Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Civil Engineering
(Applicable from the academic session 2018-2019)

SEMESTER –III (2ND YR)

CE(BS)301	Biology (Biology for Engineers)	2L + 1T =	3 Credits
Module 1	**Introduction** Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry. **Purpose:** To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry		2L
Module 2	**Classification** Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataacquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus **Purpose:** To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.		3L
Module 3	**Genetics** Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics. **Purpose:** To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"		4L
Module 4	**Biomolecules** Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids. **Purpose**: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine		4L
Module 5	**Enzymes** Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis. **Purpose:** To convey that without catalysis life would not have existed on earth		4L
Module 6	**Information Transfer** Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.\ **Purpose:** The molecular basis of coding and decoding genetic information is universal		4L
Module 7	**Macromolecular analysis** Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. **Purpose:** How to analyses biological processes at the reductionistic level		5L
Module 8	**Metabolism** Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge **Purpose:** The fundamental principles of energy transactions are the same in physical and biological world.		4L
Module 9	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.		3L
Reference	1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd		

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2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman andCompany
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company,Distributed by Satish Kumar Jain for CBS Publisher
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. BrownPublishers
6) Biology of Engineers, McGraw Hill (ISBN: 978-11-21439-931)

CE(ES)301	**Engineering Mechanics**	3L + 1T =	4 Credits
Module 1	**Introduction to Engineering Mechanics** Force Systems Basic concepts, Particleequilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant ofForce System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium ofCoplanar Systems and Spatial Systems; Static Indeterminacy		6L
Module 2	**Friction** Types of friction, Limiting friction, Laws of Friction, Static andDynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;		3L
Module 3	**Basic Structural Analysis** Equilibrium in three dimensions; Method of Sections;Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zeroforce members; Beams & types of beams; Frames & Machines;		4L
Module 4	**Centroid and Centre of Gravity** Centroid of simple figures from first principle,centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia,Moment of inertia of standard sections and composite sections; Mass moment inertia of circularplate, Cylinder, Cone, Sphere, Hook.		5L
Module 5	**Virtual Work and Energy Method-** Virtual displacements, principle of virtual work forparticle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems withfriction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational),energy equation for equilibrium. Applications of energy method for equilibrium. Stability ofequilibrium.		4L
Module 6	**Review of particle dynamics-** Rectilinear motion; Plane curvilinear motion (rectangular,path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2^{nd}law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potentialenergy.Impulse-momentum (linear, angular); Impact (Direct and oblique).		4L
Module 7	**Introduction to Kinetics of Rigid Bodies** Basic terms, general principles indynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems;D'Alembert's principle and its applications in plane motion and connected bodies; Work energyprinciple and its application in plane motion of connected bodies; Kinetics of rigid body rotation;		5L
Module 8	**Mechanical Vibrations** Basic terminology, free and forced vibrations,resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of freevibrations without damping and single degree of freedom system, simple problems, types ofpendulum, use of simple, compound and torsion pendulums;		5L
Tutorials	From the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free bodydiagrams various systems including block-pulley; To verify the principle of moment in the discapparatus; Helical block; To draw a load efficiency curve for a screw jack		6L
Reference	1. D.S. Bedi (2018), Engineering Mechanics, Khanna Publishing House, 2019 2. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall 3. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, –Dynamics, 9th Ed, Tata McGraw Hill 4. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press. 5. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress 6. Shanes and Rao (2006), Engineering Mechanics, Pearson Education, 7. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education 8. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics 9. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications 10. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co. 11. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications		

