BITS-Pilani, Hyderabad Campus: Course Description

B.E. (Hons.) Civil Engineering

(For the most updated information, please refer to the latest Bulletin)

Year	First Semester			U	Second Semester			U
I	BIO	F110	Biology Laboratory	1	MATH	F112	Mathematics II	3
	BIO	F111	General Biology	3	ME	F112	Workshop Practice	2
	CHEM	F110	Chemistry Laboratory	1	CS	F111	Computer Programming	4
	CHEM	F111	General Chemistry	3	EEE	F111	Electrical Sciences	3
	MATH	F111	Mathematics I	3	BITS	F112	Technical Report Writing	2
	PHY	F110	Physics Laboratory	1	MATH	F113	Probability and Statistics	3
	PHY	F111	Mechanics, Oscillations and Waves	3	BITS	F111	Thermodynamics	3
	BITS	F110	Engineering Graphics	2				
				17				**20**
II	MATH	F211	Mathematics III	3	ECON	F221	Principles of Economics or	3 or
			Humanities Elective	3(min)	MGTS	F221	Principles of Management Humanities Electives	3 3(min)
	CE	F211	Mechanics of Solids	3	CE	F241	Analysis of Structures	3
	CE	F231	Fluid Mechanics	3	CE	F242	Construction Planning & Technology	3
	CE	F213	Surveying	4	CE	F243	Soil Mechanics	4
	CE	F230	Civil Engineering Materials	4	CE	F244	Highway Engineering	4
					BITS	F225	Environmental Studies	3
				20(min)				**20(min)**
Summer	**BITS F221 Practical School – I (for PS Option Only)**							
III			Open/ Human Electives	1 to 4			Open/ Human Electives	2 to 5
	CE	F320	Design of Reinforced Concrete Structures	3	CE	F342	Waste & Waste Water Treatment	4
	CE	F312	Hydraulic Engineering	4	CE	F321	Engineering Hydrology	3
	CE	F313	Foundation Engineering	3	CE	F343	Design of Steel Structures	3
			Discipline Electives	6			Discipline Electives	6
				17/20				**18/21**
IV			Open Electives	8 to 14	BITS	F412	Practice School-II or	20 or
					BITS	F421	Thesis or	16
							Thesis (9) and Electives (6 to 9)	15 to 18
				8/14				**15/ 20**

Core Courses:

- CE F211 Mechanics of Solids 3 0 3
- CE F213 Surveying 3 1 4
- CE F230 Civil Engineering Materials 4
- CE F231 Fluid Mechanics 3
- CE F241 Analysis of Structures 3 0 3
- CE F242 Construction Planning and Technology 3 0 3
- CE F243 Soil Mechanics 3 1 4
- CE F244 Highway Engineering 3 1 4
- CE F312 Hydraulics Engineering 3 1 4
- CE F313 Foundation Engineering 3 0 3
- CE F320 Design of Reinforced Concrete Structures 3
- CE F321 Engineering Hydrology 3
- CE F342 Water & Waste Water Treatment 3 1 4
- CE F343 Design of Steel Structures 3 0 3

Elective Courses (any six):

- BITS F313 Multicriterion Decision Making in Engg. and Management 3 0 3
- CE F323 Introduction to Environmental Engineering 3 0 3
- CE F324 Numerical Analysis 3 0 3
- CE F325 Fundamentals of Rock Mechanics 3 0 3
- CE F345 Computational Geomechanics 3 0 3
- CE F411 Operation Research for Engineers 3 0 3
- CE F412 Disaster Management 3 0 3
- CE F413 Advanced Structural Design 3 0 3
- CE F415 Design of Prestressed Concrete Structure 3 0 3
- CE F416 Computer Applications in Civil Engineering 3 1 4
- CE F417 Applications of Artificial Intelligence in Civil Engg. 3 0 3
- CE F419 Geotechnical Earthquake Engg. and Machine Foundation 3 0 3
- CE F420 Introduction to Bridge Engineering 3 0 3
- CE F421 Analysis and Design of FRP Reinforced Concrete Structures 3 0 3
- CE F422 Urban Hydrology 2 1 3
- CE F423 Green Buildings and Energy Conservation 3 0 3
- CE F425 Airport, Railways and Waterways 3 0 3
- CE F426 Geosynthetics and Reinforced Soil Structure 3 0 3
- CE F427 System Modeling and Analysis 3 0 3
- CE F428 Earthquake Resistant Design and Construction 3 0 3
- CE F429 Design of Foundation Systems 3 0 3
- CE F430 Design of Advanced Concrete Structures 3 0 3
- CE F431 Principles of Geographical Information Systems 3 1 4
- CE F432 Structural Dynamics 3 0 3
- CE F433 Remote Sensing and Image Processing 3 1 4
- CE F434 Environmental Impact Assessment 3 0 3
- CE F435 Introduction to Finite Element Methods 3 0 3

