

Syllabus for B.Tech. Civil Engineering (Admitted Batch - 2025 to 2028)

Contents

First Semester	1
Second Semester	4
Third Semester	9
Fourth Semester	13
Fifth Semester	16
Sixth Semester	19
Seventh Semester	21
Eighth Semester	21
Programme Electives	21

First Semester

CHY1001: ENGINEERING CHEMISTRY & LAB [2 0 2 3]

Module 1: Water treatment technology: Introduction, Characteristics imparted by impurities in water, Hardness of water Degree of hardness. Determination of hardness by EDTA method. Numerical. problems. Softening of hard water: External treatment by lime soda process. Softening of hard water: Ion exchange method; Zeolite methods Softening of hard water, internal treatment by phosphate, calgon condition and colloid conditioning. Numerical problems based on lime soda process. Module 2: Advanced materials and polymers: Introduction, Definition, classification of polymers -Tacticity. Functionality, Degree of polymerization, Co-polymerization - alternating, random, block and graft polymers. Mechanism of free radical polymerization and ionic polymerization. Condensation polymerization reactions, Molecular weight of polymers, Number average and weight average molecular weights, Numerical problems. Nylon (6:6, 6, 6:10, 11), Natural rubber, Processing of Natural Rubber, Vulcanization, conducting polymers, their properties and applications. Module 3: Chemical Fuels: Classification of Fuels, Gross Calorific value and Net Calorific value. Determination of calorific value by Bomb calorimeter and Boy's calorimeter and their numerical problems. Solid, Liquid and Gaseous fuels. Dulong formula; Numerical problems. Coal and its analysis - Proximate and Ultimate analysis. Fractional Distillation, Petroleum cracking - catalytic cracking (Fixed Bed and moving bed). Numerical based on Combustion (By Weight Type and By Volume Type). Working principles of fuels cells and their applications. Module 4: Corrosion: Concept of corrosion and its importance, types of corrosion, PB Rule. Galvanic corrosion; Differential aeration corrosion: Pitting corrosion, Water line corrosion, Crevice corrosion. factors affecting corrosion, Corrosion control methods. Corrosion prevention by material selection and design alternation of environment by changing medium; Cathodic protection -sacrificial anode and impressed voltage methods, Anodic protection; Inhibitors - Anodic and Cathodic inhibitors, Protective coating - Metal coating (Electroplating).

References:

1. Engineering Chemistry, Jain P.C.; Jain M., Dhanpat Rai and Sons, Delhi, 17th Edn. 2015.
2. Engineering chemistry, Wiley India Pvt. Ltd., 2nd Edn. 2014.
3. Chemistry in Engineering and Technology, Kuriacose J.C.; Raja R. J., Vol. I/II McGraw Hill Education, 2001.
4. Materials Science for Engineering Students, Fischer T., Academic Press, London, 2009.
5. Fuel Science & Technology, James G Speight; Marcel Dekker, New York, 1990.

MAS1001: CALCULUS AND MATRICES [2 1 0 3]

Differential calculus: Curvatures, Asymptotes; Partial differentiation, total derivatives, Taylor's theorem, maxima and minima, Lagrange's method. Integral Calculus: Double and Triple integrals, Change of the order of integration. Change of variables. Applications of Multiple integrals. Vector Calculus: Differentiation of vectors and their physical meaning. Line and surface integrals. Matrix Algebra: Rank, Inverse of a matrix, and solution of linear simultaneous equations. Eigenvalues and Eigenvectors of a matrix, Cayley-Hamilton theorem.

References:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K. 2011.
2. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House. 2005.
3. M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education. 2008.

ECE1002: ELECTRONIC CIRCUITS [2 1 0 3]

Semiconductor Physics: Energy bands in solids: conductors, semiconductors, insulators, Intrinsic and extrinsic semiconductors, Carrier concentration, drift, and diffusion currents, Diodes: PN Junction Diode, Diode equation and I-V characteristics, Zener diode and its applications, Load line analysis, Clipping and clamping circuits, Rectifiers, Voltage regulators. Transistors : BJT structure and operation and its characteristics, FET structure and operations Operating regions: cutoff, active, saturation. BJT Biasing and Amplifiers: Biasing techniques: fixed, voltage-divider, Load line analysis, amplifier configurations, Operational Amplifier: Introduction to Operational Amplifier, Inverting & Non-Inverting amplifier. Introduction to Digital Logic: Logic Gates, Boolean algebra fundamentals, Logic expression simplification techniques, Karnaugh Maps (K-maps).

References:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson.
2. Ben G. Streetman, Sanjay Kumar Banerjee, "Solid State Electronic Devices", Pearson.
3. M. Morris Mano, Michael D. Ciletti, "Digital Design", Pearson.
4. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI Learning.
5. Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press.
6. Albert Paul Malvino, David Bates, "Electronic Principles", McGraw Hill Education.
7. Donald A. Neamen, "Semiconductor Physics and Devices", McGraw Hill Education.
8. Jacob Millman, Christos C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", McGraw Hill Education.

MEE1008: BASIC MECHANICAL ENGINEERING [3 0 0 3]

Proposed Syllabus: Fundamentals of Thermodynamics, System and Surroundings, Thermodynamic Properties, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Zeroth law and First law, Work done and Heat Interaction, Second Law, Applications of second law-Heat engine, Heat Pump and Refrigerator, Refrigeration and Air Conditioning: Definition, concept, Vapour Compression cycle, C.O.P., working principles and schematic diagrams of Refrigerator, Air Conditioners and its classifications, Internal Combustion Engine: Classification, Otto and Diesel cycles, Construction and working of SI and CI engine, Power Transmission: Classification and applications of mechanical drives, Belt drive and its classifications, velocity ratios, Gear Drive, Gear Trains, Manufacturing: Conventional processes, Casting, Gating System, Metal Forming: Forging, Rolling, Extrusion, Machining: Lathe and its operations, Milling and its types, Grinding, Welding and its classifications, Modern machining methods- applications, Additive Manufacturing.

References:

1. Mathur, Mehta and Tiwari, Elements of Mechanical Engineering, Jain Brother, (Thirteenth Edition), 2023.
2. Singhal R.K, Basics of Mechanical Engineering, Dream Tech press, Wiley, 2024.
3. Y.A. Cengel and M.A. Boles, Thermodynamics: An Engineering Approach, McGraw Hill (Fifth Edition), 2024.
4. Steven R. Schmid, 2024, Serope Kalpakjian, Manufacturing engineering and technology, Pearson

CSC1101: PROBLEM-SOLVING USING COMPUTERS [2 1 0 3]

Introduction to assembly and high level programming languages (programming paradigms), Basic concepts of integer and floating-point number representations; Elements of C programming language: Data types (including enumerated data types) and storage classes, constants, and variables, expressions and assignment statements, input and output statements, conditional and branch statements, iteration statements, 1-D and 2-D arrays, functions and parameter passing, recursion, strings, structures, introduction to pointers, file read and write.

