AURORA'S TECHNOLOGICAL AND RESEARCH INSTITUTE

(Approved by AICTE and Affiliated to JNTUH) (Accredited by NAAC with 'A' Grade)

Parvathapur, Uppal, Medipally (M), Medchal (D), Telangana, Hyderabad - 500 098

DEPARTMENT OF CIVIL ENGINEERING
COURSE OUTCOMES (COs)

B.Tech.1st Year I Semester R18 Syllabus Civil Engineering

CourseCode	CourseTitle/Name	CourseOutcomes
MA101BS	Mathematics-I	**At the end of this course, each student should be able to:** **CO1:** Write the matrix representation of a set of line are quations and to analyse the solution of the system of equations. **CO2:** Find the Eigen values and Eigenvectors. **CO3:** Reduce the quadratic form to canonical form using orthogonal transformations. **CO4:** Analyse the nature of sequence and series. **CO5:** Solve the applications on the mean value theorems. **CO6:** Evaluate the improper integrals using Beta and Gamma functions. **CO7:** Find the extreme values of functions of two Variables with/ without constraints.
PH102BS	Engineering Physics	**At the end of this course, each student should be able to:** **CO1:** The knowledge of Physics relevant to engineering is critical for converting ideas into technology. **CO2:** An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements. **CO3:** In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics.

		CO4: Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.
CS103ES	Programming for Problem Solving	**At the end of this course, each student should be able to:** **CO1:** To write algorithms and to draw flowcharts for solving problems. **CO2:**Toconvert the algorithms/flowcharts to C programs. **CO3:** To code and test a given logic in C programming language. **CO4**: To decompose a problem into functions and to develop modular reusable code. **CO5**: To use arrays, pointers, strings and structures to write C programs. **CO6**: Searching and sorting problems.
ME104ES	Engineering Graphics	**At the end of this course, each student should be able to:** **CO1:**Preparing working drawings to communicate the ideas and information. **CO2:** Read, understand and interpret engineering drawings.
ME104ES	Engineering Physics Lab	**At the end of this course, each student should be able to:** **CO1:** Apply the various procedures and techniques for the experiments **CO2:** Use the different measuring devices and meters to record the data with precision **CO3:** Apply the mathematical concepts / equations to obtain quantitative results. **CO4:**Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.

CS106ES	Programming for Problem Solving Lab	**At the end of this course, each student should be able to:** **CO1: F**ormulate the algorithms for simple problems. **CO2:** Tanslate given algorithms to a working and correct program **CO3:** Correct syntax errors as reported by the compilers **CO4:** Identify and correct logical errors encountered during execution **CO5:** Represent and manipulate data with arrays, strings and structures **CO6:** Use pointers of different types **CO7:** Create, read and write to and from simple text and binary files **CO8:** Modularize the code with functions so that they can be reused.
MC109ES	Environmental Science	**At the end of this course, each student should be able to:** **CO1:** Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development.

B.Tech.1stYear II Semester R18 Syllabus-Civil Engineering

CourseCode	CourseTitle/Name	CourseOutcomes
MA201BS	Mathematics-II	**At the end of this course, each student should be able to:** **CO1:** Identify whether the given differentialequationoffirstorder isexactor not. **CO2:**Solve higher differential equation and apply the concept of differential equation to realworldproblems. **CO3:** Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangularparallelepiped. **CO4:** Evaluate the line, surface and volumeintegralsandconvertingthemfromoneto another.
CH202BS	Chemistry	**At the end of this course, each student should be able to:** **CO1:** The knowledge of atomic, molecular and electronic changes, band theory related to conductivity. **CO2:** The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments **CO3:** The required skills to get clear concepts on basic spectroscopy and application to medical and other fields **CO4:** The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.
		At the end of this course, each student should be able to: **CO1:**Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.

ME203ES	Engineering Mechanics	**CO2:** Solve problem of bodies subjected to friction. **CO3:** Find the location of centroid and calculate moment of inertia of a given section. **CO4:** Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion. **CO5:** Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.
ME205ES	Engineering Workshop	**At the end of this course, each student should beable to:** **CO1:** Study and practice on machine tools and their operations. **CO2:** Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding. **CO3:** Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling. **CO4:** Apply basic electrical engineering knowledge for house wiring practice.
EN205HS	English	**At the end of this course, each student should be able to:** **CO1:** Use English Language effectively in spoken and written forms.. **CO2 :** Comprehend the given texts and respond appropriately. **CO3:** Communicate confidently in various contexts and different cultures. **CO4 :** Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
CH206BS	Engineering Chemistry Lab	**At the end of this course, each student should be able to:** **CO1:** Determination of parameters like hardness and chloride content in water.

