw-Hill Publishing Company Limited, 5th edition, 2016. 3. Dr.B.C. Punmia, K. K. Khandelwal, *Project Planning and control with Pert and CPM*, Laxmi Publications,4th Edition,2012. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 2 | - | 2 | - |
| **CO3** | 2 | - | - | - | 1 | - | - | - | - | - | - | 1 | 2 | 1 | - |
| **CO4** | 2 | - | - | - | - | - | - | - | - | - | 1 | - | - | 2 | 2 |
| **CO5** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 1 |
| **CO6** | 2 | - | 2 | - | - | 2 | 1 | - | - | - | 1 | - | - | 1 | 2 |

**20CE41EB – AIR AND NOISE POLLUTION CONTROL**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits:** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Discuss the concepts of air pollution and assess the sources. |
| CO2 | Estimate the effects of air pollutants on human beings, materials and vegetation. |
| CO3 | Estimate the quantity of air pollution. |
| CO4 | Develop the control technologies for particulate pollutants and to Relate the fundamental concept of air quality management. |
| CO5 | Discuss the concepts of sound, noise and characteristics of noise. |
| CO6 | Measure the noise and to develop control measures of noise pollution |
| **Course**  **Content** | **UNIT I**  **AIR POLLUTION:** Definition of Air Pollution - Sources & Classification, Source inventory of Air Pollutants - Air Quality and Emission standards - Sampling of Pollutants in ambient air - Stack sampling.  **UNIT II**  **EFFECTS OF AIR POLLUTANTS:** Effects of air pollution on human beings, materials, vegetation, animals – global warming – ozone layer depletion – Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.  **UNIT III**  **METEOROLOGY AND AIR POLLUTION:**Elements of atmosphere- Factors influencing air pollution, Wind rose, Mixing Depths, Lapse rates and dispersion - Atmospheric stability, Plume rise and dispersion.  **UNIT IV**  **CONTROL OF PARTICULATE POLLUTANTS:** Particle size distribution - Control mechanism - Dust removal equipment –working principle and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters and Electro Static Precipitator.  **AIR QUALITY MANAGEMENT:** Air quality standards – Air quality monitoring – Preventive measures – Zoning – Town planning regulation of new industries – Legislation and enforcement.  **UNIT V**  **NOISE POLLUTION:** Basics of acoustics and specification of sound; sound power, sound intensityand sound pressure levels; Sources of Noise, typical range of noiselevels, types of noise pollution, Characteristics of noise, Effects of noise on the human health, Reactions to noise, psychologicaleffects.  **UNITVI**  **MEASUREMENT OF NOISE:** Assessment and Evaluation,Frequency sensitivity and equal loudness characteristics, Vibration – Measurement - Measuring Noise at workplace and community levels.  **NOISE CONTROL AND ABATEMENT MEASURES:** Noise control at the source, Source-Path-ReceiverConcept, Control of Noise Source by Design and Redress, Noise controlin the transmission path, Acoustical Separation, Physical Barriers, Isolators and Silencers,Protecting the receiver, Equipment and Shelters | |
| **Textbooks**  **and**  **References** | **TEXT BOOKS:**   1. D. Anjaneyulu, *Air Pollution and Control Technologies*, Allied Publishers, 2nd edition, reprint in 2020. 2. M.N. Rao, and H. V. N. Rao, *Air Pollution Control*, Tata-McGraw-Hill Publication, 1st edition, 2017. 3. S.C. Bhatia, *Noise Pollution and its control,*Atlantic Publication, 2007.   **REFERENCES**   1. W. L. Heumann, *Industrial Air Pollution Control Systems*, McGraw-Hill, 1997. 2. S. P Mahajan, *Pollution Control in Process Industries*, Tata McGraw-Hill Publishing Company, 1991. 3. S.W Peavy, D.R. Rowe and G. Tchobanoglous, *Environmental Engineering*, McGraw Hill, 1985. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | - | 1 | - | 3 | - | - | - | - | - | - | - | 1 | - |
| **CO2** | 2 | 1 | - | 1 | 1 | 3 | - | 1 | 2 | - | - | 1 | - | 2 | 1 |
| **CO3** | 3 | 3 | - | 1 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | - |
| **CO4** | 2 | 2 | 3 | 3 | 3 | 1 | 2 | - | - | - | 2 | 1 | - | 2 | 1 |
| **CO5** | 1 | 1 | - | - | - | 1 | - | - | - | - | - | 1 | - | 1 | 1 |
| **CO6** | 2 | 2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 2 | - | 2 | 1 |