References:

1. E. Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2017.
2. Y. P. Kanetkar, "Let us C", 16th Edition, BPB Publication, 2017.
3. B. W. Kernighan, D. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice Hall of India, 2014.
4. B. Gottfried, "Schaums Outline Series: Programming with C", 3rd Edition, McGraw Hill Publication, 2012.

DOA1001: Universal Human Values [1 0 0 1]

Universal Human Value: Introductions, Sanskars-Educational, Aspirations and Concerns, Self-Management, Health, Trust, Relationships, Harmony, society and nature, Need for a holistic perspective and way of living, Right Understanding (Knowing)- Knower, Known & the Process.

References:

1. R R Gaur, R Asthana, G P Bagaria, (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi, 2019
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022

CSC1130: PROBLEM-SOLVING USING COMPUTERS LAB [0 0 2 1]

Digital computer fundamentals: Algorithms and flowcharts; Programming (Using C): data types, variables, operators, expressions, statements, control structures, functions, arrays and pointers, recursion, structures, files, input/output, some standard library functions.

References:

1. E. Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2017.
2. Y. P. Kanetkar, "Let us C", 16th Edition, BPB Publication, 2017.
3. B. W. Kernighan, D. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice Hall of India, 2014.
4. B. Gottfried, "Schaums Outline Series: Programming with C", 3rd Edition, McGraw Hill Publication, 2012.

LLC1011: COMMUNICATION SKILLS [2 0 0 2]

Communication: Definition, Significance, Characteristics, Features, Process, and Types (Verbal, Non-verbal, Intercultural Communication), Levels and Flow, Barriers to Communication; Listening Skills: Hearing vs. Listening, Types of Listening; Barriers to Effective Listening; Speaking Skills: Public Speaking and Debates; Presentation Skills,

Dynamics of Professional Presentation (Verbal and Audio-visual Communication), Group Discussion and Personal Interview; Soft Skills- Critical Thinking, Diversity Awareness, Persuasion and Negotiation Skills, and Technology in Communication; Reading Skills: Reading Types and Techniques, Comprehension.

References:

1. Raman, M., & Sharma, S. (2015). Technical communication: Principles and practice (3rd ed.). Oxford University Press.
2. Sharma, R. C., & Mohan, K. (2016). Business correspondence and report writing (5th ed.). McGraw-Hill Education.
3. Kaul, A. (2009). Effective business communication (2nd ed.). PHI Learning.
4. Jain, V., & Chandrasekaran, M. (2013). Professional communication skills. S. Chand Publishing.
5. Guffey, M. E., & Loewy, D. (2016). Essentials of business communication (10th ed.). Cengage Learning.
6. Lesikar, R. V., & Flatley, M. E. (2005). Basic business communication: Skills for empowering the Internet generation (11th ed.). McGraw-Hill Education.

MEE1036: ENGINEERING GRAPHICS [0 0 2 1]

Introduction to Engineering Graphics. Principle of Orthographic Projections, Projection of objects located in different quadrants. Introduction to AutoCAD, Basic commands for 2D drawing. Projections of points, lines and planes, Projections of Solids: Prisms, Pyramids, Cylinders and Cones Isometric Projection: Isometric view of Solids, Conversion of Orthographic Views to Isometric Views.

References:

1. Engineering Drawing, N.D. Bhatt, Charotar Publication.
2. Engineering Graphics, Basant Aggarwal & CM Aggarwal, McGraw Hill Publication.
3. Engineering Graphics with AutoCAD, DM Kulkarni & AP Rastogi, PHI Learning Private Limited.
4. Engineering Graphics with AutoCAD, TM Jeyapovan, Vikas Publishing House

Second Semester

PHY1001: ENGINEERING PHYSICS & LAB [2 1 2 4]

Optics: Interference, coherence, Young's Double slit interference, fringe width, intensity in double slit interference (using phasor method), thin film interference, Newton's rings, diffraction and wave theory of light, single-slit diffraction, intensity in single-slit diffraction (qualitative discussion**), diffraction at a circular aperture, Raleigh's criterion for optical resolution, double-slit interference and diffraction (qualitative discussion**), combined-intensity in double-slit diffraction (qualitative discussion**), diffraction of light through multiples slits (qualitative discussion**), diffraction gratings (qualitative discussion**), dispersion and resolving power (qualitative discussion**), polarization of electromagnetic waves, polarizing sheets, Malus law, polarization by reflection. Quantum Physics: Black body and basic laws of radiation (classical concept) - Stefan's law, Wein's displacement law, Rayleigh-Jeans law, ultraviolet catastrophe, Planck's hypothesis and Planck's law (quantum concept), classical predictions and quantum mechanical interpretation of Photoelectric effect (qualitative discussion**), Compton effect (qualitative discussion**), photons and electromagnetic waves, de Broglie hypothesis and matter waves, Davisson-Germer experiment, quantum particle (wave packet, phase velocity, group velocity and their relations), the uncertainty principle. Quantum Mechanics: An interpretation of quantum mechanics, wave function and its significance, time independent Schrödinger equation and its applications - particle in a box, particle in a well of finite height (qualitative discussion**), quantum mechanical tunneling through a potential barrier and its applications. Basic concept of quantum computing (qualitative discussion**). Applied Physics: X-ray Spectrum, origin of characteristic and continuous spectrum, Duane-Hunt relation, Moseley's law, Laser and characteristics of laser light, spontaneous and stimulated transitions, metastable states, population inversion, components of a

typical laser system. Superconductivity theory: Meissner Effect, type I and type II superconductor, BCS theory of superconductivity in metals (qualitative discussion**). Experiential learning in Physics: Experiments on interference, diffraction (single slit and grating) and polarization, ultrasonic waves, quantum physics (photo electric effect, Black body radiation) and electronic materials.

**** Qualitative discussion:** It refers the conceptual discussions the fundamental ideas and theory. Additionally, a short discussion on mathematical expressions without complex derivations and also includes numerical problems.

References:

1. Halliday, Resnick, Krane, PHYSICS, Volume 2, 5th edition, John Wiley & Sons, Inc, 2011 (For Optics)
2. Beiser & Mahajan, Modern Physics, Mc Graw Hill, 6th edition., 2009 (For Quantum Physics, Quantum Mechanics, Atomic Physics, Electronic materials)
3. Serway & Jewett, PHYSICS for Scientists and Engineers with Modern Physics; Volume 2, 6th edition

MAS1002: COMPUTATIONAL MATHEMATICS [2 1 0 3]

Numerical Methods: Finite difference and interpolation for equal and unequal intervals, Numerical differentiation and integration. Solution of algebraic and transcendental equations, solutions of ordinary differential equations. Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism of graphs, Euler and Hamiltonian paths, Graph coloring. Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.