		CO2: Estimation of rate constant of a reaction from concentration – time relationships. **CO3:**Determination of physical properties like adsorption and viscosity.. **CO4:** Calculation of Rf values of some organic molecules by TLC technique.

CourseCode	CourseTitle/Name	CourseOutcomes
* EN207HS	English Language and Communication Skills Lab	**At the end of this course, each student should be able to:** **CO1:** Better understanding of nuances of English language through audio- visual experience and group activities **CO2:** Neutralization of accent for intelligibility **CO3:** Speaking skills with clarity and confidence which in turn enhances their employability skills.

B.Tech. II Year I Semester R18 Syllabus-Civil Engineering

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CE301PC	Surveying and Geomatics	**At the end of this course, each student should be able to:** **CO1:** Apply the knowledge to calculate angles, distances and levels **CO2:** Identify data collection methods and prepare field notes **CO3:** Understand the working principles of survey instruments, measurement errors and corrective measures **CO4:** Interpret survey data and compute areas and volumes, levels by different type of equipment and relate the knowledge to the modern equipment and methodologies.
CE302PC	Engineering Geology	**At the end of this course, each student should be able to:** **CO1:** Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice **CO2:** The fundamentals of the engineering properties of Earth materials and fluids. **CO3:** Rock mass characterization and the mechanics of planar rock slides and topples.
CE303PC	Strength of Materials - I	**At the end of this course, each student should be able to:** **CO1:** Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, related to the strength of structured and mechanical components. **CO2:** Recognize various types loads applied on structural components of simple framing geometries and understand the nature of internal stresses that will develop within the components.

		CO3: To evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading. **CO4:** Analyze various situations involving structural members subjected to plane stresses by application of Mohr's circle of stress; **CO5:** Frame an idea to design a system, component, or process.
MA304BS	Probability and Statistics	**At the end of this course, each student should be able to:** **CO1:**Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
CE305PC	Fluid Mechanics	**At the end of this course, each student should be able to:** **CO1:** Understand the broad principles of fluid statics, kinematics and dynamics **CO2:** Understand definitions of the basic terms used in fluid mechanics and characteristics of fluids and its flow. **CO3:** Understand classifications of fluid flow. **CO4:** Be able to apply the continuity, momentum and energy principles.
CE306PC	Surveying Lab	**At the end of this course, each student should be able to:** **CO1:** Apply the principle of surveying for civil Engineering Applications **CO2:**Calculation of areas, Drawing plans and contour maps using different measuring equipment at field level. **CO3:** Write a technical laboratory report.
CE307PC	Strength of Materials Lab	**At the end of this course, each student should be able to:** **CO1:** Configure & Operate a data acquisition system using various testing machines of solid materials **CO2:**Compute and Analyze engineering values (e.g. stress or strain) from laboratory measurements **CO3:** Write a technical laboratory report.

CE308PC	Engineering Geology Lab	**At the end of this course, each student should be able to:** **CO1:**Understands the method and ways of investigations required for Civil Engg projects **CO2:**Identify the various rocks, minerals depending on geological classifications **CO3:**Will able to learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides and settlement. **CO4:** Write a technical laboratory report.
MC309	Constitution of India	**At the end of this course, each student should be able to:** **CO1 :** Able to understand historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration. **CO2:** Able to apply the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy. **CO3:** Able to analyze the History, features of Indian constitution, the role Governor and Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government. **CO4:** Able to evaluate Preamble, Fundamental Rights and Duties, Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women.

CourseCode	CourseTitle/Name	CourseOutcomes
EE401ES	Basic Electrical and Electronics Engineering	**At the end of this course, each student should be able to:** **CO1:** To analyze and solve electrical circuits using network laws and theorems. **CO2:** To understand and analyze basic Electric and Magnetic circuits **CO3:** To study the working principles of Electrical Machines **CO4:** To introduce components of Low Voltage Electrical Installations **CO5:** To identify and characterize diodes and various types of transistors.
CE402ES	Basic Mechanical Engineering for Civil Engineers	**At the end of this course, each student should be able to:** **CO1:** To understand the mechanical equipment for the usage at civil engineering systems, **CO2:** To familiarize with the general principles and requirement for refrigeration, manufacturing, **CO3:** To realize the techniques employed to construct civil engineering systems.
CE403PC	Building Materials, Construction and Planning	**At the end of this course, each student should be able to:** **CO1:** Define the Basic terminology that is used in the industry **CO2:** Categorize different building materials, properties and their uses **CO3:**Understand the Prevention of damage measures and good workmanship. **CO4:** Explain different building services.