CE F211 Mechanics of Solids   [3 0 3]

Introduction to mechanics of rigid bodies and deformable bodies, Thermal stresses, Equilibrium of forces, Bending moment and shear force diagrams for determinate beams and frames, Analysis of statically determinate trusses; Flexural and shear Stresses in beams, Combined stresses, Stresses and strains on inclined planes, Introduction to torsion, Torsion in shafts, Slope and deflection in beams due to bending, Introduction to Energy Methods, Stresses in thin cylindrical shells, Suspension cables, Failure theories, Buckling of columns using Euler's Theory.

CE F213 Surveying   [3 1 4]

Overview of Traditional Surveying Techniques like Chain surveying, Compass surveying and Plane Table Surveying, Traverse Computations and Adjustments, Levelling, Contouring, Curve Setting: Different methods of setting Simple Circular Curve, Compound Curve, Reverse Curve, Trigonometric Levelling, Tachometric Surveying, Surveying with GPS / DGPS and Total Stations and Electronic Distance Measurement, Introduction to aerial photogrammetry.

CE F230 Civil Engineering Materials   [3 2 4]

Different types of cements, chemical composition, properties and tests, coarse and fine aggregate for concrete, tests on aggregates, grading of aggregates and its effect on concrete properties, chemical and mineral admixtures, properties and tests on fresh and hardened concrete; transportation and placing of concrete, non-destructive testing of concrete, durability of concrete, quality control and acceptance criteria of concrete, Factors in the choice of mix proportions, Proportioning of concrete mixes by various methods – BIS method of mix design; Introduction to

special concretes. Manufacturing/sources, classification, applications, properties and testing of bricks, blocks, tiles, aggregates, lime, timber, paints, glass, bitumen, cutback, emulsion, modified bitumen, steel, non-ferrous metals, polymeric materials, geosynthetics, etc. Low cost and waste material in construction. Latest, BIS, IRC & ASTM specifications and guidelines of all above mentioned material, and construction equipment.

CE F231 Fluid Mechanics   [3 0 3]

Concepts and definitions; compressibility of fluids, Fluid pressure and measurement, Fluid statics, Buoyancy, Rigid body motion, Fluid Kinematics, Conservation laws: Control Volume approach, Differential analysis of fluid flow, Study of flow pattern through Orifices and mouthpieces, Notches and weirs, Analysis of flow through pipes, Viscous fluid flow analysis: Analysis of flow through pipes, Dimensional analysis and similitude.

CE F241 Analysis of Structures   [3 0 3]

Static and kinematic Indeterminacy, Energy principles; Force Methods of analysis: strain energy method, consistent deformation method, Displacement Methods of analysis: Slope- deflection method, Moment distribution method; Introduction to Matrix Methods of structural analysis: Flexibility and Stiffness Methods, Influence Line Diagrams; Analysis of Moving/Rolling loads (for determinate structures), Introduction to approximate analysis of frames and trusses, Analysis of Three-hinged, two- hinged and fixed Arches, Analysis of indeterminate trusses. Exposure to relevant software.