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CE(ES)302	Energy Science & Engineering	1L + 1T =	2 Credits
Module 1	**Introduction to Energy Science** Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. **Tutorials:**Compile a World map showing Energy Reserves by source, Total Energyconsumption, Per capita energy consumption and Carbon Footprint		3L
Module 2	**Energy Sources** Overview of energy systems, sources, transformations, efficiency, andstorage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future,Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen;Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energystorages, high efficiency batteries) **Tutorials:**Compile a Word Map showing Alternative Energy sourceusage; Compile a Process diagram for a Pumped Storageproject; Collect details of a typical North Sea oil platform. Compile a map of India showing exiting potential and utilizedpotential for hydro power. List the pros and cons for Thermal,hydro, nuclear and solar power projects.		4L
Module 3	**Energy & Environment** Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumptionand sustainability; introduction to the economics of energy; How the economic system determinesproduction and consumption; linkages between economic and environmental outcomes; How futureenergy use can be influenced by economic, environmental, trade, and research policy **Tutorials:**Study the functioning of an Electro Static Precipitator in athermal power plant; study the uses of coarse and fine Fly Ashfrom thermal power plants. Compile the safety provisions indesign and construction of a reactor containment building		5L
Module 4	**Civil Engineering Projects connected with the Energy Sources** Coal miningtechnologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solarchimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydropower stations above-ground and underground along with associated dams, tunnels, penstocks, etc.;Nuclear reactor containment buildings and associated buildings, design and construction constraintsand testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposalsystems **Tutorials:**Compile a process diagram for a typical underground hydropower project; Collect details of a model solar chimneyproject; collect details of a wave energy project at Vizhinjam;Collect details of the Kalpasar (Tidal energy) project		10L
Module 5	**Engineering for Energy conservation** Concept of Green Building and GreenArchitecture; Green building concepts (Green building encompasses everything from the choice ofbuilding materials to where a building is located, how it is designed and operated); LEED ratings;Identification of energy related enterprises that represent the breath of the industry and prioritizingthese as candidates; Embodied energy analysis and use as a tool for measuring sustainability. EnergyAudit of Facilities and optimization of energy consumption. **Tutorials:**Draw a typical geometrical orientation of a house in your areato avoid sun's radiation in the bed room in the evening;Identify typical examples of Indian buildings having variousLEED ratings; List various building materials with theirembodied energy content. Do an Energy Audit of yourDepartmental Building in the college		8L
Reference	1. O.P, Gupta, Energy Technology, Khanna Book Publishing, (2019) 2. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press 3. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems andSustainability: Power for a Sustainable Future. Oxford University Press 4. Chakrabarti, Energy Engineering & Management, PHI 5.Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam 6. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematicsof Decision Making, Loulou, Richard; Waaub, XVIII, 7. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley 8. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment 9. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company 10. Related papers published in international journals		

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CE(BS)302	**Mathematics-III** **(Transform & Discrete Mathematics)**	2L + 0T	2 Credits
(Prerequisite 2c, 5b-d, 6b)			
Module 1	**Transform Calculus -1** Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials;aplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions.Finding inverse Laplace transform by different methods, convolution theorem. Evaluation ofintegrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.		6 L
Module 2	**Transform Calculus-2** Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and theirapplications.		6 L
Module 3	**Sets, relations and functions** Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types ofrelations, their compositions and inverses. Different types of functions, their compositions andinverses.		4 L
Module 4	**Propositional Logic** Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deductiontheorem, etc. Decision problems of propositional logic. Introduction to first order logic and firstorder theory.		4 L
Module 5	**Partially ordered sets** Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices.Boolean and pseudo Boolean lattices.		4 L
Module 6	**Algebraic Structures** Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange'stheorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures.Error correcting code. Algebraic structures with two binary operations- ring, integral domain, andfield. Boolean algebra and boolean ring (Definitions and simple examples only).		4 L
Module 7	**Introduction to Counting** Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation,combination, summations. Introduction to recurrence relation and generating functions.		3 L
Module 8	**Introduction to Graphs** Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.		3 L
Reference	1.C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000. 2. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999. 3. R.L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994. 4. K. H. Rosen, Discrete Mathematics and its Applications, 6th Ed., Tata McGraw-Hill, 2007. 5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Ed., Jones and Bartlett, 2010. 6. N. Deo, Graph Theory, Prentice Hall of India, 1974. 7. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999. 8. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997. 9. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. 10. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. 11. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000. 12. S.B. Singh. Discrete Structures, Khanna Publishing House, 2019 13. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008. 14. Chandrika Prasad, Advanced Engineering Mathematics, KPB		

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CE(HS)301	Humanities-I (Effective Technical Communication)	3L + 0T	3 Credits
Module 1	Information Design and Development- Different kinds of technical documents,Information development life cycle, Organization structures, factors affecting information anddocument design, Strategies for organization, Information design and writing for print and for onlinemedia.	4L	
Module 2	Technical Writing, Grammar and Editing- Technical writing process, forms of discourse,Writing drafts and revising, Collaborative writing, creating indexes, technical writing style andlanguage. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriatetechnical style. Introduction to advanced technical communication, Usability, Hunan factors,Managing technical communication projects, time estimation, Single sourcing, Localization.	8L	
Module 3	Self Development and Assessment- Self assessment, Awareness, Perception andAttitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time;Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity	8L	
Module 4	Communication and Technical Writing- Public speaking, Group discussion, Oral;presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writingreports, project proposals, brochures, newsletters, technical articles, manuals, official notes, businessletters, memos, progress reports, minutes of meetings, event report.	8L	
Module 5	Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes,Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Workculture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving,Creativity.	8L	
Reference	1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004 2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843) 3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House 4. Shiv Khera, You Can Win, Macmillan Books, New York, 2003. 5. Raman Sharma, Technical Communications, Oxford Publication, London, 2004. 6. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4) 7. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002. 8. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)		