**20CE41EC – GROUND IMPROVEMENT TECHNIQUES**

**(Civil Engineering)**

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| **Course Category** | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Geo Technical Engineering- II | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course**  **Outcomes** | CO1 | Outline the problematic soils and suitability of ground improvement techniques |
| CO2 | Comprehend various mechanical densification methods of soils. |
| CO3 | Understand dewatering methods and Evaluate the preloading technique along with construction of different types of vertical drains for accelerating consolidation. |
| CO4 | Apply the grouting techniques under different conditions. |
| CO5 | Analyze the design procedure for reinforced earth wall |
| CO6 | Assess the application geotextiles in various fields and understand the soil confinement systems. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION:** Need for Ground Improvement – Different types of problematic soils – Emerging trends in ground Improvement – classification of ground improvement techniques – factors affecting the selection of ground improvement techniques – Suitability, feasibility and durability of ground improvement techniques  **UNIT – II**  **METHODS OF STABILIZATION:**introduction – requirements of soil stabilization – mechanical stabilization – Portland cement stabilization – Bituminous stabilization – chemical stabilization – construction methods.  **UNIT – III**  **HYDRAULIC MODIFICATION:** Introduction **–** filter requirements – ground water and seepage control – methods of dewatering – open sumps and ditches, wellpoint systems , deep-well drainage, vacuum dewatering systems and dewatering by Electro-osmosis – Design steps for dewatering systems – Drains – open drains and closed drains – general principle, design of vertical drains, types and construction of vertical drains – efficiency of vertical drains and applications.  **UNIT – IV**  **GROUTING AND INJECTION:** Introduction – aspects of grouting – Different varieties of grout materials - grouting procedure – Grouting under difficult conditions.  **UNIT – V**  **REINFORCED EARTH:**Introduction – mechanism of reinforced soil - components – advantages of reinforced earth structures and other applications of soil reinforcement – procedure for the design of reinforced earth wall  **UNIT – VI**  **GEOTEXTILES**: Introduction – advantages of geotextiles – functions of geotextiles – use of geotextiles in earth dam construction, road works, railway works, erosion control and bearing capacity improvement – storage, handling and placement of geotextiles.  **SOIL CONFINEMENT SYSTEMS**: Concept of confinement, Gabion walls - function, application, advantage - Crib walls, Sand bags, Evergreen systems and fabric form work | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Dr. P. Purushothama raj, *Ground improvement techniques*, Laxmi Publications, 2nd edition, 2016. 2. Koerner, R. M, *Designing with Geo-synthetics,* Prentice Hall Inc. 2005. 3. G L Sivakumar Babu, *An introduction to soil reinforcement and geosynthetics*, Universities press, 1st edition, 2019.   **REFERENCE BOOKS:**   1. Manfred R. Haussmann, *Engineering principles of ground modification,* Pearson Education Inc. New Delhi, 2008. 2. B.C. Punmia, A. K. Jain & A. K. Jain, *Soil Mechanics and Foundation Engineering*, Laksmi publications, 17th edition, 2017. 3. B. M. Das, *Principles of Geotechnical Engineering*, Cengage learning, 9th edition, 2017. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | 1 | - | 1 | 2 | 1 | - | 2 | - | - | - | - | 1 | - | 2 | 2 |
| **CO 2** | 1 | 2 | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 2 | 2 |
| **CO 3** | 2 | 2 | 2 | 1 | 1 | - | 1 | - | - | - | - | 2 | - | 2 | 2 |
| **CO 4** | 2 | - | - | 1 | 2 | - | 1 | - | - | - | - | - | - | 2 | 2 |
| **CO 5** | 2 | 2 | 2 | 2 | 1 | - | 1 | - | - | - | - | 1 | - | 2 | 2 |
| **CO 6** | 2 | 1 | 1 | 1 | 1 | - | 2 | - | - | - | - | 1 | - | 2 | 2 |

**20CE41SC - COMPREHENSIVE DESIGN LABORATORY**

**(Civil Engineering)**

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| **Course Category** | Skill Oriented | **Credits** | 2 |
| **Course Type** | Practical | **Lecture – Tutorial –Practical** | 0-0-4 |
| **Prerequisite** | Strength of Materials, EDRCS, STAAD Lab | **Sessional Evaluation** | 40 |
| **Semester End Exam. Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Carryout analysis and design of Bunker |
| CO2 | Analyze and design silos |
| CO3 | Carryout analysis and design of overhead water tank |
| CO4 | Analyze and design of intz tank |
| CO5 | Carryout analyze and design of transmission tower |
| CO6 | Analysis and design of telecommunication tower |
| **Course Content** | 1. Analysis and design of Bunker (Square/ Rectangular/Circular). 2. Analysis and design of silos. 3. Analysis and design of overhead water tank. 4. Analysis and design of intz tank. 5. Analysis and design of transmission tower. 6. Analysis and design of telecommunication tower. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| **CO2** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| **CO4** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| **CO6** | 3 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | - | 3 | 3 | 2 | 3 |

**N.B.K.R. INSTITUTE OF SCIENCE &TECHNOLOGY :: VIDYANAGAR**

*(AUTONOMOUS)*

**CIVIL ENGINEERING**

**SCHEME OF INSTRUCTION AND EVALUATION**

(With effect from the batch admitted in the academic year 2020-2021)

**IV YEAR OF FOUR YEAR B.TECH. DEGREE COURSE – II SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| S.NO. | Course  Code | Course Title | Contact Hours/  Week | | | Credits | Evaluation | | | | | | | | | | | | | | |
| Sessional  Test-I | | | | | Sessional  Test-II | | | | | Total Sessional Marks (Max. 80) | | Semester  End Examination | | Max.  Total Marks |
| **THEORY** | L | T | P | Test-I  (2 hrs.) | | Assignment-I | Max.  Marks | | Test-II  (2 hrs.) | | Assignment-II | | Max  Marks | Duration  In Hours | Max.  Marks |
|  | | **MAJOR PROJECT** | | | | | | | | | | | | | | | | | | | |
| 1 | 20CE42PR | Project Work and Internship | 0 | 0 | 3 | 12 | - | - | | | - | | - | | - | - | | Continuous assessment  and seminar (40 marks) | - | 60 | 100 |
|  | | **TOTAL** |  |  |  | **12** |  | | | | | | | | | | | | | | |

**List of Open electives to be offered by CED:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No** | **Course Code** | **Course Name** | **S.No** | **Course Code** | **Course Name** |
| 1. | 20CEXXO1 | Remote Sensing | 5. | 20CEXXO5 | Basics of Transportation Engineering |
| 2. | 20CEXXO2 | Building Technology | 6. | 20CEXXO6 | Water Resources Management |
| 3. | 20CEXXO3 | Environmental Impact and Management | 7. | 20CEXXO7 | Cost Effective Housing Techniques |
| 4. | 20CEXXO4 | Disaster Management | 8. | 20CEXXO8 | Environmental Pollution and Control |

**N.B.K.R INSTITUTE OF SCIENCE &TECHNOLOGY: VIDYANAGAR**

(Autonomous)