References:

1. Liu and Mohapatra, "Elements of Discrete Mathematics", McGraw Hill, 2018
2. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill, 2019
3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, Addison Wesley, 2020
4. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, PHI Learning Private Limited, Delhi India.
5. Numerical Methods: M.K. Jain, S.R.K. Iyenger and R.K. Jain, 2021
6. Sastry S. S., Introductory methods of Numerical analysis, (4e), PHI, 2007.

CHY1002: ENVIRONMENTAL STUDIES [2 0 0 2]

Unit I - Introduction to Environmental Studies and Ecology Meaning, multidisciplinary nature of environmental science, applications in engineering disciplines, environmental ethics, sustainable development. Types and Structure of Ecosystem. Unit II - Biodiversity and Natural Resources Importance, classification, conservation methods. Renewable and non-renewable, Resource consumption, different types of energy, Conventional sources & Non-Conventional sources of energy. Unit III - Environmental Pollution and Disaster Management Environmental Pollution and control: Air / Water / Soil / Noise pollution, Water demand, Water quality standards, basics of water treatment, Conservation of water, Characteristics of sewage, treatment and disposal, Solid waste management. Meaning, natural disasters especially earthquakes & Manmade disasters Unit IV - Global environmental problems and Environmental Management Global environmental problems, Environmental acts, Laws and Policies, EIA, Case studies of the past related to environmental issues.

References:

1. Rajagopalan, R., Environmental Studies: From Crisis to Cure, (2e), Oxford University Press, 2016.
2. De, A. K. and De, A. K., Environmental Studies (2e), New Age Publishers, New Delhi, 2009.
3. Bharucha E., Text book of Environmental Studies for undergraduate courses, (4e), Universities Press, Hyderabad, 2013.

EEE1001: ELECTRICAL TECHNOLOGY [2 0 0 2]

DC Circuit Analysis: Kirchhoff's laws, Voltage and Current Source Transformation, Analysis of resistive circuits by Mesh & Node analysis methods, DC Network Theorems: Superposition, Thevenin, Maximum Power Transfer. AC circuit Analysis: Single phase AC Circuits: Phasors, Analysis of Series RL, RC and RLC circuits, Impedance, Power, Power factor. Three phase AC Circuits: Types of connections, Line & Phase values. Magnetic Circuits: Electromagnetic Induction, Self-Inductance, Mutual Inductance, Coupling Coefficient and dot rule. Single phase transformer: Introduction, Construction, Operating principle, Emf equation, Losses and Efficiency. Clean Energy Systems & Electric Mobility: Solar Energy, Wind Energy, Electric Vehicles (EV): Architecture, Key components, EVs as source and load.

Reference Books:

1. I.J. Nagrath and D. P. Kothari, Basic Electrical Engineering (4e), Tata McGraw Hill (2019).
2. T.K. Nagasarkar and M.S. Sukhija, Basic Electrical Engineering (3e), Oxford University Press, 2017.
3. E. Hughes, Electrical and Electronic Technology (9e), Pearson Education, 2008.
4. D. C. Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 2012.
5. S. N. Singh, Basic Electrical Engineering, PHI, 2011.

CIV1002: ENGINEERING MATERIALS AND MECHANICS [2 1 0 3]

Engineering Materials: Introduction: Structure of engineering materials, different materials properties. Structure - Property Relationship: Metals, alloys, glass, ceramics, organic polymers and composite materials. Engineering Mechanics: Introduction: Introduction to engineering mechanics and application of mechanics of material in different branches of science. Force systems, moment of force, Varignon's theorem, equilibrium and resultant of forces, Degrees of freedom, Free body diagram, reactions, equations of equilibrium and static indeterminacy. Friction: Introduction to friction, principle of friction and applications of friction. Virtual Work: Introduction, concept of virtual work, principle of virtual work, application of virtual work on beams carrying point load, uniformly distributed load and framed structures. Kinetics of Motion: Introduction, Torque, Mass Moment of Inertia of a thin rod, circular ring, solid sphere and radius of gyration. The kinetic energy of rotation, body motion connected to a chain and pulley. Concept of stress and strain: Simple stress and strain, Hooke's law, shear stress and volumetric stress, Elastic constant and their relationship, Poisson's ratio. Stresses in composite and compound bars. Thermal and Hoop stress in the compound section and cylindrical shell. Transformation of stress and strain: Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain. Centroid and Moment of Inertia: Centroid and Moments of inertia of simple and composite bodies.

References:

1. J. Martin, Materials for Engineering, CRC Press, UK, 2006.
2. R. S. Khurmi, Engineering Mechanics, S. Chand Publication, Delhi, 2019.
3. R. C. Hibbeler, Engineering Mechanics, Pearson Education, 2017.
4. S. Timoshenko, D. H. Young, J. V. Rao and S. Pati, Engineering Mechanics, McGraw-Hill Education, 2017.

MEE1038: CREATIVITY & INNOVATION IDEA LAB [1 0 2 2]

Introduction: Definition of creativity and innovation, purpose, examples, innovation theories, economics. The brain: Features, habits, lateral thinking, critical thinking, brainstorming, mind mapping, TRIZ (Theory of Inventive Problem Solving). Creative and innovative examples: Aerospace, agriculture, biomedical, chemical and transport engineering applications. Design Thinking: Empathize, define, ideate, prototype and testing, product development methodology. Introduction to AR and VR: Clarification of AR (Augmented Reality), VR (Virtual Reality), and MR (Mixed Reality). Application areas: Product Design, Aerospace, Education & Training, Healthcare, Infrastructure, and Defence. Intellectual Property Rights (IPR) and commercialization: Types of IPR, protecting and managing IPR, commercialization through tech transfer vs startup. Arduino: Introduction of Arduino and its different modules, Basic programming environment of Arduino, interfacing with different sensors and actuators. Raspberry Pi (RPi): Introduction, interfacing different elements (sensors & actuators) with RPi3D Printing: Overview of 3D printing technology, applications, Filament and selection criteria, Adjustment of resolution, Model Orientation, 3D printing errors. Experimental work: Practical in AR/VR, CNC machines, IoT Tech and 3D printing.

References:

1. Stuart G Walesh, Introduction to Creativity and Innovation for Engineers, Pearson, 2017.
2. Keith Sawyer, Zig Zag: The Surprising Path to Greater Creativity, Jossey-Bass, 2013.
3. H Scott Fogler and Steven E LeBlanc, Strategies for creative problem solving, Prentice Hall, Second edition 2008.
4. Hiran Vedom, AIM Prime Paybook: A Practical Guide to Science based Entrepreneurship, Venture Center Pune and Atal Innovation Mission, 2022.