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CE(HS)302	Introduction to Civil Engineering	1L + 1T=	2 Credits
Module 1	**Basic Understanding**: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career **Tutorials** Develop a matrix of various disciplines and possibleroles for engineers in each		1 L
Module 2	**History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers **Tutorials** Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each		1 L
Module 3	**Overview of National Planning for Construction and Infrastructure Development**; Positionof construction industry vis-à-vis other industries, five year plan outlays for construction; currentbudgets for infrastructure works **Tutorials** Develop a Strategic Plan for Civil Engineering worksfor next ten years based on past investments andidentify one typical on-going mega project in eacharea		1 L
Module 4	**Fundamentals of Architecture & Town Planning**: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; BuildingSystems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities **Tutorials** Identify ten best civil engineering projects with highaesthetic appeal with one possible factor for each; Listdown the possible systems required for a typical SmartCity		1 L
Module 5	**Fundamentals of Building Materials**: Stones, bricks, mortars, Plain, Reinforced &PrestressedConcrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites;Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes **Tutorials** Identify three top new materials and their potential inconstruction; Visit a Concrete Lab and make a report		2 L
Module 6	**Basics of Construction Management & Contracts Management**: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management **Tutorials** Identify 5 typical construction methods and list theiradvantages/ positive features		2 L
Module 7	**Environmental Engineering & Sustainability**: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction **Tutorials** Sustainability principles, Sustainable builtenvironment, water treatment systems, and good practicesof wastewater management. examples of Solid andhazardous waste management, Air pollution andcontrol		2L
Module 8	**Geotechnical Engineering**: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling **Tutorials** List top five tunnel projects in India and their features;collect and study geotechnical investigation report ofany one Metro Rail (underground) project; Visit aconstruction site and make a site visit report		2 L
Module 9	**Hydraulics, Hydrology &Water Resources Engineering**: Fundamentals of fluid flow, basics ofwater supply systems; Underground Structures; Underground Structures Multi-purpose reservoirprojects **Tutorials** Identify three river interlinking projects and theirfeatures; visit a Hydraulics Lab and make a report		1 L
Module 10	**Ocean Engineering**: Basics of Wave and Current Systems; Sediment transport systems; Ports &Harbours and other marine structures **Tutorials** Identify 5 typical ports in India and list the structuresavailable in them; Visit a related/similar		1 L

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	facility, ifpossible in nearby place and make a report	
Module 11	**Power Plant Structures**: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects **Tutorials** Collect the typical layout for a large thermal powerplant and a large hydro power plant and identify all thestructures and systems falling in them.	1 L
Module 12	**Structural Engineering**: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies; **Tutorials** Identify 5 unique features for typical buildings,bridges, tall structures and large span structures; VisitStructures Testing Lab/facility and make a report	3 L
Module 13	**Surveying & Geomatics**: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; **Tutorials** Collect visual representations prepared by a TotalStation and LIDAR and compare; Study typicalGoogle street map and Google Earth Map and studyhow each can facilitate the other	1 L
Module 14	**Traffic &Transportation Engineering**: Investments in transport infrastructure development inIndia for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety underheterogeneous traffic; Sustainable and resilient pavement materials, design, construction andmanagement; Case studies and examples. **Tutorials** Investments in transport infrastructure; Developmentsand challenges; Intelligent Transport Systems; SmartCities, Urban Transport; Road Safety; Sustainable andresilient highway design principles; Plan a sustainabletransport system for a city; Identify keyfeatures/components in the planning and design of agreen field highway/airport/port/railway and the cost –economics.	1 L
Module 15	**Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non-Destructivetesting systems; Use of carbon fibre wrapping and carbon composites in repairs. **Tutorials** Collect the history of a major rehabilitation project andlist the interesting features	1 L
Module 16	**Computational Methods, IT, IoT in Civil Engineering:** Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …) **Tutorials** Visit an AutoCad lab and prepare a report; Identify teninteresting software systems used in Civil Engg andtheir key features	2 L
Module 17	**Industrial lectures**: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning; **Tutorials** For each case study list the interesting features	2 L
Module 18	**Basics of Professionalism**: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction	3 L
Tutorials	List 5 cases of violation of professional ethics and listpreventive measures; Identify 5 interesting projectsand their positive features; Write 400 word reports on one ancient monument and a modern marvel of civilengineering	5L
Reference	1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract 2. The National Building Code, BIS, (2017) 3. RERA Act, (2017) 4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset 5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai 6. Avtarsingh (2002), Law of Contract, Eastern Book Co. 7. Dutt (1994), Indian Contract Act, Eastern Law House 8. Anson W.R.(1979), Law of Contract, Oxford University Press 9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration 10. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.	