CE404PC	Strength of Materials - II	**At the end of this course, each student should be able to:** **CO1:**Describe the concepts and principles, understand the theory of elasticity, and perform calculations, relative to the strength of structures and mechanical components in particular to torsion and direct compression; **CO2:**To evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading **CO3:** Analyze strength and stability of structural members subjected to Direct, and Direct and Bending stresses; **CO4:**Understand and evaluate the shear center and unsymmetrical bending. **CO5:** Frame an idea to design a system, component, or process.
CE405PC	Hydraulics and Hydraulic Machinery	**At the end of this course, each student should be able to:** **CO1:**Apply their knowledge of fluid mechanics in addressing problems in open channels and hydraulic machinery. **CO2:**Understand and solve problems in uniform, gradually and rapidly varied flows in open channel in steady state conditions. **CO3:**Apply dimensional analysis and to differentiate the model, prototype and similitude conditions for practical problems. **CO4:**Get the knowledge on different hydraulic machinery devices and its principles that will be utilized in hydropower development and for other practical usages

CE406PC	Structural Analysis - I	At the end of this course, each student should be able to: **CO1:** An ability to apply knowledge of mathematics, science, and engineering **CO2:** Analyse the statically indeterminate bars and continuous beams **CO3:** Draw strength behaviour of members for static and dynamic loading. **CO4:** Calculate the stiffness parameters in beams and pin jointed trusses. **CO5:** Understand the indeterminacy aspects to consider for a total structural system. **CO6:** Identify, formulate, and solve engineering problems with real time loading.
CE407PC	Computer aided Civil Engineering Drawing	At the end of this course, each student should be able to: **CO1:** Use the Autocad commands for drawing 2D & 3D building drawings required for different civil engg applications. **CO2:** Plan and draw Civil Engineering Buildings as per aspect and orientation. **CO3:** Presenting drawings as per user requirements and preparation of technical report.

CE409PC	Hydraulics and Hydraulic Machinery Lab	**At the end of this course, each student should be able to:** **CO1:**Describe the basic measurement techniques of fluid mechanics and its appropriate application. **CO2:**Interpret the results obtained in the laboratory for various experiments. **CO3:**Discover the practical working of Hydraulic machines- different types of Turbines, Pumps, and other miscellaneous hydraulics machines. **CO4:** Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions. **CO5:** Write a technical laboratory report
EE409ES	Basic Electrical and Electronics Engineering Lab	**At the end of this course, each student should be able to:** **CO1:**To analyze and solve electrical circuits using network laws and theorems.. **CO2:**To understand and analyze basic Electric and Magnetic circuits **CO3:**To study the working principles of Electrical Machines **CO4:** To introduce components of Low Voltage Electrical Installations **CO5:** To identify and characterize diodes and various types of transistors.
		At the end of this course, each student should be able to: **CO1 :**Students will have developed a better understanding of important issues related to gender in contemporary India **CO2:** Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.

| MC409 | Gender Sensitization Lab | **CO3:** Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
 CO4: Students will acquire insight into the gendered division of labour and its relation to politics and economics.
 CO5: Men and women students and professionals will be better equipped to work and live together as equals
 CO6: Students will develop a sense of appreciation of women in all walks of life.
 CO7: Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence. |

CourseCode	CourseTitle/Name	CourseOutcomes
CE501	Structural Analysis-II	**At the end of this course, each student should be able to:** **CO1:** Analyze the two hinged arches. **CO2:** Solve statically indeterminate beams and portal frames using classical methods **CO3:** Sketch the shear force and bending moment diagrams for indeterminate structures. **CO4:** Formulate the stiffness matrix and analyze the beams by matrix methods.
CE502PC	Geotechnical Engineering	**At the end of this course, each student should be able to:** **CO1:** Characterize and classify the soils **CO2:** Able to estimate seepage, stresses under various loading conditions and compaction characteristics **CO3:** Able to analyse the compressibility of the soils **CO4:** Able to understand the strength of soils under various drainage conditions.
CE503PC	Structural Engineering –I (RCC)	**At the end of this course, each student should be able to:** **CO1:** Compare and Design the singly reinforced, doubly reinforced and flanged sections. **CO2:** Design the axially loaded, uniaxial and biaxial bending columns. **CO3:** Classify the footings and Design the isolated square, rectangular and circular footings **CO4:** Distinguish and Design the one-way and two-way slabs.
		At the end of this course, each student should be able to: **CO1:** An ability to apply the knowledge of mathematics, science and engineering in the areas of traffic engineering, highway development and maintenance.