**Department of Civil Engineering**

**(With effect from the batch admitted in the academic year 2020-2021)**

**&**

**B.Tech (Lateral entry scheme)**

**(For the batches admitted from the academic year 2021-22)**

**List of Open electives for 2019-20 admitted batch to be offered by CED:**

|  |  |  |
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| **S.No** | **Course Code** | **Course Name** |
| 1 | 20CEXXO1 | Remote Sensing |
| 2 | 20CEXXO2 | Building Technology |
| 3 | 20CEXXO3 | Environmental Impact and Management |
| 4 | 20CEXXO4 | Disaster Management |
| 5. | 20CEXXO5 | Basics of Transportation Engineering |
| 6. | 20CEXXO6 | Water Resources Management |
| 7. | 20CEXXO7 | Cost Effective Housing Techniques |
| 8. | 20CEXXO8 | Environmental Pollution and Control |

**20CEXXO1 –REMOTE SENSING**

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| --- | --- | --- | --- |
| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand remote sensing terms and concepts of the physical applications of such a system. |
| CO2 | Understand the different technical aspects of a remote sensing network with special emphasis on India remote sensing technology. |
| CO3 | Compare different types of data obtained from a remote sensing network with tools specifically designed for the purpose. |
| CO4 | Understand about various methods of corrections applied to data to ensure maximum credibility and accountability to the data collected. |
| CO5 | Apply remote sensing in agriculture and forest resources management. |
| CO6 | Apply remote sensing in Land use/Land cover and coastal zone management. |
| **Course**  **Content** | **UNIT – I**  **BASIC CONCEPTS OF REMOTE SENSING:**Definition of Remote Sensing; History of Remote Sensing and Indian Space Program;Remote Sensing Process;Source of energy – Concept of energy, Electromagnetic radiation, Electromagnetic Spectrum; Interaction of electromagnetic radiation with atmosphere, Vegetation, soil and water – Absorption, Scattering, Refraction, Reflection;Spectral Reflectance Curve; Atmospheric windows; Advantages and Limitations of Remote Sensing.  **UNIT – II**  **REMOTE SENSING SYSTEM:**Introduction; Types of Remote Sensing -Classification Based on Platform, Energy Source, Imaging Media, Regions of Electromagnetic Spectrum, Number of Bands; Characteristics of Images; Orbital Characteristics of Satellite; Remote Sensing Satellites; Definitions – Swath, Nadir, path, row, Orbital calendar.  **SENSORS CHARACTERISITICS:** Sensor Resolutions- Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution  **UNIT – III**  **VISUAL IMAGE INTERPRETATION:**Introduction; Information Extraction by Human and Computer; Remote Sensing Data Products; Image Interpretation; Elements of Visual Image Interpretation -Location, Size, Shape, Shadow, Tone, Colour, Texture, Pattern, Height and Depth, Site, Situation, and Association; Interpretation Keys  **UNIT – IV**  **DIGITAL IMAGE PROCESSING:**Introduction; Categorization of Image Processing; Image Processing Systems; Data Formats of Digital Image; Pre-processing - Radiometric Correction of Remotely Sensed Data, Geometric Correction of Remotely Sensed Data, Miscellaneous Pre-processing; Image Enhancement - Image Reduction, Image Magnification, Colour Compositing, Transect Extraction, Contrast Enhancement; Filtering;  **UNIT – V**  **APPLICATIONS OF REMOTE SENSING FOR EARTH RESOURCES MANAGEMENT – I :**Agriculture – crop production forecasting, agricultural drought assessment, precision farming; Forestry – Type and density mapping, forest cover change, forest status in India;  **UNIT – VI**  **APPLICATIONS OF REMOTE SENSING FOR EARTH RESOURCES MANAGEMENT – II:**  Land cover/Land use mapping – Wastelands, Urban sprawl; Water Resources; Coastal Zone Management – Coastal zone ecosystem, Coastal regulation zone, integrated coastal zone management. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Bhatta B, *Remote sensing and GIS*, Oxford University Press, 3rd edition, 2021. 2. George Joseph, C Jeganathan, *Fundamentals of remote sensing*, Universities Press, 3nd Edition, 2018. 3. TsurgCharg, *Introduction to Geographic information system,* Tata McGraw Hill Education Private Limited. 2nd edition, 2014.   **REFERENCES:**   1. John R.Jensen, *Remote sensing of the environment– An earth resources perspective,* Pearson Education,2ndedition, 2014. 2. Peter ABurragh and Rachael McDonnnell,*Principals of Geo physical Information system*, Oxford Publications 2nd edition, 2004. 3. A. Kumar, *Basics of remote sensing & GIS,* Laxmi publications, 3rd edition, 2009. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO2** | - | 2 | 2 | - | - | - | 1 | - | - | 2 |  | 2 | 1 | 1 | 1 |
| **CO3** | 2 | - | 1 | - | 1 | - | 1 | - | - | - | - | - | 2 | 1 | 1 |
| **CO4** | - | 1 | - | 1 | - | - | - | - | - | 1 | - | - | 2 | 1 | 1 |
| **CO5** | 2 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | 2 | 1 | 1 |
| **CO6** | 2 | 1 | - | 2 | - | - | 2 | - | - | 2 | - | 1 | 2 | 1 | 1 |

**20CEXXO2– BUILDING TECHNOLOGY**

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| **Course Category:** | Open Elective | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture - Tutorial - Practical:** | 3 - 0 - 0 |
| **Prerequisite:** | None | **Sessional Evaluation :**  **Univ. Exam Evaluation:**  **Total Marks:** | 40  60  100 |