CE F242 Construction Planning and Technology   **[3 0 3]**

Principal components of a building system and their interrelationships, functional planning and requirements of a building and its components using relevant codes, building processes, types and construction of foundation systems, masonry, walls, floors, roofs, vertical transportation, doors, windows, building finishes, plumbing services, damp proofing, temporary supporting structures; introduction to planning and scheduling of projects, construction project network analysis, Introduction to quantity estimation, costing and valuation, contracts, tenders, engineering economy and cost benefit analysis of a project, introduction to building information modeling, computer applications in construction management. Exposure to relevant software.

CE F243 Soil Mechanics   **[3 1 4]**

Introduction, Origin and classification of soils, index properties of soil, Compaction characteristics of different soils, lab and field compaction, quality control, Effective stress principle, capillarity, Darcy's law, permeability, Seepage through soils: piping, quick- sand condition, flow nets, flow through dams, filters, Stress in soils due to applied loads, Boussinesq equatin, Newmark's In- fluence Chart, Approximate Method, Compressibility and consol- idation characteristics, Consolidation Settlement, Shear Strength and Mohr-Coulomb strength criterion, direct, UCS and triaxial shear tests, strength of loose and dense sands, pore pressures, Skempton's coefficients. Site investigations, methods of drilling, sampling, in situ test - SPT, CPT, plate load and geophysical tests, immediate settlement based on elastic theories and in-situ tests. Exposure to relevant software.

CE F244 Highway Engineering   **[3 1 4]**

Overview of basic characteristics of Transportation systems, social factors and strategic consideration, Road development plans, Highway development projects in India, Road Development organizations, Stages in highway alignment and Detailed project Report preparation, Introduction to transportation planning, Geometric design Standards: Cross section elements, sight distances, horizontal and vertical alignments, Pavement Material Characterization: Aggregate testing and blending, Bitumen and Bituminous Concrete testing and mixture design proto- cols, introduction to Superpave Mixture Design protocols, IRC methods for the design of flexible and rigid highway pavements, Overview of different stages in flexible and rigid highway construction, Overview of Highway Evaluations and Maintenance, Traffic Engineering: Traffic Characteristics, Highway capacity and level of service concepts, Traffic measurement and analysis, Traffic signals, parking studies and analysis, traffic accidents, Introduction to Intelligent Transportation Systems. Exposure to relevant software.

CE F312 Hydraulics Engineering   **[3 1 4]**

Behaviour of real fluids: boundary layer theory, turbulent flow through conduits; analysis of closed-conduit hydraulic systems including pipes, valves, fittings, and pumps, water hammer in pipes, pipe networks analysis: Hardy cross method and linear graph method; Open channel hydraulics: uniform and non- uniform flow; flow past immersed bodies: drag and lift; Analysis of Impact of jets; Introduction to fluid machinery.

CE F313 Foundation Engineering [3 0 3]

Earth Pressure theories, Retaining structures, design and checks for stability, General requirement for satisfactory performance of shallow foundations, general, local and punching shear failures, bearing capacity, settlement, tilt and rotation of foundations, proportioning of Shallow Foundations, footings on layered soils and slopes, Deep foundations, capacity of single and group Piles, laterally loaded pile, Stability of slopes, Intro- duction to Ground Improvement Techniques and geosynthetics with applications, Introduction to machine foundations for different type of machines, Introduction to geotechnical earthquake engineering and liquefaction of soils, computer applications in foundation design.

CE F320 Design of Reinforced Concrete Structures [3 0 3]

Design Philosophies: Concepts of working stress in comparison with limit state method; Limit state design for flexure of Singly and doubly reinforced rectangular and flanged section beams; one-way and two-way slabs; Design for bond, anchorage and development length; Design of beams for shear; Limit state of serviceability for beams and slabs; Limit state design for col- lapse of columns subjected to axial, uni-axial and bi-axial bending; Design of simple footings; Design of simple stair cases.

CE F321 Engineering Hydrology [3 0 3]

Introduction to hydrometeorology; Precipitation measurement and analysis; Hydrologic abstractions; Stream flow measurement; Runoff and hydrographs; Floods; flood routing; Ground water hydrology; Sediment transport; Introduction to irrigation engineering, Introduction to dams, spillways, diversion head- works and distribution systems.