BIT1001: BIOLOGY FOR ENGINEERS [2 0 0 2]

Biomolecules and their applications: Carbohydrates (e.g., cellulose-based water filters etc.), Lipids (e.g., biodiesel etc.), Nucleic acids (e.g., RNA and DNA vaccines, cloning), Proteins (e.g., proteins in food applications, enzymes in biosensors etc.). Biomimicing: Brain and neurons - evolution of Artificial Neural Networks, Machine Learning techniques. Eye (Digital Camera), electronic nose, electronic tongue, electronic skin. Bioinspired materials: Echolocation (ultrasonography, sonars), Photosynthesis (bionic leaf). Lotus leaf effect (self-cleaning surfaces), Plant burrs (Velcro) Trends in Bioengineering: Bioprinting techniques and materials, 3D printing of ear, and skin. Muscular and Skeletal systems as scaffolds, Bioimaging and Artificial Intelligence for disease diagnosis. Self-healing Bioconcrete. Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals).

References:

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011.
2. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.
3. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
9. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.

10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

MEE1037: MATLAB For Engineers Lab [0 0 2 1]

Introduction to MATLAB environment and basic commands, Interactive Computation, Vectors and Matrices, Matrix Operations and Manipulations, Character strings, Creating Plots, Generic Functions, Saving and Loading Data, Programming in MATLAB: Anonymous Functions, Symbolic Math Toolbox, Relational and Logical operations, Loops, Polynomials, Curve Fitting, Interpolation, and Numerical Techniques, Solving Equations (ODE and PDE), Simple engineering problems. Engineering Applications: Introduction to MATLAB Toolboxes with examples based on core engineering.

Reference:

1. Getting Started With MATLAB, Rudra Pratap, Oxford Press

DOA1002: WELLNESS AND COMMUNITY SERVICES [1 0 0 1]

Option 1: Yoga and Wellness

Meaning and definition of wellness; work-life balance. Components of total health and fitness; relationship between physical activity and wellness. Introduction to yoga: basic concepts from Indian traditions. Practice of selected asanas (postures) and their benefits. Introduction to basic pranayama (breathing techniques) and relaxation. Stress management through yoga.

References:

1. Saraswati, S. N. (2012). Gheranda Samhita/Commentary on the Yoga Teachings of Maharshi Gheranda. Yoga Publications Trust.
2. Hoeger, W. W. K., et al. (2016). Fitness and Wellness, 12th Ed., Cengage Learning.
3. Park, K. (2009). Park's Textbook of Preventive and Social Medicine, 20th ed., Banarsidas Bhanot.

Option 2: Sports and Physical Education

Introduction to physical education and its objectives. Components and importance of physical fitness. Basic anatomy and physiology relevant to exercise. Principles of sports training, warming up, and skill development. Correct posture and prevention of common injuries. Stress management through physical activity, yoga, and meditation.

References:

1. Saraswati, S. N. (2012). Gheranda Samhita/Commentary on the Yoga Teachings of Maharshi Gheranda. Yoga Publications Trust.
2. Hoeger, W. W. K., et al. (2016). Fitness and Wellness, 12th Ed., Cengage Learning.
3. Park, K. (2009). Park's Textbook of Preventive and Social Medicine, 20th ed., Banarsidas Bhanot.

Option 3: National Cadet Corps (NCC)

Introduction to NCC: aims, organization, and incentives. Basics of personality development and leadership. Health and hygiene: personal and food hygiene, basic first aid. Introduction to yoga and physical exercises. Environmental awareness: conservation, pollution control.

References:

1. Gupta, R. (2016). NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, Ramesh Publishing House.
2. Park, K. (2009). Park's Textbook of Preventive and Social Medicine, 20th ed., Banarsidas Bhanot.
3. Bharucha, Erach (2005). Textbook of Environmental Studies, Universities Press.

Option 4: National Service Scheme (NSS)

Introduction to NSS: history, aims, and organizational structure. Roles and responsibilities of NSS volunteers. Community mobilization and volunteerism (shramdan). Youth leadership and life competencies (communication, problem-solving). Social harmony, national integration, and citizenship.

References:

1. Gupta, R. (2016). NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, Ramesh Publishing House.
2. Park, K. (2009). Park's Textbook of Preventive and Social Medicine, 20th ed., Banarsidas Bhanot.
3. Bharucha, Erach (2005). Textbook of Environmental Studies, Universities Press.

Third Semester**MAS2001: STATISTICS AND PROBABILITY [3 0 0 3]**

Probability Theory and Random Variables: Probability (Only One Lecture), Random variables, Cumulative distribution functions, Discrete random variables, Continuous random variables, Independent random variables, Probability mass and density functions, Expectation of random variables, Chebyshev's inequality, Central limit theorem. Probability distribution: Binomial, Poisson, Uniform, Normal, Exponential Theory of Estimation: Maximum Likelihood and method moment estimation, Sufficient statistics, Bayesian estimation, Confidence intervals for means. Tests of Statistical Hypothesis: Introduction, Parameter and Statistic, Standard error, Statistical hypotheses, Critical region, Tests of hypotheses and significance, Type I and Type II errors, level of significance. Test about one mean, Test about equality of two means, Test of variances, Chi square test, Analysis of Variance.

Reference Books:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B., An Outline of Statistical Theory, Vol. II, 3rd Edn. World Press, Kolkata, 2005.
2. Kendall and Stuart, Advanced Theory of Statistics Vol.-II, Charles Griffin & Co. Ltd, London, 1961.
3. Casella, G. and Berger, R.L., Statistical Inference, Second Edn. Thomson Duxbury, 2002.
4. Hogg, R.V. and Tanis, E.A., Probability and Statistical Inference, 3rd Edn. Macmillan Publishing Co., Inc., 1988.
5. Feller, W., An Introduction to Probability Theory and Its Applications, Vol. 1, 3rd Edition, John Wiley, 1968.

MEE2001: ENGINEERING ECONOMICS [3 0 0 3]

Concept and Value Analysis, Economic Decision Making, Types of Estimates, Accounting and Control, Elements of Cost, Prime Cost, Overheads, Types of Cost, Process Cost & Cost of Production, Break Even Analysis, Inventory Control & Management, EOQ, Financial Analysis, Simple payback, Return on Investment, NPV (Net Present Value), IRR (Internal rate of Return), Life Cycle Cost Method, Sensitivity Analysis, Project Financing Options. Budget and Budgetary Control, Concept of Budgeting, Type of Budgets. Risk - Risk vs Return, System Concept and Value Analysis, System Analysis & System Engineering, Value Analysis. Replacement Analysis, Depreciation, Network Analysis, Network Techniques, PERT (Programme evaluation and review technique), CPM (Critical Path Method).

Reference:

1. R. Panneerselvam, Engineering Economics, Prentice Hall of India, Latest Edition.
2. Riggs, D.D. Bedworth and S.U. Randhawa, Engineering Economics, McGraw-Hill Education, Latest Edition.

3. P.L. Mehta, Managerial Economics, Sultan Chand & Sons, Latest Edition.
4. E.L. Grant, W.G. Ireson and R.S. Leavenworth, Principles of Engineering Economic Analysis, John Wiley, Latest Edition.
5. G. J. Tiesen, W.J. Fabrycky and H.G. Tiesen, Engineering Economy, Prentice Hall of India, Latest Edition.