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| **Course Outcomes** | CO1 | Identify the factors to be considered in planning and construction of buildings and Plan a building following the bye-law**s** |
| CO2 | Understand various types of stones and methods of manufacturing of bricks and tiles. |
| CO3 | Identify the importance of ingredients of lime, cement and concrete. |
| CO4 | Provide scope of smart construction materials alternative for cement and also be able to understand various types of masonry construction. |
| CO5 | Evaluate various building components and their various types. |
| CO6 | Understand the techniques and importance of damp proofing and finishing works of the building. |
| **Course**  **Content** | **UNIT – I**  **Fundamentals requirements of buildings:** Terms used in building drawing as per National Building Code (N.B.C) – Factors affecting in selection of site – Functional requirements of a residential building – Minimum size requirements as per N.B.C. – Standard sizes of Door – Windows and ventilators.  Basic building elements, Principles of planning. Relevant building by-laws (N.B.C) & Municipal, orientation of buildings – Provision of rainwater harvesting – provision for physically handicapped facilities.  **UNIT – II**  **Stones:** Properties of building stones – Relation to their structural requirements – Classification of stones.  **Bricks:** Composition of good brick earth, various types of bricks.  **Tile**: Characteristics of good tile and types of tiles.  **UNIT – III**  **Lime:** Various ingredients of lime –Constituents of lime stone – Classification of lime.  **Cement:** Portland cement – Chemical Composition – Hydration, setting and fineness of cement – Various types of cement and their properties – Various field and laboratory tests for Cement – Various ingredients of cement concrete and their importance – Various tests for concrete.  **UNIT – IV**  **Wood:**Introduction– Classification of timber (I.S.: 399) – Characteristics of good timber– Defects in timber – Types and Uses of Ply-wood and Engineered wood.–Uses of materialslike Aluminium, Gypsum, Glass and Bituminous materials.  **Masonry:** Types of masonry – English and Flemish bonds – Cavity, partition and shear walls.  **Smart Construction Materials:** Overview and use of Fly ash, Silica fume, Carbon fibers, Self-healing materials and Fiber reinforced plastics – Benefits of Nano-technology in construction industry.  **UNIT – V**  **Building Components:** Lintels – Arches – Vaults – Stair cases.  **Floors:** Different types of floors – Concrete – Mosaic and Terrazzo floors.  **Roofs:** Pitched roofs – Lean to roof – Coupled Roofs – Trussed roofs – King and Queen post Trusses – Flat roofs – R.C.C Roofs–Doors and windows.  **UNIT – VI**  **Building Finishes:** Damp Proofing and water proofing materials and uses. Plastering – Pointing – White washing and distempering.  **Paints:** Constituents of paint – Types of paints –Painting of new/old wood – Varnish. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. S.C. Rangwala, *Engineering Materials*, Charotar publishing house, 43rd Edition, 2019. 2. B.C. Punmia, Arun K Jain, Ashok K Jain, *Building Construction*, Laxmi Publications, 11th Edition, 2016. 3. Dr. N. Kumara Swamy& A. KameswaraRao, *Building Planning and Drawing*, Charotar publishing house, 9th Edition, 2019.   **REFERENCE BOOKS:**   1. S.K. Duggal, *Building Materials*, New age international, 4th Edition, 2012. 2. Sushil Kumar, *Building Construction*, Standard Publisher, 19th Edition 2020. 3. S. Mahaboob Basha, *Building Materials, Construction and Planning*, , Anuradha Publications, 2011. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 1 | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | - | - |
| **CO2** | 1 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | 1 | - | - | - |
| **CO3** | 1 | 1 | 2 | - | 2 | - | - | - | - | - | - | 1 | - | - | - |
| **CO4** | 2 | - | 2 | - | 1 | 1 | 1 | - | - | - | 1 | 2 | - | - | - |
| **CO5** | 2 | - | 2 | - | 2 | 1 | - | - | - | - | 1 | 1 | - | - | - |
| **CO6** | 1 | 2 | 1 | - | 2 | 2 | - | 2 | - | 2 | - | - | 1 | 1 | 1 |

**20CEXXO3 – ENVIRONMENTAL IMPACT AND MANAGEMENT**

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| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Carry out scoping and screening of developmental projects for environmental and social assessments. |
| CO2 | Explain different methodologies for environmental impact prediction and assessment. |
| CO3 | Explain impact of development activities and land use. |
| CO4 | Plan Environmental impact assessments and environmental management plans. |
| CO5 | Evaluate mitigation and impacts |
| CO6 | Know the problems related to environment due to industries. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION TO EIA:** Environmental ethics – Need of EIA for Engineering projects – Classification of environmental parameters – Purposes of EIA – Goals of EIA.  **UNIT – II**  **EIA METHODOLOGIES:** Introduction – Criteria for the selection of EIA methodology – Categorization of methodologies – Matrix methods – Network method – Environmental Media quality index method – Cost / benefit analysis.  **UNIT – III**  **IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE:** Introduction and methodology for the assessment of soil and ground water – delineation of study area – identification of activities – Procurement of relevant soil quality – Impact prediction – Assessment of impacts.  **UNIT – IV**  **METHODOLOGY FOR THE ASSESMENT OF IMPACTS OF SOME ATTRIBUTES:** Surface water – Air and biological environment – Methodology and generalized approach for the assessment of impact of development activities on vegetation and wildlife – Environmental impact of deforestation and incorporation of mitigation measures.  **UNIT – V**  **MITIGATION AND IMPACT ASSESMENT:** EIA process and mitigation, elements of mitigation, approaches to mitigation, typical mitigation measures.  **UNIT – VI**  **CASE STUDIES:** Environmental impact of large scale water resources projects – environmental impact of thermal and nuclear power plants and on oil refineries. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Anji reddy Maredy, *Environmental Impact Assessment*, Butterworth-Heinemann, 2017. 2. R.R. Barthwal, *Environmental Impact Assessment* New Age International Private Limited; 2nd edition, 2012. 3. Shukla, S.K. and Srivastava, P.R., *Concepts in Environmental Impact Analysis*, Commonwealth Publishers, 1992.   **REFERENCES:**   1. Dr. N.S. Raman, Dr. Y.R.M Rao, Environmental Impact Assessment, Laxmi Publications Pvt. Ltd., 2017. 2. R.L Canter, *Environmental Impact Assessment*, McGraw Hill Inc., 1977. 3. John G. Rau and David C Hooten, *Environmental Impact Analysis Handbook*, McGraw Hill higher education, 1980. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | - | - | 1 | - | 2 | - | 1 | - | - | 1 | - | - | - |
| **CO2** | 2 | 1 | - | - | - | 2 | 1 | 1 | 1 | - | - | - | - | - | - |
| **CO3** | 1 | 1 | - | - | - | 2 | 2 | 1 | - | 2 | - | - | - | - | - |
| **CO4** | 2 | 1 | 2 | 1 | 2 | 1 | - | 2 | - | - | - | - | - | - | - |
| **CO5** | 1 | - | - | - | - | - | 2 | 1 | 2 | - | 1 | 1 | - | - | - |
| **CO6** | 2 | 2 | - | 1 | - | - | 2 | - | 2 | - | 1 | 2 | - | - | - |