CE F342 Water & Waste Water Treatment [3 1 4]

Water supply and waste water systems; capacity requirements; analysis of water and waste water; treatment requirements; unit operations and processes of treatment, design of treatment units; disposal of waste water and sludge; design of sewers and water distribution networks; rural sanitation; effluent re- purification and reuse.

CE F343 Design of Steel Structures [3 0 3]

Introduction to Limit State Design and Plastic design, Limit state design of bolted and welded connections, Eccentric connection, Design of Tension Members, Design of Compression Members, Design of Beams, Design of plate girders, Column bases. Exposure to relevant software.

Electives (any six):

BITS F313 Multicriterion Decision Making in Engineering and Management   [3 0 3]

Introduction, Single Objective Optimization, Estimation of weights, Multiobjective optimization, Classification Methods, Discrete Multicriterion Decision Making, Fuzzy Logic based discrete MCDM, Correlation coefficients and group decision making, Advanced topics of decision making, Case studies.

CE F323 Introduction to Environmental Engineering   [3 0 3]

Introduction to environmental systems; Material (conservative and non-conservative systems) and energy balances; Risk Assessment; Water pollution and management; Air pollution and management; Essentials of Solid waste management; environ- mental noise pollution and its control; radioactive waste management; Modelling of Environmental systems; Introduction to Environmental impact assessment; Legislations.

CE F324 Numerical Analysis   [3 0 3]

Introduction, Conventional optimization, Multi-objective Optimization, Fuzzy logic and its extensions, in multi-objective optimization, Multicriterion Decision Making, Deterministic analysis, Stochastic analysis, Fuzzy analysis, Classification problems, Hybrid approaches in Decision Making, Genetic Algorithms, Artificial Intelligence, Artificial Neural networks, Practical applications in Engineering.

CE F325 Fundamentals of Rock Mechanics   [3 0 3]

Internal structure of Earth; Types of rocks and geological features; Intact rock and rock mass; Shear strength; Rock mass classification systems; Rock slope failure mechanisms; Convergence Confinement Method, Ground and Support Reaction Curves, Longitudinal Deformation Profile, Construction of Metro Tunnels, Cut and Cover Method, Tunnel Boring Machine; Stresses in rocks, Rock burst, Squeezing ground conditions; Methods for improvement of rock mass response.

CE F345 Computational Geomechanics   [3 0 3]

General Theory of Elasticity; Analysis of Stress and Strain, Spherical and Deviatoric Stress Tensors, General state of stress in three-dimensions in cylindrical coordinate system, Three-dimensional Mohr's stress Circle, Strain Transformation, Octahedral Strains, Mohr's Circle for Strain, Equations of Compatibility for Strain; Pore pressure and stress-strain response of soil due to undrained loading, Volume Change Behaviour, Peak State and Dilatancy, Rowe's Dilatancy Theory; Critical State Parameters, Failure line in p´-q space and e-p´ space, Soil Yielding, Strain Hardening and Strain Softening; Introduction to failure theories of soils, their relative merits and demerits and applicability for different types of soil; Computer Applications; Suitability of the failure models in real-time geotechnical problems.

CE F411 Operation Research for Engineers   **[3 0 3]**

Linear programming, Simplex method, Duality and sensitivity analysis, Transportation model and its variants, Integer linear programming, Nonlinear programming, Introduction to Multi- objective optimization and case study, Game theory, Evolutionary computation, Inventory models, Queuing system, Decision making under certainty, risk, and uncertainty.

CE F412 Disaster Management   **[3 0 3]**

Definitions, types of hazards, natural and man-made disasters, impact, causes and effects, damages, coping mechanism and relief assistance, disaster continuum, preparedness, prevention, mitigation, warning and management, vulnerability assessment, rehabilitation and reconstruction after disasters, pre disaster planning for earthquakes, cyclones, floods, draught and famine, disaster resistant constructions, non-structural and structural mitigation measures, guiding principles of mitigation, education and training for disasters, disaster case studies, computer use in dis- aster scenario development.

CE F413 Advanced Structural Design   **[3 0 3]**

Design of concrete chimneys, water tanks, retaining walls, bunkers and silos, Design of steel tanks, towers, Roof trusses and Gantry Girder design, Design of plate girders, Design of Beam-Columns.