CE504PC	Transportation Engineering	**CO2:** An ability to design, conduct experiments to assess the suitability of the highway materials like soil, bitumen, aggregates and a variety of bituminous mixtures. Also the students will develop the ability to interpret the results and assess the suitability of these materials for construction of highways. **CO3:** An ability to design flexible and rigid highway pavements for varying traffic compositions as well as soil subgrade and environmental conditions using the standards stipulated by Indian Roads Congress. **CO4:** An ability to evaluate the structural and functional conditions of in-service highway pavements and provide solution in the form of routine maintenance measures or designed overlays using Indian Roads congress guidelines. **CO5:** An ability to assess the issues related to road traffic and provide engineering solutions supported with an understanding of road user psychological and behavioural patterns.
CE511PE	Professional Elective- I Concrete Technology	**At the end of this course, each student should be able to:** **CO1:** Determine the properties of concrete ingredients i.e. cement, sand, coarse aggregate by conducting different tests. Recognize the effects of the rheology and early age properties of concrete on its long-term behavior. **CO2:** Apply the use of various chemical admixtures and mineral additives to design cement-based materials with tailor-made properties **CO3:** Useadvanced laboratory techniques to characterize cement-based materials. **CO4:** Perform mix design and engineering properties of special concretes such as high-performance concrete, self-compacting concrete, and fibre reinforced concrete.

CE512PE	Professional Elective- I Theory of Elasticity	**At the end of this course, each student should be able to:** **CO1:**The more fundamental elasticity model of deformation should replace elementary strength of material analysis. **CO2:** Able to understand theory, formulate and to present solutions to a wide class of problems in 2D and 3D **CO3:** Acquire the foundation for advanced study in areas of solid mechanics.
CE513PE	Professional Elective- I Rock Mechanics	**At the end of this course, each student should be able to:** **CO1:** Able to determine the required rock properties and classify rock mass **CO2:**Determination of bearing capacity of rocks, **CO3:**Checking the stability of slopes, and design underground and open excavation. **CO4:**The students will be able to predict strength of rock mass with respect to various Civil Engineering applications
SM505MS	Engineering Economics and Accountancy	**At the end of this course, each student should be able to:** **CO1:** To perform and evaluate present and future worth of the alternate projects and to appraise projects by using traditional and DCF Methods. To carry out cost benefit analysis of projects and to calculate BEP of different alternative projects.
CE506PC	Highway Engineering and Concrete Technology Lab	**At the end of this course, each student should be able to:** **CO1:**Categorize the test on materials used Civil Engineering Building & Pavement constructions **CO2:**To perform the tests on concrete for it characterization.

		CO3: To Design Concrete Mix Proportioning by Using Indian Standard Method. **CO4:**Examine the tests performed for Bitumen mixes. **CO5:**To prepare a laboratory report.
CE507PC	Geotechnical Engineering Lab	**At the end of this course, each student should be able to:** **CO1:**At the end of the course, the student will be able to Classify and evaluate the behavior of the soils subjected to various loads.
EN508HS	Advanced Communication Skills Lab	**At the end of this course, each student should be able to:** **CO1:**To improve the students鈥 fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts. **CO2:**Further, they would be required to communicate their ideas relevantly and coherently in writing. **CO3:**To prepare all the students for their placements.
*MC509	Intellectual Property Rights	**At the end of this course, each student should be able to:** **CO1:** Identify different types of intellectual properties(IPS), the right of ownership, scope of protection as well as the ways to create and to extract value from IP **CO2:** Recognize the crucial role of IP in organizations of different industries sectors for the purpose of product and technology development.