**20CEXXO4 –DISASTER MANAGEMENT**

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| **Course Category:** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Hazards and disasters and different approaches to disaster and their mitigation. |
| CO2 | types of disasters, exogenous disasters and their effects. |
| CO3 | Endogenous disasters and their effects. |
| CO4 | Man induced disasters and their effects. |
| CO5 | Disaster management through engineering applications. |
| CO6 | Case study on disasters in national and international level. |
| **Course**  **Content** | **UNIT-I**  **ENVIRONMENTAL HAZARDS & DISASTERS:** Meaning of Environmental hazards – Environmental Disasters Environmental stress – Concept of Environmental Hazards – Different approaches and relation with human Ecology - Landscape Approach –[Ecosystem](http://www.indiastudychannel.com/resources/55702-Syllabus-DISASTER-MANAGEMENT.aspx) Approach – Perception approach – Human ecology & its application in geographical researches.  **UNIT –II**  **TYPES OF ENVIRONMENTAL HAZARDS & DISASTERS:** Natural hazards and Disasters – Man induced hazards & Disasters – Natural Hazards – Planetary Hazards/ Disasters – Extra Planetary Hazards/ disasters Planetary Hazards – Endogenous Hazards – Exogenous Hazards Endogenous Hazards.  Volcanic Eruption – Earthquakes – Landslides – Volcanic Hazards/ Disasters. Causes and distribution of Volcanoes – Environmental impacts of volcanic eruptions – Earthquake Hazards/ Disasters – Causes of Earthquakes – Distribution of earthquakes – Hazardous effects of earthquakes – Human adjustment – Perception & mitigation of earthquake.  **UNIT –III**  **EXOGENOUS HAZARDS AND DISASTERS**: Infrequent events – Cumulative atmospheric hazards/ disasters Infrequent events – Cyclones – Lightning – Hailstorms.  **CYCLONES:** Tropical cyclones & Local storms – Destruction by tropical cyclones & local storms – Causes – Distribution human adjustment – Perception & mitigation)Cumulative atmospheric hazards and disasters – Floods – Droughts – Cold waves – Heat waves. Floods: – Causes of floods – Flood control measures (Human adjustment – Perception & mitigation) – Droughts: – Impacts of droughts – Drought control measures – Extra Planetary Hazards/ Disasters.  **UNIT –IV**  **SOIL EROSION**: Mechanics & forms of Soil Erosion – Factors and causes of Soil Erosion – Conservation measures of Soil Erosion. Chemical hazards/ disasters – Release of toxic chemicals – nuclear explosion – Sedimentation processes. Sedimentation processes: – Global Sedimentation problems – Regional Sedimentation problems – Sedimentation and Environmental problems – Corrective measures of Erosion and Sedimentation. Biological hazards/ disasters: – Population Explosion.  **UNIT –V**  **EMERGING APPROACHES IN DISASTER MANAGEMENT:**  Three Stages   1. Pre- disaster stage (preparedness). 2. Emergency Stage. 3. Post Disaster stage-Rehabilitation.   **UNIT – VI**  **CASE STUDIES:**   1. Bhuj Earthquake – Gujarat 2001. 2. Indian Ocean earthquake and Tsunami, 2004. 3. Chernobyl disaster, Ukraine 1986. 4. Bhopal Gas tragedy, 1984. 5. Kerala Floods, 2018. | |

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| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Tushar Bhattacharya,*Disaster Science and Management*, McGraw hill Publications, 1st Edition, 2017. 2. Donald Hyndman and David Hyndman,*Natural Hazards and Disasters*, Brooks/Cole, 5th Edition, 2016. 3. Rajib Shah, RR Krishna Murthy,*Disaster Management: Global Problems and Local Solutions*, CRC Press, 1st Edition, 2009.   **REFERENCES:**   1. R B Singh, *Natural Hazards and Disaster Management: Vulnerability and Mitigation,* Rawat Publications, Reprint edition, 2006. 2. [Pardeep and Sahni](http://www.flipkart.com/author/pardeep-sahni/), *Disaster Mitigation: Experiences and Reflections*, Prentice Hall India Learning Private Limited, New title edition, 2001. 3. H.K. Gupta, *Disaster Management*, Universities Press, India, 2003. |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | - | - | - | - | - | 2 | - | 1 | - | - | 1 | - | - | - |
| **CO2** | 1 | - | - | - | - | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - |
| **CO3** | - | - | - | - | - | 2 | 2 | 1 | - | 2 | - | - | 1 | 1 | - |
| **CO4** | 1 | - | - | - | - | 1 | - | 2 | - | - | - | - | - | 1 | - |
| **CO5** | 1 | 1 | - | - | - | - | 2 | 1 | 2 | - | 1 | 1 | - | 1 | - |
| **CO6** | - | - | - | - | - | - | 2 | - | 2 | - | 1 | 2 | - | 1 | - |