CIV2101: FLUID MECHANICS [4 0 0 4]

Introduction: Definition of fluids, fluid Properties of fluids: density, viscosity, and surface tension, Units and dimensions in fluid mechanics, Fundamental principles and applications in civil engineering, Hydrostatics: Pressure distribution in fluids, Buoyancy and Archimedes' principle, Manometry and pressure measurement in civil engineering applications, Fluid Kinematics: Description of fluid flow, Eulerian and Lagrangian approaches, Streamlines, flownet in civil engineering systems. Fluid Dynamics: Euler's and Bernoulli's Equations, Euler's equation of motion, Bernoulli's theorem and its applications to pressure distribution. Impact on civil engineering structures Pipe Flow: Laminar and turbulent flows in pipes and channels, Pipe flow and pressure drop calculations, Friction losses in pipes, Minor losses and fittings, Dimensional Analysis Buckingham Pi theorem, Dimensionless numbers in fluid mechanics, Open Channel Flow: types of flow in open channels, Specific energy, and critical flow, gradually varied and rapidly varied flows in civil engineering systems. Flow Measurements: Pitot tubes and orifices, Venturi meters and flow nozzles, Weirs and flumes. Pumping and Pump Selection: Pump types and characteristics, Pump selection for civil engineering projects Energy efficiency and considerations in pump design, turbines. Introduction to Hydraulics: Water distribution systems in civil engineering, Hydraulic analysis of networks and pipes, hydraulic structures

Textbooks:

1. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publications, New Delhi, India, 2018.
2. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd ed., Rajsons Publications Pvt Ltd, New Delhi 2019.
3. R.K. Rajput, A Textbook of Fluid Mechanics, S. Chand Publication, Jaipur, India, 2018.

Reference Books:

1. V. L. Streeter, E. B Wiley, Fluid Mechanics, McGraw Hill book Co., New York. 1998.
2. Çengel Yunus, John M Cimbala, Fluid Mechanics Fundamentals and Applications, Tata McGraw Hill Education Pvt. Limited New Delhi, 2011.
3. R.J. Garde, Fluid Mechanics through problems, New age international Pvt. Ltd., Publishing, New Delhi. 2003.

CIV2102: SURVEYING AND PRACTICES [3 0 3 4]

Surveying: Principles of surveying. Errors and their adjustment. Maps: scale, coordinate system. Distance and angle measurement. Levelling and trigonometric levelling. Traversing and triangulation survey. EDM and Total station. Curves setting. Photogrammetry: Types of photographs, Flying height and scale. Remote Sensing: Basic concept, Electromagnetic spectrum, Spectral signature. GIS: Data Sources, Data Models and Data Structures. Chain surveying: direct and indirect ranging; uses of cross staff. Compass surveying; surveyor's compass and prismatic compass. Levelling: profile levelling, fly levelling, reciprocal levelling, and inverted staff reading problem. Theodolite, Tachometric survey. Total station and Curve setting.

Textbooks:

1. K.R. Arora, Surveying Vol. I, 17th ed., Rajsons Publications, New Delhi, India, 2019.
2. S. K. Duggal, Surveying Vol. 1, 5th ed., McGraw-Hill, New Delhi, India, 2019.
3. N. N. Basak, Surveying & Levelling, 2nd ed., McGraw Hill Education, New Delhi, India, 2017.

Reference Books:

1. B.C. Punmia, Surveying Vol. I, 17th ed., Laxmi Publications, New Delhi, India, 2016.
2. R. Agor, Advanced Surveying, 5th ed., Khanna Publishers, New Delhi, India, 2016.
3. G. Satheesh, R. Sathikumar, N. Madhu, Advanced Surveying, 2nd ed., Pearson, Pallavaram, Chennai, India, 2017.

CIV2103: STRENGTH OF MATERIALS [3 1 0 4]

Thick and Thin Cylinders and Shells. Stresses due to Impact and Suddenly applied load on compound bars. Mohr's circle of stress and strain. Failure theories: Introduction - Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory. Shear force and bending moment diagrams for point load, UDL, UVL and their combinations for different types of statically determinate beams. Determination bending stresses and section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections. Determination of slope and deflection using Macaulay's method, moment-area method and conjugate beam method. Stability of Columns- Euler's formula, Rankine-Gordon formula. Torsion of circular shaft. Analysis of Arches and Suspension Bridge.

Textbooks:

1. R. K. Rajput, Strength of Materials, 7th ed., S Chand & Co., Jaipur, India, 2018.
2. B.C. Punmia, Strength of Materials and Mechanics of Structures: Vol. I, 10th ed., Laxmi Publications (P) Ltd., New Delhi, India, 2018.
3. R. Subramanian, Strength of Materials, 3rd ed., Oxford University Press, New Delhi, India, 2016.

Reference Books:

1. P.S. Gahlot, D. Gehlot, Fundamentals of Structural Mechanics, 1st ed., CBS Publishers & Distributors Pvt. Ltd., Bengaluru, India, 2012.
2. S. B. Junarkar, H. J. Shah, Mechanics of Structures Vol.-I, 3rd ed., Charotar Publishing House, Gujarat, India, 2013.
3. R.K. Kaushik, Strength of Materials, Dreamtech Press, New Delhi, India, 2019.

CIV2104: BUILDING MATERIALS AND CONSTRUCTION TECHNOLOGY [4 0 0 4]

Functions of buildings and structures in general. Loads on buildings as per IS 875, IS 1893 and NBC. Functional requirements of buildings and the necessity of byelaws. Cement: Types, production, consistency and setting. Lime and supplementary cementation materials. Introduction to Calcined Clay Limestone Cements (LC³). Fly ash bricks and mortar and their properties. Requirements of walls and types of walls. Structural steel, properties and its behaviour in service and corrosion. Plastics and Polymers in construction, admixture paints, sealants and adhesives. Timber, plywood, glass, and aluminium. Classification of buildings, load-bearing and framed structure; Sequence of construction activity; excavation, foundations, Damp Proofing; Construction joints, brick and stone masonry, stairs, arches & lintels, Temporary structural support viz. shoring, shuttering, underpinning and scaffolding; Fabrication and Erection work; Construction practices for plastering, pointing, painting, flooring.

Textbooks:

1. P. C. Varghese, *Building Materials*, 2e, Prentice Hall India Learning Private Limited, 2015.
2. A. K. Misra, *Building Materials and Construction*, 1e, S Chand Publishing, 2017.
3. S.C. Rangwala, *Building Construction*, 34e, Charotar Publishing House, New Delhi, India, 2022.
4. B. C. Punmia, A. K. Jain and A. K. Jain, *Building Construction*, 12e, Laxmi Publication, 2025.