CourseCode	CourseTitle/Name	CourseOutcomes
CE601PC	Hydrology & Water Resources Engineering	**At the end of this course, each student should be able to:** **CO1:**Understand the different concepts and terms used in engineering hydrology **CO2:** To identify and explain various formulae used in estimation of surface and Ground water hydrology components. **CO3:**Demonstrate their knowledge to connect hydrology to the field requirement.
CE602PC	Environmental Engineering	**At the end of this course, each student should be able to:** **CO1:**Assess characteristics of water and wastewater and their impacts **CO2:**Estimate quantities of water and waste water and plan conveyance components. **CO3:** Design components of water and waste water treatment plants **CO4:**Be conversant with issues of air pollution and control.
CE603PC	Foundation Engineering	**At the end of this course, each student should be able to:** **CO1:** understand the principles and methods of Geotechnical Exploration **CO2:** decide the suitability of soils and check the stability of slopes. **CO3:**calculate lateral earth pressures and check the stability of retaining walls. **CO4:** analyse and design the shallow and deep foundations
CE604PC	Structural Engineering –II (Steel)	**At the end of this course, each student should be able to:** **CO1:**Analyze the tension members, compression members. **CO2:**Design the tension members, compression members and column bases and joints and

		connections
		CO3: Analyze and Design the beams including built-up sections and beam and connections.
		CO4: Identify and Design the various components of welded plate girder including stiffeners.
CE611PE	ProfessionalElective-II: Prestressed Concrete	**At the end of this course, each student should be able to:**
		CO1: Acquire the knowledge of evolution of process of prestressing.
		CO2: Acquire the knowledge of various prestressing techniques.
		CO3: Develop skills in analysis design of prestressed structural elements as per the IS codal provisions
CE612PE:	ProfessionalElective-II: Elements Of Earthquake Engineering	**At the end of this course, each student should be able to:**
		CO1: Explain and derive fundamental equations in structural dynamics
		CO2: Discuss and explain causes and Theories on earthquake, seismic waves, measurement of earthquakes
		CO3: Evaluate base shear using IS methods
		CO4: Design and Detail the reinforcement for earthquake forces
CE613PE:	ProfessionalElective-II: Advanced Structural Analysis	**At the end of this course, each student should be able to:**
		CO1: Analyze the multistory building frames by various approximate methods
		CO2: Solve the continuous beams, portal frames by matrix methods of analysis..
		CO3: Analyze and design of large frames with or without shear walls

	Open Elective-I:	Please Refer Annexure-I
CE605PC	Environmental Engineering Lab	**At the end of this course, each student should be able to:** **CO1:**Understand about the equipment used to conduct the test procedures. **CO2:**Perform the experiments in the lab. **CO3:**Examine and Estimate water, waste water, air and soil Quality. **CO4:** Compare the water, air quality standards with prescribed standards set by the local governments **CO5:** Develop a report on the quality aspect of the environment.
CE606PC	Computer Aided Design Lab	**At the end of this course, each student should be able to:** **CO1:**Model the geometry of real-world structure Represent the physical model of structural element/structure **CO2:** Perform analysis **CO3:** Interpret from the Post processing results **CO4:** Design the structural elements and a system as per IS Codes.
*MC609	Environmental Science	**At the end of this course, each student should be able to:** **CO1:**Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development.

B.Tech.IV Year I Semester R18 Syllabus-Civil Engineering

CourseCode	CourseTitle/Name	CourseOutcomes
CE701PC	Estimation, Costing and Project Management	**At the end of this course, each student should be able to:** **CO1:**Understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure. **CO2:**Quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure. **CO3:**Understand how competitive bidding works and how to submit a competitive bid proposal. **CO4:** An idea of how to optimize construction projects based on costs **CO4:** An idea how construction projects are administered with respect to contract structures and issues. **CO5:** An ability to put forward ideas and understandings to others with effective communication processes.
CE711PE	Professional Elective –III Remote Sensing &Gis	**At the end of this course, each student should be able to:** **CO1:**Describe different concepts and terms used in Remote Sensing and its data **CO2:** Understand the Data conversion and Process in different coordinate systems of GIS interface **CO3:**Evaluate the accuracy of Data and implementing a GIS **CO4:** Understand the applicability of RS and GIS for various applications.