CE F415 Design of Prestressed Concrete Structure   **[3 0 3]**

Introduction to basic concepts of prestressing; load balancing technique prestressing systems; analysis of prestress; losses in prestress; deflection; design of anchorage zone, design of pre-stressed concrete girders.

CE F416 Computer Applications in Civil Engineering   **[3 1 4]**

The basics and use of recent Civil Engineering Software related to Hydraulics, Structures, Transportation, Geo-technology and Construction Planning and Management etc., Practical assignments on industry related problems using the above software.

CE F417 Applications of Artificial Intelligence in Civil Engineering   **[3 0 3]**

Introduction to Artificial Intelligence and soft computing; Neural networks: Introduction, models, and its application in civil engineering, fuzzy logic and its application in decision making, Clustering; Genetic algorithms; Expert systems; Introduction to ma- chine learning (Support Vector Machine), case studies.

CE F419 Geotechnical Earthquake Engineering and Machine Foundation   **[3 0 3]**

Seismic hazard, Engineering seismology, Wave propagation, Dynamic Soil Properties, Dynamic bearing capacity, Seismic de- sign of foundation, Seismic slope stability, Dynamic earth pressure, Seismic design of retaining structure, Liquefaction, Design of machine foundation, Soil improvement techniques, Seismic design codes.

CE F420 Introduction to Bridge Engineering [3 0 3]

Investigations for bridges, types of bridges and loading standards, selection of bridge type, analysis of culverts and girder bridges, pier and abutments, different types of bridge foundations.

CE F421 Analysis and Design of FRP Reinforced Concrete Structures [3 0 3]

Course description is to be developed.

CE F422 Urban Hydrology [2 1 3]

Urban hydrology, Hydrological and planning models, Urban flooding: Planning, forecasting and mitigation strategies, General circulation models and downscaling approaches, Management of Syphonic rainwater systems and detention facilities, sustainable urban drainage systems, Impact of anthropogenic activities, case studies.

CE F423 Green Buildings and Energy Conservation [3 0 3]

Climate zones and sun path diagram, thermal comfort, heat flow through building materials, energy efficient building design factors like site planning, plan form and orientation, construction techniques, materials and finishes, natural day lighting and ventilation strategies, thermal performance of building elements, Efficient water management in buildings, Green building rating system, Vernacular architecture and its use in contemporary design, Case studies of contemporary green buildings.

CE F425 Airport, Railways and Waterways [3 0 3]

Airports: Characteristics of aircrafts related to airport design; runway orientation, length, capacity, configuration and number, taxiway layout, high-speed exit taxiway, terminal building functional areas, visual aids; grading and drainage; Railways: com- ponent of railway tracks, train resistance and tractive power, curves and super elevation, switches and crossing, signalling and interlocking, high speed tracks, track stresses. Tunnelling: necessity of tunnels, ventilation, lighting and drainage; Water transportation: nature of water transportation, classes of harbours, desirable features of harbour site, planning and design of port faculties; Pipeline transportation systems: need and planning.

CE F426 Geosynthetics and Reinforced Soil Structure [3 0 3]

Geo-synthetics: classification, functions, applications, properties & testing, Applications and advantages of reinforced soil structure. Principles, concepts and mechanism of reinforced soil. Soil- reinforcement interface friction. Behaviour of Reinforced earth walls, basis of wall design, internal and external stability condition, Codal provisions; Seismic design consideration. Bearing capacity improvement and design of foundations resting on rein- forced soil; embankments on soft soils; Design of reinforced soil slopes, Indian experiences. Use of geosynthetics for separations, drainage and filtration. Use of geosynthetics in roads, air- ports and railways, India Road Congress, AASHTO and other relevant guidelines; randomly distributed fiber reinforced soil. Soil nailing. Geocell, PVD, Geosynthetics in Environmental Control: Liners for ponds and canals; covers and liners for landfills – material aspects and stability considerations; Use of jute, coir, natural Geotextiles, waste products such as scrap tire, LDPE and HDPE strips, as reinforcing material.