5. P. C. Varghese, *Building Construction*, 2e, Prentice Hall India Learning Private Limited, 2017.

Reference Books:

1. SP 20, Handbook on Masonry Design and Construction, B.I.S. Publication, 1991.
2. SP 62 (S&T), Handbook on Building Construction Practices, B.I.S. Publication, 1997.

CIV2130: MATERIAL TESTING LABORATORY [0 0 2 1]

Tension and shear tests on mild steel, hardness tests by Rockwell and Brinell methods. Impact test by Izod and Charpy methods. Test on Bricks - Dimensional tolerance, Compressive Strength, Absorption, Efflorescence. Tests on Flooring Tiles: Wear resistance, Breaking Strength Test, Absorption. Determination of specific gravity, Fineness, standard consistency, setting time, and soundness of cement. Determination of water absorption, specific gravity and particle size distribution. Determination of workability of concrete by slump test, compaction factor test and Vee-Bee consistometer method. Determination of compressive, and flexural strength of concrete. Introduction to Non-Destructive test of concrete.

Textbooks:

1. Technical Teachers Training Institute, *Laboratory Manual of Strength of Materials*, Oxford University Press, 2010.

References Books:

1. Technical Teachers Training Institute, *Laboratory Manual of Strength of Materials*, Oxford University Press, 2010.
2. IS 3495 (Part 1 to 5):1992, *Methods of Tests of Burnt Clay Building Bricks*, 2019.
3. IS 4031 (Part 1 to 10): 1996, *Methods of Physical Tests for Hydraulic Cement*, 2021
4. IS 13311 (Part 1 and 2): 1992, *Method of Non-destructive Testing of Concrete*, 2018

CIV2131: FLUID MECHANICS LAB [0 0 2 1]

Calibration of V - Notch, Rectangular notch, Cippoletti Notch, Broad crested weir, curved weir, orifices, mouth pieces, Venturimeter, orifice meter, Venturi flume, standing wave flume, Determination of Friction factor of pipes, Tests on Impact of jet on Vanes, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan Turbine.

Textbooks:

1. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publications, New Delhi, India, 2018.
2. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, 22nd ed., Rajsons Publications Pvt Ltd, New Delhi 2019.
3. R.K. Rajput, A Textbook of Fluid Mechanics, S. Chand Publication, Jaipur, India, 2018.

Reference Books:

1. V. L. Streeter, E. B Wiley, *Fluid Mechanics*, McGraw Hill book Co., New York. 1998.
2. Çengel Yunus, John M Cimbala, *Fluid Mechanics Fundamentals and Applications*, Tata McGraw Hill Education Pvt. Limited New Delhi, 2011.
3. R.J. Garde, *Fluid Mechanics through problems*, New age international Pvt. Ltd., Publishing, New Delhi. 2003.

Fourth Semester**DOA2101: PRINCIPLES OF MANAGEMENT [3 0 0 3]**

Management: Definition, Functions, Concept, Scope of Management, Nature of Management, Levels of Management, Managerial Skills, Roles of a Manager, Difference between Management and Administration Evolution of Management Thoughts, Classical Approach- scientific management, Administrative Management and Bureaucracy; NeoClassical Approach: Human relations movement and Behavioural approach; Modern Approach: Quantitative approach, Systems approach, and Contingency approach; Forms of organization: Sole Proprietorship, Partnership, Co-operative Organization, and Company; Functions of Management: Planning, Concept, Importance, Strategies, Planning Premises, Decision making, Management by Objectives (MBO), Process of Planning: Organizing: Concept, Importance, Process of Organizing, Types of Organizational Structures, Span of Management, Line and Staff Relationship, Centralization and Decentralization; Staffing: Concept, Scope of Staffing, Manpower Planning, Selection & Training, Performance Appraisal; Directing: Concept, Importance, Need Hierarchy theory, Leadership: Concept, Characteristics of Leadership, and Leadership styles; Communication: Types, Process, Channels and Barriers of Communication; Coordinating: Definition, Characteristics, Principles and Techniques of Coordination, Concept of Managerial Effectiveness; Controlling: Concept, Importance, Process of Controlling, Management Control Techniques, Effective Control Systems.

Reference Book(s):

1. Stephen P. Robbins, Mary Coulter, David De Cenzo, Fundamentals of Management, (9e), Pearson Education India, 2016.
2. Mitra, J.K., Principles of Management, Oxford Publication, 2017.
3. Koontz, H., Essentials of Management, (11e), Tata McGraw Hill Education, 2020.
4. Bhushan, Y.K., Fundamentals of Business Organization and Management, (9e), Sultan Chand & Sons, 2014.
5. PC Tripathi, PN Reddy, Ashish Bajpai, Principles of Management, (7e), Tata McGraw-Hill Education, 2021.

CIV2201: STRUCTURAL ANALYSIS [3 1 0 4]

Introduction to indeterminate structures, degrees of freedom per node with static and kinematic indeterminacy. Slope and Deflection of fixed beams, continuous beams and frames by three moments theorem and conjugate beam method. Castigliano's theorem and its applications. Influence line diagram of moving loads on beam and frame. Analysis of indeterminate beams and frames by moment distribution method and slope-deflection method. Approximate analysis of frames by portal method and cantilever method. Introduction to matrix method of structural analysis.

Textbook:

1. S. Ramamrutham, R. Narayanan, (11e), Theory of Structures, Dhanpat Rai Publications, New Delhi, 2020.
2. B. C. Punmia, Strength of Materials and Mechanics of Structures: Vol. I, (10e), Laxmi Publications (P) Ltd., 2018.
3. S. P. Gupta, G. S. Pandit, R. Gupta, (5e), Structural Analysis - A Matrix Approach-Volume 2, McGraw Hill, New Delhi, 2018.

Reference book:

1. C. K. Wang, Indeterminate Structural Analysis, Indian Ed., McGraw Hill Education, 2017

2. S. Timoshenko, D. H. Young, *Mechanics of Structures*, (3e), Mc Graw Hill Book Co., 2015
3. R. C. Hibbler, *Structural Analysis*, (8e), Pearsons, 2014

CIV2203: ENVIRONMENTAL ENGINEERING - 1 [4 0 0 4]

Sources of water, water quality requirement for different applications, characteristics of water and quality standards, water quality indices; water demand, population forecasting methods, unit processes and operations; Drinking Water Treatment: primary, secondary & tertiary treatment, Component of water supply system, conveyance of water, distribution system, water supply appurtenances, service reservoirs and design. Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits. Characteristics, generation, collection and transportation of solid wastes, Sanitary landfills, technologies for processing of MSW: incineration, composting, pyrolysis. engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal). Definition, measurements and limits.

Textbooks:

1. S. K. Garg, *Water Supply Engineering*, 37e, Khanna Publishers, New Delhi, 2012.
2. G. S. Birdie, *Water Supply and Sanitary Engineering*, Dhanpath Rai and Sons, New Delhi, 2012.
3. B. C. Punmia, *Water Supply and Sanitary Engineering*, Dhanpath Rai and Sons, New Delhi, 2010
4. Modi, Sethi, *Water Supply and Sanitary Engineering*, Dhanpath Rai and Sons, New Delhi, 2010.
5. C. S. Rao, *Environmental Pollution Control Engineering*, New Age International, 2007.