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11. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency
13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
14. Bare text (2005), Right to Information Act
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
18. Vee, Charles &Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd
19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
20. Ethics in Engineering- M.W.Martin&R.Schinzinger, McGraw-Hill
21. Engineering Ethics, National Institute for Engineering Ethics, USA
22. www.ieindia.org
23. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri -CEIBS
25. CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm
26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
27. Contract &Agreements , http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
28. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
29. Business & Personal Law. Chapter 7. "How Contracts Arise", http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
30. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
31. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.html
32. Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02), http://www.sandia.gov/policy/14g.pdf

LABORATORY/ SESSIONAL

CE(ES)391	**Basic Electronics**	1L + 2P	2 Credits
Theory			
Module 1	Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as aRectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings,Applications;	4L	
Module 2	Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET)– Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal OxideSemiconductor (MOS) FETs, Introduction to CMOS circuits;	4L	
Module 3	Transistor Amplifiers and Oscillators covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies,Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;	4L	
Module 4	Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;	4L	
Practical			
Module 1	Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards andPrinted Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes,BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;		
Module 2	Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of SinusoidalSignals using Lissajous Patterns on CRO; (CRO);		
Module 3	Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and OutputCharacteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;		

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Module 4	Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source(CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers,Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators;	
Module 5	Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and MonostableMultivibrators;	
Module 6	Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and DFlip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit ShiftRegister ICs; Functionality of Up-Down / Decade Counter ICs;	
Reference	1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India 2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India 3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education, 4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH 5. R.T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson	

CE(ES)392	**Computer-aided Civil Engineering Drawing**	1L + 2P	2 Credits
Module 1	**INTRODUCTION** Introduction to concept of drawings, Interpretation of typicaldrawings, Planning drawings to show information concisely and comprehensively; optimallayout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems,reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modifycommands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms andstandards.		2 L
Module 2	**SYMBOLS AND SIGN CONVENTIONS** Materials, Architectural, Structural, Electricaland Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawingsymbols, welding symbols; dimensioning standards		2 L
Module 3	**MASONRY BONDS** English Bond and Flemish Bond – Corner wall and Cross walls -One brick wall and one and half brick wall		1 L
Module 4	BUILDING DRAWING Terms, Elements of planning building drawing, Methods ofmaking line drawing and detailed drawing. Site plan, floor plan, elevation and section drawingof small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standardfittings & fixtures, finishes. Use of Notes to improve clarity		5 L
Module 5	PICTORIAL VIEW Principles of isometrics and perspective drawing. Perspective viewof building. Fundamentals of Building Information Modelling (BIM)		2 L
Drawings			
1	Buildings with load bearing walls including details of doors and windows.		6P
2	Taking standard drawings of a typical two storeyed building including all MEP,joinery, rebars, finishing and other details and writing out a description of theFacility in about 500-700 words		4P
3	RCC framed structures		6P
4	Reinforcement drawings for typical slabs, beams, columns and spread footings		6P
5	Industrial buildings - North light roof structures – Trusses		4P
6	Perspective view of one and two storey buildings		4P
Reference	1. Subhash C Sharma &Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers 2. Pradeep Jain & A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House (2019) 3. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi 4. Sham TickooSwapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education, 5. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd., 6. Shah, Engineering Drawings and Computers, Pearson 7. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,		

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8. (Corresponding set of) CAD Software Theory and User Manuals. 9. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian. 10. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons,		

CE(ES)393	Life Science	1L + 2P	2 Credits
Module 1A	**Plant Physiology** Transpiration; Mineral nutrition		3 L
Module 1B	**Ecology** Ecosystems- Components, types, flow of matter and energy in anecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum;Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids;		3 L
Module 2A	**Population Dynamics** Population ecology- Population characteristics,ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations,polymorphism and heterogeneity;		3 L
Module 2B	**Environmental Management** Principles: Perspectives, concerns andmanagement strategies; Policies and legal aspects- Environment Protection Acts and modification,International Treaties; Environmental Impact Assessment- Case studies (International Airport,thermal power plant);		3 L
Module 3A	**Molecular Genetics** Structures of DNA and RNA; Concept of Gene, Generegulation, e.g., Operon concept		3 L
Module 3B	**Biotechnology** Basic concepts: Totipotency and Cell manipulation; Plant &Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNATechnology- Techniques and applications		3 L
Module 4	**Biostatistics** Introduction to Biostatistics:-Terms used, types of data;Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysisof Data- Hypothesis testing and ANNOVA (single factor)		4 L
Module 5	**Laboratory & FieldworkSessions** Comparison of stomatal index in differentplants; Study of mineral crystals in plants; Determination of diversity indices in plant communities;To construct ecological pyramids of population sizes in an ecosystem; Determination of ImportanceValue Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g.,Airport, Thermal/Nuclear Power Plant/ Oil spill scenario); Preparation and extraction of genomic DNA and determination of yield by UV absorbance; Isolation of Plasmid DNA and its separation byGel Electrophoresis; Data analysis using Bio-statistical tools;		15 P
References	1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd 2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons 3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company 4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher 5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers 6. Life Sciences, Vol. I & II, Pathfinder Publications		