CE712PE	Professional Elective –III Ground Improvement Techniques	**At the end of this course, each student should be able to:** **CO1:**Know the necessity of ground improvement **CO2:** Understand the various ground improvement techniques available **CO3:**Select & design suitable ground improvement technique for existing soil conditions in the field.
CE713PE	Professional Elective -III Advanced Structural Design	**At the end of this course, each student should be able to:** **CO1:**Enhance the capabilities to design the special structural elements as per Indian standard code of practice. **CO2:** Analyze, design, draw and detailing of critical structural components with a level of accuracy.
CE721PE	Professional Elective –IV Irrigation And Hydraulic Structures	**At the end of this course, each student should be able to:** **CO1:**Know types of water retaining structures for multiple purposes and its key parameters considered for planning and designing **CO2:**Understand details in any Irrigation System and its requirements. **CO3:**Know, Analyze and Design of a irrigation system components.
CE722PE	Professional Elective –IV Pipeline Engineering	**At the end of this course, each student should be able to:** **CO1:**Get an understanding of the key steps in a pipeline's lifecycle: design, construction, installation, asset management and maintenance.
CE723PE	Professional Elective –IV Ground Water Hydrology	**At the end of this course, each student should be able to:** **CO1:**Identify different fundamental equations and concepts as applied in the Groundwater studies **CO2:** Discuss and derive differential equation governing

		groundwater flow in three dimensions **CO3:** To solve groundwater mathematical equations and analyze pumping tests in steady and non steady flow cases **CO4:** Distinguish and understand the saline water intrusion problem in costal aquifers.
	Open Elective –II	Please Refer Annexure-I
CE703PC	Industrial Oriented Mini Project/ Summer Internship	**At the end of this course, each student should be able to:** **CO1:**Formulate a real world problem and develop its Requirements. **CO2:**Student will be exposed to industrial Awareness **CO3:**Self learning technologies, methods and/or techniques that contribute to the software solution of the project.
CE704PC	Seminar	**At the end of this course, each student should be able to:** **CO1:**Ability to work in actual working environment. **CO2:**Ability to utilize technical resources **CO3:**Ability to write technical documents and give oral presentations related to the work completed.
CE705PC	Project Stage - I	**At the end of this course, each student should be able to:** **CO1:**Formulate a real world problem and develop its Requirements. **CO2:**Student will be exposed to industrial awareness **CO3:**Self learning technologies, methods and/or techniques that contribute to the software solution of the project.

B.Tech.IV Year II Semester R18-Civil Engineering

CourseCode	CourseTitle/Name	CourseOutcomes
CE811PE	Professional Elective –V Solid Waste Management	**At the end of this course, each student should be able to:** **CO1:**Identify the physical and chemical composition of solid wastes **CO2:** Analyze the functional elements for solid waste management. **CO3:** Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes. **CO4:** Identify and design waste disposal systems.
CE812PE	Professional Elective –V Environmental Impact Assessment	**At the end of this course, each student should be able to:** **CO1:**Identify the environmental attributes to be considered for the EIA study **CO2:** Formulate objectives of the EIA studies **CO3:** Identify the methodology to prepare rapid EIA **CO4:** Prepare EIA reports and environmental management plans.
CE813PE	Professional Elective –V Air Pollution	**At the end of this course, each student should be able to:** **CO1:**Identify sampling and analysis techniques for air quality assessment **CO2:** Describe the plume behavior for atmospheric stability conditions **CO3:** Apply plume dispersion modelling and assess the concentrations **CO4:** Design air pollution controlling devices.

CE821PE	Professional Elective –VI Airport, Railways, And Waterways	**At the end of this course, each student should be able to:** **CO1:** An ability to design of runways and taxiways. **CO2:** An ability to design the infrastructure for large and small airports **CO3:** An ability to design various crossings and signals in Railway Projects. **CO4:** An ability plan the harbors and ports projects including the infrastructure required for new ports and harbors.
CE822PE	Professional Elective –VI Urban Transportation Planning	**At the end of this course, each student should be able to:** **CO1:** An ability to apply the knowledge of mathematics, science and engineering in the areas of traffic engineering, highway development and maintenance. **CO2:** An ability to design, conduct experiments to assess the suitability of the highway materials like soil, bitumen, aggregates and a variety of bituminous mixtures. Also the students will develop the ability to interpret the results and assess the suitability of these materials for construction of highways. **CO3:** An ability to design flexible and rigid highway pavements for varying traffic compositions as well as soil subgrade and environmental conditions using the standards stipulated by Indian Roads Congress. **CO4:** An ability to evaluate the structural and functional conditions of in-service highway pavements and provide solution in the form of routine maintenance measures or designed overlays using Indian Roads congress guidelines. **CO5:** An ability to assess the issues related to road traffic and provide engineering solutions supported with an understanding of road user psychological and behavioural patterns.

CourseCode	CourseTitle/Name	CourseOutcomes
CE823PE	Professional Elective –VI Finite Element Methods for Civil Engineering	**At the end of this course, each student should be able to:** Analyse simple structural elements using Finite Element approach.