Reference Books:

1. *Manual on water supply and treatment CPHEEO*, Ministry of Urban development, New Delhi, 1991.
2. H. S. Peavy, D. R. Rowe and G. Tchobanoglous, *Environmental Engineering*, Mc-Graw - Hill International, 1985.
3. G.M. Masters & W. Ela. *Introduction to Environmental Engineering and Science*, PHI Publishers, 2008.

CIV2204: CONCRETE TECHNOLOGY [3 0 0 3]

Introduction to concrete, its components and use. Hydraulic cements: Manufacturing, emissions, composition, types, hydration and microstructural development of Portland cements; Special hydraulic cements. Aggregates: Properties, types of aggregates, classification of aggregates, grading of aggregates, packing and void contents, adsorption and absorption properties, effects of aggregates on concrete properties, interfacial transition zone, lightweight aggregates, recycled aggregates. Mix design of concrete: roles of water-to-cement ratio, water content, chemical admixtures, mineral additives, and aggregates. Chemical admixtures: Water reducers, superplasticisers, accelerators, retarders, air-entraining admixtures. Mineral additives: Slags, fly ashes, rice husk ash, metakaolin, calcined clays, silica fume, limestone powder. Properties of fresh concrete: Workability, rheology, shrinkage, bleeding, test methods. Durability of concrete: Mass transport in concrete, carbonation, chloride ingress, sulphate attack, salt attack, frost, salt scaling, alkali silica reaction, repair. Cracking: Chemical shrinkage, autogenous shrinkage, drying shrinkage, plastic shrinkage, thermal cracking. Non-destructive testing and repair of concrete. Quality in practice: provisions of IS456.

Textbooks:

1. M.S. Shetty and A.K. Jain, *Concrete Technology: Theory and Practice*, 8e, S. Chand and Company, 2018.
2. M.L. Gambhir, *Concrete Technology: Theory and Practice*, 5e, Tata McGraw-Hill, 2017.
3. P. K. Mehta and P. J. M. Monteiro, *Concrete Microstructure, Properties and Materials*, 4e, McGraw-Hill Education India, 2013.

Reference Books:

1. A. M. Neville, Properties of Concrete, McGraw-Hill, Singapore, 2012.
2. IS 10262:2009 Guidelines for concrete mix design proportioning.
3. IS 516:1959 Method of Tests for Strength of Concrete, Reprint 2006.

CIV2205: CONSTRUCTION PROJECT MANAGEMENT [3 1 0 4]

Construction Projects: Classification, construction team, conceptual planning stage, design stage, procurement stage, execution, and close-out stage. Project management: Objectives and function, Work Breakdown Structure, planning, scheduling, types of schedules. Network Schedules: rules, preparation, and numbering. CPM analysis: activity times, floats, critical path. PERT Analysis: time estimates, slack, critical path, uncertainty in project duration. Project Costs: direct and Indirect costs, time-cost trade-offs. Construction equipment management: Classification, earthmoving, hoisting, hauling, piling, compaction, and concreting equipment, selection of construction equipment, depreciation, owning and operating cost. Construction safety management: Need, case studies on construction accidents, safety acts and regulations, contract safety specifications, safety and health policies, responsibilities of stakeholders, accident costs. Introduction to lean construction and Building Information Modeling.

Textbooks:

1. B. Sengupta, M Guha, Construction Management and Planning, McGraw Hill, 2016 Reprint
2. B. C. Punamia, K K Khandelwal, Project Planning and Control with PERT and CPM, Laxmi Publications Pvt Ltd, 2014 Reprint
3. S. C. Sharma, Construction Equipment and Management, Khanna Book Publishing Company, 2016.
4. N.K. Jha, D.A. Patel, A. Singh, Construction Safety Management, Pearson Education, 1st Edition, 2022.

References Books:

1. D. Lock, Project Management, 10th Edition, 2013, Routledge, Taylor & Francis.
2. Peurifoy, Schexnayder, Shapira, Construction Planning, Equipment and Methods, Tata McGraw Hill, 2015 Reprint.
3. SP 70 : 2001, Handbook on Construction Safety Practices, Bureau Of Indian Standards, New Delhi.

CIV2230: ENVIRONMENTAL ENGINEERING LABORATORY [0 0 2 1]

Determination of solids - total solids, suspended solids, dissolved solids, volatile solids, fixed solids, settleable solids. Determination of turbidity, pH, alkalinity, acidity, chloride, fluorides, dissolved oxygen and total hardness in water sample, Jar test. Residual chlorine and chlorine demand in a given water sample. Determination of percentage available chlorine in Bleaching powder. Determination of biochemical oxygen demand and chemical oxygen demand in a given water sample. Determination of. Total count test and determination of most probable number in water sample. Determination of PM10 and PM2.5, sulphur dioxide and oxides of nitrogen in ambient air. Demonstration of pipes, joints and fixtures, sanitary fittings.

Textbooks:

1. Standard Methods for the Examination of water and wastewater: AWWA, APHA, WPCF, 2012.
2. IS - 3025 - 1964 - Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry, IIT New Delhi.

Reference Books:

1. Lab Manual, ISO 14001 Environmental Management, Regulatory Standards for Drinking Water and Sewage disposal
2. Clair Sawyer and Perry McCarty and Gene Parkin, "Chemistry for Environmental Engineering and Science", McGraw-Hill Series in Civil and Environmental Engineering, McGraw Hill, New York. 2002.

CIV2270: PROJECT BASED LEARNING-2 [0 0 6 3]

Students are required to work on projects relevant to Civil Engineering discipline under the guidance of mentors. Project work will be done in IV semester. The educational value of project-based learning is aimed to build students creative capacity to work through different scenario, commonly in small teams. Typically, project-based learning takes through the following phases or steps: identifying a problem and potential solution based on feedback from experts, instructors, and/or peers. Depending on the goals of the instructor, the size and scope of the project can vary accordingly.

Fifth Semester

CIV3101: GEOTECHNICAL ENGINEERING [3 1 0 4]

Introduction: Definition, Historical development of Geotechnical Engineering. Basic Definitions and Relationships: Phase relationships of soil, Basic definitions, Volume relationships, Weight relationships, Relative density. Determination of Index Properties: Particle size distribution by sieve and sedimentation analysis and Consistency limits. Classification of Soils: Gradation of soil, Particle size classification, Unified Soil Classification and Indian Standard Classification. Soil Structure and Clay Mineralogy: Inter-particle forces; Diffused Double Layer, Clay minerals and their properties. Flow through Soils: Darcy's law, Factors affecting and Determination of permeability. Seepage Analysis: Seepage forces, One dimensional and two-dimensional flow, Laplace equation, Stream and potential functions, Uses of flow net, Determination of phreatic line of an earthen dam and Design of filters. Stress in Soil Mass: Total, effective and neutral stress, Effective stress principle, Stress point and Stress path, Calculation of stresses, Soil-water systems-capillarity and Quick sand phenomenon. Shear Strength of Soils: Mohr's circle, Mohr's strength theory, Mohr-Coulomb's strength theory, Determination of shear. Compaction of Soils: Theory of compaction, Laboratory compaction tests, Factors affecting compaction, Methods of compaction and types of equipment used in field.