**20CEXXO5– BASICS OF TRANSPORTATION ENGINEERING**

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| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand various types of roads and road patterns. |
| CO2 | Understand concepts of highway geometric design. |
| CO3 | Understand traffic signs and markings. |
| CO4 | Understand basics permanent way and its components. |
| CO5 | Understand basics of air transportation. |
| CO6 | Understand components of airport. |
| **Course**  **Content** | **UNIT – I**  **IMPORTANCE OF TRANSPORTATION** modes of transportation, characteristics of road transport, methods of classification of roads, road patterns. Requirements of ideal alignment, factors controlling alignment, master plan and its phasing. Problems on saturating system concept.  **UNIT II**  **HIGHWAY GEOMETRIC DESIGN**: design controls and criteria, highway cross- section elements- pavement surface characteristics, camber, width of pavement, kerbs, road margins, right of way, formation width, site distance- stopping sight distance, PIEV theory, analysis of SSD, over taking sight distance and its analysis. Design of a horizontal alignment- horizontal curves- effect of centrifugal force at horizontal curve, derivation of super elevation, extra widening  **UNIT III**  **TRAFFIC SIGNS**: Importance-Need for international standardization-Types of traffic signs-Warning signs-Prohibitory signs-Mandatory signs-Informatory signs-Indication signs-Direction signs, advance direction signs and place identification signs-Location height and maintenance of traffic signs  **ROAD MARKINGS**: Function-Types of road markings, material and color, centre lines, traffic lane lines, pedestrian crossings.  **UNIT IV**  **BASICS OF RAILWAY ENGINEERING:** Permanent way and its components, gauges, types of rails, functions of rails, types of sleepers, functions of sleepers, ballast, types of ballast, List of classification of stations, yards- types only.  **UNIT V**  **BASICS OF AIRPORT ENGINEERING:** Introduction to air transportation, characteristics of air transport, components of airports and functions- terminal area and landing area, parts of aircraft, classification of airports, different kinds of flights, factors affecting site selection for an airport, Airport terminal building, patterns of parking, aprons, hangers.  **UNIT VI**  **BASICS OF HARBOUR ENGINEERING:**Water transportation**-**Importance**,** types-inland and ocean transportation**,** Tides, Wind and waves – Currents, uses and effects of tides at harbor, Classification of harbour’s and ports, Site selection, requirements of good port, Loading and unloading facilities of harbour-Quays-wharves- piers- dolphins- Jetties – Fenders – Aprons, Transit sheds - Ware houses , Breakwaters(List of break waters only). | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. Khanna, S.K. Justo C.E.G& veeraraghavulu,“*Highway Engineering*” Nem chand&bros,10th edition, 2018. 2. S.C.Saxena & S.P.Arora, “*A Text Book of Railway Engineering*” Dhanpat Rai publications, 7th edition, 2015. 3. S.K.Khanna, M.G.Arora & S.S.Jain, “*Airport Planning and Design*” Nem chad brothers, 2nd edition.,1999. 4. R. Srinivasan, “*Docks and Harbour Engineering*” Charotar publishing hose Pvt. Ltd, 29th edition, 2018.   **REFERENCE BOOKS:**   1. C.Venkatramaiah “*Transportation Engineering Vol I& II*” Universities Press (India) Private Ltd, 1st edition, 2016. 2. Dr. L.R.Kadiyali, “*Principles and Practice of Highway Engineering*” Khanna publishers, 7th edition, 2019. 3. S.C.Rangwala , *A Text Book of Railway Engineering* , Chartor publishing house, 26th edition, 2016. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | 1 | 1 | 2 | 3 | 1 | - | 1 | 2 | 1 | - | - | - | - |
| **CO2** | 3 | 2 | 2 | 3 | 2 | - | 1 | - | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 1 | 3 | - | 1 | 1 | - | - | - | 1 | 2 | 1 | 2 | - | 1 | 1 |
| **CO4** | 1 | - | 2 | 2 | 3 | - | 1 | - | 1 | 1 | 2 | 1 | - | - | - |
| **CO5** | 2 | 3 | 2 | 1 | 2 | - | 1 | 2 | - | 3 | 2 | 1 | - | - | - |
| **CO6** | 1 | - | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | - |

**20CEXXO6 –WATER RESOURCES MANAGEMENT**

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| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0- 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the nature of groundwater and its role in the water cycle. |
| CO2 | Apply the concept of Darcy’s law for estimating discharge and understand their characteristics and classifications. |
| CO3 | Familiar with the technology of water wells and groundwater monitoring. |
| CO4 | Familiar with the technology to investigation the surface and subsurface water. |
| CO5 | Understand the importance of artificial recharge and employ the artificial ground water recharge techniques. |
| CO6 | Identify the saline water intrusion locations. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION:** Ground water utilization and historical background – Ground water in hydrologic cycle. Ground water budget and ground water level fluctuations and environmental influence.  **UNIT – II**  **OCCURRENCE AND MOVEMENT OF GROUND WATER**: Origin & age of ground water – Rock properties affecting groundwater– Groundwater column, zones of aeration & saturation, aquifers and their characteristics and classification –Groundwater basins & springs – Darcy’s Law – Permeability & its determination –Dupuit’s assumptions.  **UNIT – III**  **ADVANCED WELL HYDRAULICS:** Steady and unsteady uniformradial flow to a well in a confined, unconfinedand leaky aquifer – Well flow near aquifer boundaries for special conditions, partially penetrating.  **UNIT – IV**  **SURFACE SUB-SURFACE INVESTIGATION OF GROUND WATER:** Geological – Geophysical Exploration– Remote Sensing – Electric Resistivity –Seismic refraction based methods for surface investigation of ground water– Test drilling & ground water level measurement– Sub-surface ground water investigation through geophysical – Resistivity.  **UNIT – V**  **ARTIFICIAL GROUND WATER RECHARGE:** Concept and methods of artificial ground water recharge– Recharge mounds and induced recharge – Wastewater recharge for reuse – Water spreading.  **UNIT – VI**  **SALINE WATER INTRUSION IN AQUIFERS:** Ghyben-Herzberg relation between fresh & saline waters – Shape & structure of the fresh and saline water interface – Upcoming of saline water – Fresh-saline water relations on oceanic islands – Seawater intrusion in karst terrains – Saline water intrusion control. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. David K. Todd, Larry W. Mays,*Groundwater hydrology*, Wiley India Pvt Ltd., 3rd edition, 2011. 2. H. M. Raghunath, *Ground Water*, Newage publishers, 3rd edition, 2007. 3. R. N. Saxena and D.C. Gupta, *Elements of Hydrology and Groundwater*, PHI Learning, 3rd edition, 2017.   **REFERENCE BOOKS:**   1. K.Subramanya, *Engineering Hydrology*, Tata McGraw Hill Publishing Company, 4th edition, 2019. 2. K. Karanth, Ground Water Assessment, Development and Management, McGraw Hill Education, 2nd edition, 2017. 3. Bhagu R. Chahar, *Groundwater Hydrology*, McGraw Hill Education, 1st edition, 2017. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 1 | 2 | - | - | 2 | - | - | - | - | 1 | - | - | - |
| **CO2** | - | 3 | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| **CO3** | - | - | 2 | - | - | - | 1 | - | - | 2 | - | 2 | - | 1 | - |
| **CO4** | 2 | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 1 | - |
| **CO6** | - | 2 | - | - | 1 | - | 2 | - | - | 2 | - | 1 | - | 1 | - |

**20CEXXO7 – COST EFFECTIVE HOUSING TECHNIQUES**

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| **Course Category** | Open elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture-Tutorial-Practical** | 3-0-0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **External Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Acquire basic knowledge in housing. |
| CO2 | Acquire basic knowledge in housing programmes. |
| CO3 | Able to design, evaluation, construction and financing of housing projects. |
| CO4 | Familiar with the innovative construction materials. |
| CO5 | Be in position to adopt the suitable techniques in rural areas. |
| CO6 | Be in position to adopt the suitable techniques in disaster prone areas by using locally available materials. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION TO HOUSING:** Definition of Basic Terms: House – Home – Household – Apartments – Multi storied Buildings – Special Buildings – Objectives and strategies of national housing policies including slum housing policy – Principle of sustainable housing – Integrated approach on arriving holding capacity and density norms – All basic infrastructure consideration – Institutions for housing at national – State and Local levels.  **UNIT – II**  **HOUSING PROGRAMMES:** Basic Concepts – Contents and standards for housing programmes – Sites and services – Neighborhoods – Plotted land development programs – Open development plots – Apartments – Gated communities – Townships – Rental housing – Co-operative housing – Slum housing programmes – Slum improvement – Slum redevelopment relocation.  Use of GIS and MIS in Slum Housing Projects – Role of public housing agencies –Private sector in supply – Quality – Infrastructure and pricing – Role of Non-Government Organizations in slum housing.  **UNIT – III**  **Development and adoption of lowcost Housingtechnology:**Introduction – Adoption of innovative cost effective construction techniques – Adoption of precast elements – Adopting of total prefabrication of mass housing in India – General remarks on pre-cast rooting/flooring systems – Economical wall system – Single brick thick loading bearing wall – 19cm thick load bearing masonry walls – Half brick thick load bearing wall – Fly ash gypsum thick for masonry – Stone block masonry – Adoption of precast R.C. plank and join system for roof/floor in the building.  **UNIT – IV**  **Alternative building materials for low cost housing and Infrastructure SERVICES:** Introduction – Substitute for scarce materials – Ferrocement – Gypsum boards – Timber substitutions – Industrial wastes – Agricultural wastes – Low cost infrastructure services: Introduce – Present status – Technological options – Low cost sanitation – Domestic wall – Water supply – Energy.  **UNIT – V**  **RURAL HOUSING:** Introduction traditional practice of rural housing continuous – Mud housing technology – Mud Roofs – Characteristics of mud – Fire treatment for thatch roof – Soil stabilization – Rural housing programs.  **UNIT – VI**  **Housing in Disaster prone AREAS:** Introduction – Earthquake – Damages to houses – Traditional prone areas – Type of damages and railways of Non-engineered buildings – Repair and restore action of earthquake damaged non -engineered buildings recommendations for future constructions – Requirements of structural safety of thin pre-cost roofing units against earthquake forces – Status of R& D in earthquake strengthening measures – Floods – Cyclone – Future safety. | |
| **Textbooks**  **&**  **References** | **TEXTBOOKS:** G. C. Mathur, Low *Cost Housing in Developing Countries*, [Oxford & IBH Publishing Co. Pvt. Ltd.](https://librarysearch.nirmauni.ac.in/cgi-bin/koha/opac-search.pl?q=Provider:Oxford%20%26%20IBH%20Publishing%20Co.%20Pvt.%20Ltd.), 1993.  1. A. K. Lal, *Hand Book of Low Cost Housing,*New Age International Publishers, 1995. 2. Kiado- Rudhai. G,*Light weight concrete,*Publishing home of Hungarian Academy of Sciences, 1963. 3. **REFERENCES:** 4. A.G. Madhava Rao, D.S. RamaChandra Murthy &G.Annamalai,*Modern Trends In Housing In Developing Countries,* 1984*.* 5. Neville A.M. Pitman, *Properties of Concrete,* Publishing home of Hungarian Academy of Sciences, 1963. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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| **CO1** | 2 | 1 | 1 | - | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | - | - | 1 |
| **CO2** | - | 2 | 1 | 1 | 2 | 2 | 1 | 3 | - | 2 | 2 | 3 | - | - | 1 |
| **CO3** | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | - | 2 | 2 | 2 | 1 | 1 | 1 |
| **CO4** | - | 2 | 1 | 1 | 2 | 2 | 1 | 3 | - | 2 | 2 | 2 | - | 1 | 2 |
| **CO5** | - | 3 | 2 | 2 | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | 1 | - |
| **CO6** | - | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | - | 1 | - |