Annexure-I
OpenElective–I
(CommonforEEE, ECE, CSE, IT,ME)

CourseCode	CourseTitle/Name	CourseOutcomes
CE600OE	**OpenElective– I**DisasterPreparedness&Pl anningManagement	**At the end of this course, each student should be able to:** **CO1:**TheapplicationofDisasterConceptsto Management **CO2:**AnalyzingRelationshipbetweenDevelopment And Disasters. **CO3:**AbilitytounderstandCategoriesofDisasters **CO4:**Realizationoftheresponsibilitiesto society
CS600OE	**OpenElective–I** Entrepreneurship	**At the end of this course, each student should be able to:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.
CS601OE	**OpenElective– I**Fundamentals ofManagement forEngineers	**At the end of this course, each student should be able to:** ThestudentsunderstandthesignificanceofManagementi ntheirProfession.ThevariousManagementFunctionslike Planning,Organizing,Staffing, Leading, Motivation and Control aspects arelearntinthiscourse.Thestudentscanexplorethe ManagementPracticesintheirdomainarea.

CS602OE	**Open Elective–I** CyberLaw&Ethics	**At the end of this course, each student should be able to:** **CO1:**The students will understand the importance of professional practice, Law and Ethics in their personal lives and professional careers. **CO2:**The students will learn the rights and responsibilitiesasanemployee,teammember and a global citizen.
EC600OE	**Open Elective–I** Fundamentals of Internet of Things	**At the end of this course, each student should be able to:** **CO1:** Knownbasicprotocolsinsensornetworks. **CO2:**ProgramandconfigureArduinoboardsfor Various designs.
		CO3: Pythonprogrammingandinterfacingfor RaspberryPi. **CO4:** Design IoT applications in different domains.
EE600OE	**OpenElective–I** ReliabilityEngineering	**At the end of this course, each student should be able to:** **CO1:**Model various systems applying reliability networks **CO2:**Evaluatethereliabilityofsimpleand complex systems **CO3:**Estimate the limiting state probabilities of repairablesystems **CO4:**Applyvariousmathematicalmodelsfor Evaluating reliability of irreparable systems.
EE601OE	**OpenElective–I**RenewableEnergy Sources	**At the end of this course, each student should be able to:** **CO1:**Understand the principles of wind power and Solar photo voltaic power generation, fuel cells. **CO2:**Assess the cost of generation for conventional and renewable energy plants. **CO3:**Designsuitablepowercontrollerforwindand Solar applications. **CO4:**Analyze the issues involved in the integration of renewable energy sources to the grid.

| ME600OE | **Open Elective–I**
Quantitative Analysis for Business Decisions | **At the end of this course, each student should be able to:**
 CO1: Familiar with issues that would crop up in business
CO2: AbletoformulateMathematicalModelto resolvetheissue
CO3: Able to select technique for solving the formulated Mathematical Model.
CO4: Abletoanalyzetheresultsobtainedthrough The selected technique for implementation. |

OpenElective–II
(CommonforEEE, ECE, CSE, IT,ME)

CourseCode	CourseTitle/Name	CourseOutcomes
CS700OE	**OpenElective–II** Data Structures	**At the end of this course, each student should be able to:** **CO1:**Ability to select the data structures that efficiently model the information in a problem. **CO2:**Ability to assess efficiency trade-offs among different data structure implementations or combinations. **CO3:**Implement and know the application of algorithms for sorting and pattern matching. **CO4:**Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.
CS701OE	**OpenElective–II** Artificial Intelligence	**At the end of this course, each student should be able to:** **CO1:**Ability to formulate an efficient problem space for a problem expressed in natural language. **CO2:**Select a search algorithm for a problem and estimate its time and space complexities. **CO3:**Possess the skill for representing knowledge using the appropriate technique for a given problem. **CO4:**Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.
CS702OE	**OpenElective–II** Python Programming	**At the end of this course, each student should be able to:** **CO1:**Examine Python syntax and semantics and be fluent in the use of Python flow control and functions. **CO2:**Demonstrate proficiency in handling Strings and File Systems.