CE F427 System Modeling and Analysis   **[3 0 3]**

Systems and system's approach, Modelling of physical system and non-physical system, Continuous and discrete systems, Time domain analysis, Frequency response, Steady-space analysis.

CE F428 Earthquake Resistant Design and Construction   **[3 0 3]**

Earthquake resistant design philosophy. Ground motion characterization, response spectra and design spectra. Free and forced vibration analysis of single and multiple degree of freedom system. Seismic analysis and design of buildings and other structures as per relevant codes. Seismic design of foundations and liquefaction of soil, Earthquake resistant construction and detailing for masonry & concrete structure as per relevant codes.

CE F429 Design of Foundation Systems   **[3 0 3]**

Evaluation and interpretation of soil properties, dynamic properties of soil, geophysical and seismic methods, Stress in soil mass due to applied load, various methods of settlement analysis, static and dynamic bearing capacity of footings, bearing capacity of footings resting on layered soils and footing on or near slopes, tilt, rotation and horizontal displacement of foundations subjected to eccentric-inclined loads, foundations on rocks, seismic design of shallow foundations, analysis of raft foundations, circular and annular rafts, structural design of shallow foundations, pile foundations load capacity and settlements, various methods of analysis of laterally loaded Pile Foundations, uplift capacity, piles subjected to dynamic loads, seismic design of pile foundations, structural design of pile foundations, static and dynamic earth pressure theories, stability analysis of retaining walls, reinforced earth wall design, machine foundations for reciprocating machines, impact type, rotary machines such as turbines, turbogenerator, IS code provisions on foundations, co- dal provisions on structural and earthquake resistant design of foundations.

CE F430 Design of Advanced Concrete Structures   **[3 0 3]**

Design of footings and stair cases, Determination of deflection and crack width in beams and slabs, Design of flat slabs, Design of beam column joints, Design of circular Slabs, Design of Retaining walls, Design of beams curved in plan.

CE F431 Principles of Geographical Information Systems   **[3 1 4]**

Introduction to Geographical Information Systems (GIS), Spatial data models, Coordinate systems and geo-referencing, Map projections, Databases and database management systems, Spatial databases, Interpolation methods: Deterministic and Statistical. Digital elevation models and their applications, Network analysis, GNSS, Strategies for development, implementation and management of GIS, Next generation GIS, Case studies on use of GIS from various fields such as water and land resources, environment, transportation; Introduction to remote sensing & Image processing.

CE F432 Structural Dynamics   **[3 0 3]**

Free and forced vibrations, single and multi-degree systems, continuous systems, response of various systems to different excitations, damping; numerical evaluation of dynamic response, frequency domain analysis, mode superposition, direct integration for dynamic response.

CE F433 Remote Sensing and Image Processing   **[3 1 4]**

Overview, Fundamental concepts of remote sensing, Air photo Interpretation, Multispectral, Thermal and hyper spectral Scanning, Microwave remote sensing, Photographic Systems, Photogrammetry, Digital Image Processing, Image File format, Pre- Processing of Data, Enhancement techniques, Image Transformations, Image classification, Spatial Filtering, Applications.

CE F434 Environmental Impact Assessment   **[3 0 3]**

Environment and global problems; Framing Environmental is- sues; effects of infrastructure development on environment; pre- diction and assessment of environmental impacts of infrastructure projects: technical and procedural aspects, guidelines and legal aspects of environmental protection, impacts on air, water, soil and noise environment, valuation, strategic assessment, mathematical modeling for environmental processes; social im- pact assessment (SIA), dislocation/disruption impact of Infra- structure projects; Life Cycle Assessments (LCA) and risk analysis methodologies; mitigation of environmental impacts; case studies; environmental management plan (EMP), national and international certification and guidelines including ISO.

CE F435 Introduction to Finite Element Methods   **[3 0 3]**

Element properties, Isoparametric formulations, analysis of framed structures, plane stress, plane strain, and axisymmetric problems, analysis of plate bending, FEM Software applications in Civil Engineering, Introduction to FEM programming. Exposure to relevant software.