**20CEXXO8 - ENVIRONMENTAL POLLUTION AND CONTROL**

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| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial – Practical** | 3-0-0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the nature, significance and effects of pollution. |
| CO2 | Understand the effects of air pollution and various controlling parameters. |
| CO3 | Understand the effects of water pollution and various controlling parameters. |
| CO4 | Understand the various methods for solid and hazardous waste disposal. |
| CO5 | Understand the environmental legislation acts for industrial pollution control. |
| CO6 | Understanding the characteristics and effects of noise pollution. |
| **Course Content** | **UNIT – I**  **THE NATURE OF POLLUTION:**  Air pollution and its effects on living and non-living things. Water pollution and its effects on living and non-living things, solid wastes and land pollution.  **UNIT – II**  **AIR POLLUTION CONTROL:**  Influence of metereological parameters, physical principles, dry systems, fabric collectors, wet scrubbers, electrostatic precipitations, fume incineration tall sacks. Physical separation systems gravity setting chambers, inertial separators, cyclones, fabric collectors, wet scrubbers, electrostatic precipitators, fume incineration.  **UNIT – III**  **WATER POLLUTION CONTROL:**  Routine methods for removal of suspended and dissolved impurities, advance methods like chemical oxidation, membrane separation process, and biological process for removal of phosphorous and nitrogen. Land treatment, eutrophication control.  **UNIT – IV**  **SOLD WASTE MANAGEMENT:**  Quantities and characterizations of municipal solid wastes, recovery of materials and energy, sanitary land filling. Disposal of hazardous wastes.  **UNIT – V**  **ENVIRONMENTAL LEGISLATION AND INDUSTRIAL POLLUTION CONTROL:**  Legislation conserving water pollution air pollution and hazards wastes. Caste studies of pollution control in cement industries, paper, & pulp industries, brewing.  **UNIT – VI**  **NOISE POLLUTION CONTROL:** Basics of acoustics and specification of sound; sound power, sound intensityand sound pressure levels; Sources of Noise, typical range of noiselevels, types of noise pollution, Characteristics of noise, Effects of noise on the human health, Reactions to noise, psychologicaleffects. | |
| **Textbooks and Reference books** | **TEXT BOOKS:**   1. CS Rao, *Environmental Pollution Control Engineering*, New Age International Private Limited; 4th edition, October 2021. 2. [P. R. Trivedi](https://www.google.co.in/search?sa=X&biw=1366&bih=639&tbm=bks&tbm=bks&q=inauthor:%22P.+R.+Trivedi%22&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ9AgITTAD), [*Environmental Pollution and Control*](https://books.google.co.in/books?id=NxwNtk3aw54C&printsec=frontcover&dq=ENVIRONMENTAL+POLLUTION+AND+CONTROL&hl=en&sa=X&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ6AEISzAD), APH Publishing Corporation, December 2004. 3. [J. Jeffrey Peirce](https://www.google.co.in/search?sa=X&biw=1366&bih=639&tbm=bks&tbm=bks&q=inauthor:%22J.+Jeffrey+Peirce%22&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ9AgINzAA), ‎[P Aarne Vesilind](https://www.google.co.in/search?sa=X&biw=1366&bih=639&tbm=bks&tbm=bks&q=inauthor:%22P+Aarne+Vesilind%22&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ9AgIODAA), ‎[Ruth Weiner](https://www.google.co.in/search?sa=X&biw=1366&bih=639&tbm=bks&tbm=bks&q=inauthor:%22Ruth+Weiner%22&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ9AgIOTAA), [*Environmental Pollution and Control*](https://books.google.co.in/books?id=zxn3TgTOxggC&printsec=frontcover&dq=ENVIRONMENTAL+POLLUTION+AND+CONTROL&hl=en&sa=X&ved=0ahUKEwjrp9Dz8KbNAhUDrI8KHfytD2kQ6AEINTAA),  Butterworth-Heinemann publishers, 4th edition , January 1998.   **REFERENCE BOOKS:**   1. Howard Peavy, Donald Rowe, George Tchobanoglous, *Environmental Engineering*, McGraw Hill Education publishers, First edition, July 2017 2. S.C. Bhatia, *Noise Pollution and its control*, Atlantic Publication, 2007. 3. P.A Vesilind, J.J. Peirce, *Environmental pollution and control*, Butterworth-Heinemann publishers, 4thedition, November 1997. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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| **CO1** | - | 1 | - | - | - | 2 | 1 | - | - | - | - | 1 | - | 1 | - |
| **CO2** | 2 | 2 | 1 | 1 | 1 | 2 | 1 | - | - | - | - | 2 | - | 2 | 1 |
| **CO3** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | - | - | - | - | 2 | - | 2 | 1 |
| **CO4** | 1 | 2 | 1 | 1 | 2 | 2 | 1 | - | - | - | - | 2 | - | 2 | 1 |
| **CO5** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | - | - | - | - | 2 | - | 2 | 1 |
| **CO6** | - | 1 | - | - | 1 | 2 | 1 | - | - | - | - | 2 | - | 2 | 1 |

**List of MOOC'S Platforms**

1. [http://nptel.ac.in](http://nptel.ac.in/)
2. <https://swayam.gov.in/>