		CO3:Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions. CO4:Interpret the concepts of Object-Oriented Programming as used in Python. CO5:Implement exemplary applications related to Network Programming, Web Services and Databases in Python.
CS703OE	**OpenElective–II** Java Programming	**At the end of this course, each student should be able to:** CO1:Develop Programs with reusability Develop programs to handle multitasking CO2:Develop programs to handle exceptions CO3:Develop applications for a range of problems using object-oriented programming techniques CO4:Design simple Graphical User Interface Applications.
EC700OE	**OpenElective–II** Electronic Sensors	**At the end of this course, each student should be able to:** CO1:Learn about sensor Principle, Classification and Characterization. CO2:Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors Understand the basic concepts of Smart Sensors CO3:Design a system with sensors CO4:UNIT - I Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environ
EE700OE	**OpenElective–II** Utilization Of Electrical Energy	**At the end of this course, each student should be able to:** CO1:Understand basic principles of electric heating and welding. CO2:Determine the lighting requirements for flood lighting, household and industrial needs. CO3:Calculate heat developed in induction furnace. CO4:Evaluate speed time curves for traction.

		At the end of this course, each student should be able to:
EE701OE	**OpenElective–II** Electric Drives And Control	**CO1:**Understand the various drive mechanisms and methods for energy conservation. **CO2:**Apply power electronic converters to control the speed of DC motors and induction motors. **CO3:**Evaluate the motor and power converter for a specific application. **CO4:**Develop closed loop control strategies of drives
ME700OE	**OpenElective–II** Basic Mechanical Engineering	**At the end of this course, each student should be able to:** **CO1:** To understand the mechanical equipment for usage at engineering systems. **CO2:**To familiarize with the general principles and requirements for refrigeration, manufacturing, **C03:** To realize the techniques employed to engineering systems.

Open Elective –III
(CommonforEEE, ECE,CSE, IT,ME)

CourseCode	CourseTitle/Name	CourseOutcomes
CE800OE	**Open Elective – III**Environmental ImpactAssessment	**At the end of this course, each student should be able to:** **CO1:**Identify the environmental attributes to be considered for the EIA study **CO2:**Formulate objectives of the EIA studies **CO3:**Identify the methodology to prepare rapid EIA **CO4:**Prepare EIA reports and environmental management plans
CS800OE	**Open Elective – III** Machine Learning	**At the end of this course, each student should be able to:** **CO1:**Understand the concepts of computational intelligence like machine learning.

		CO2: Ability to get the skill to apply machine learning techniques to address the real time problems in different areas. **CO3:**Understand the Neural Networks and its usage in machine learning application.
CS801OE	**Open Elective – III** Mobile Application Development	**At the end of this course, each student should be able to:** **CO1:**Student understands the working of Android OS Practically. **CO2:**Student will be able to develop Android user interfaces **CO3:**Student will be able to develop, deploy and maintain the Android Applications.

CS802OE	**OpenElective–III** Scripting Languages	**At the end of this course, each student should be able to:** **CO1:**Comprehend the differences between typical scripting languages and typical system and application programming languages. **CO2:**Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language for solving a given problem. **CO3:**Acquire programming skills in scripting language
CS803OE	**OpenElective–III** Database Management Systems	**At the end of this course, each student should be able to:** **CO1:**Gain knowledge of fundamentals of DBMS, database design and normal forms **CO2:**Master the basics of SQL for retrieval and management of data. **CO3:**Be acquainted with the basics of transaction processing and concurrency control. **CO4:**Familiarity with database storage structures and access technique.

EC800OE	**OpenElective–III** Measuring Instruments	**At the end of this course, each student should be able to:** **CO1:**Able to identify suitable sensors and transducers for real time applications. **CO2:**Able to translate theoretical concepts into working models. Able to understand the basic of measuring device and use them in relevant situation.
EE800OE	**OpenElective–III** Basics Of Power Plant Engineering	Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.
EE801OE	**OpenElective–III** Energy Sources And Applications	**At the end of this course, each student should be able to:** **CO1:**List and generally explain the main sources of energy and their primary applications nationally and internationally Understand the energy sources and scientific concepts/principles behind them **CO2:**Understand effect of using these sources on the environment and climate **CO3:**Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment. **CO4:**List and describe the primary renewable energy resources and technologies. **CO5:**To quantify energy demands and make comparisons among energy uses, resources, and technologies. **CO6:**Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation. **CO7:**Understand the Engineering involved in projects utilizing these sources.

ME800OE	**OpenElective–III** Non-Conventional Sources Of Energy	**At the end of this course, each student should be able to:** **CO1:** Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and analyze the working of solar and thermal systems. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen. **CO2:** Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator. **CO3:** Identify methods of energy storage for specific Applications.