Textbooks:

1. B.C. Punmia, A.K. Jain and A. K. Jain, *Soil Mechanics and Foundations*, 18e, Laxmi Publications, 2023.
2. V. N. S. Murthy, *Textbook Of Soil Mechanics and Foundation Engineering*, 1e, CBS Publishers and Distributors Pvt Ltd, 2018.
3. K. R. Arora, *Soil Mechanics and Foundation Engineering*, 7e, Standard Publishers Distributors, 2017.

Reference Books:

1. K. Terzaghi, R. B. Peck and M. Gholamreza, *Soil Mechanics in Engineering Practice*, 3e, John Wiley and Sons, Inc., 1996
2. T. W Lambe and R. V. Whitman, *Soil Mechanics*, John Wiley and Sons, Inc., 1991.

CIV3102: DESIGN OF REINFORCED CONCRETE STRUCTURES [3 1 0 4]

Introduction: Overview and scope of the subject. Limit state method design and analysis of singly reinforced, doubly reinforced, and flanged beams. Anchorage bond, Flexural bond. Splicing of reinforcement, Anchorage. Limit state Design of one-way and two-way slabs. Design and detailing of a doglegged staircase. Design of columns and footings and use of SP16 handbook. Determination of short-term, and long-term deflections of R.C beams & Crack width. Bar bending schedule.

Textbooks:

1. Pillai S. U., Menon D., *Reinforced Concrete Design*, (4e), Tata McGraw Hill, 2021.
2. Raju N. K., *Design of Reinforced Structures: IS 456:2000*, (4e), CBS Publisher and Distributors Pvt. Ltd., 2019
3. Shah H. J., *Reinforced Concrete Vol. I Part 1*, (12e), Charotar Publishing House Pvt. Ltd., 2021.
4. Shah H. J., *Reinforced Concrete Vol. I Part 2*, (12e), Charotar Publishing House Pvt. Ltd., 2021
5. IS 456:2000, *Plain and Reinforced Concrete Code of Practice*, Reaffirmed 2021, Bureau of Indian Standards, 2022
6. SP 16, *Design Aids for Reinforced Concrete to IS 456:1978*, Bureau of Indian Standards, 1980.

Reference Books:

1. Subramanian N., *Design of Reinforced Concrete Structures*, (3e), Orford University Publications, 2014.
2. Verghese P. C., *Limit State Design of Reinforced Concrete*, (2e), Prentice Hall of India, 2009.

CIV3103: ENVIRONMENTAL ENGINEERING - 2 [3 0 0 3]

Wastewater: Introduction, characteristics of sewage. Collection of sewage, components of sewerage systems and layout, quantity of sanitary sewage and variations. Hydraulic design of sewers. Treatment of sewage: Various units and their purposes, layout of different units, preliminary treatment, screening and grit removal units, oil and grease removal, primary treatment, secondary treatment, activated sludge process, Membrane bioreactor technology, Sequencing batch reactor, trickling filter, sludge digestion and drying beds, stabilization pond, septic tank, soakage systems, recent trends in sewage treatment. Tertiary and advanced wastewater treatment - nutrient removal. Waste water disposal and reuse: Guidelines for effluent disposal. Disposal of sewage by dilution, self-purification of streams, sewage disposal by irrigation, sewage farming and wastewater reuse. Drainage system and building and community patterns.

Textbooks:

1. C. Sawyer, P. McCarty and G. Parkin, *Chemistry for Environmental Engineering and Science*, 5e, McGraw Hill, New Delhi, 2003.
2. S. K. Garg, *Environmental Engg- II Volume - II*, Khanna Publishers, New Delhi, 2015.
3. G. S. Birdie, *Water Supply and Sanitary Engineering*, Dhanpat Rai and Sons, New Delhi, 2012

Reference Books:

1. Standard Methods, APHEA, *American Public Health Association*, 1015 Fifteenth Street, NW, Washington, DC.
2. Manual on sewage and sewage treatment CPHEO, Ministry of Urban development, New Delhi.
3. IS Standards 2490 - 1974, 3360 - 1974, 3307 - 1974, Indian Standard Institution, Manak Bhavan, New Delhi.
4. Metcalf, Eddy, *Waste Water Engineering - Treatment and Reuse*, Tata McGraw Hill, New Delhi, 1974.

CIV3104: HIGHWAY ENGINEERING [3 1 0 4]

Importance of road transport and highway development in India; Road development plans: Nagpur, Bombay, and Vision 2021; Bharatmala & Gati Shakti initiatives; Classification of roads (IRC), NH network & rural roads (PMGSY). Highway alignment: factors, surveys (remote sensing & GIS applications). Design standards (IRC:73, 86, 92); Cross-sectional elements; Design of horizontal and vertical alignment; Sight distances: SSD, OSD, ISD; Design of superelevation, transition curves, gradients. Traffic characteristics and surveys; Traffic density and passenger car units; Intersection design and control (signals, roundabouts, interchanges); Intelligent Transport Systems (ITS) and smart mobility; Traffic signs and road markings (IRC:67, IRC:35); Capacity analysis, Level of Service

(LOS), urban traffic models. Materials: Soil, aggregates, bitumen, modified binders. Material characterisation and testing (as per IRC/SP). Design of flexible pavements: CBR, IRC:37-2018. Design of rigid pavements: IRC:58-2015; Use of mechanistic-empirical methods and HDM-4 basics. Highway construction methods: WBM, WMM, DBM, BC, PQC; Quality control and assurance in construction; Sustainable practices: Use of waste materials (plastic, fly ash), green pavements; Maintenance strategies: Preventive, routine, and rehabilitation; Pavement evaluation: FWD, Benkelman Beam Deflection; Pavement Management Systems (PMS).

Textbooks:

1. S. K. Khanna, C. E. G. Justo and A. Veeraragavan, *Highway Engineering*, 10e, Nem Chand & Bros., 2017
2. L. R. Kadiyali, *Traffic Engineering and Transport Planning*, 9e, Khanna Publishers, 2028.
3. S. K. Sharma, *Principles, Practice and Design of Highway Engineering*, 10e, John Wiley & Sons, 2015.

Reference Books:

1. E.J. Yoder and M.W. Witczak, *Principles of Pavement Design*, 2e, John Wiley & Sons, 1991.
2. IRC Codes: IRC:73, IRC:86, IRC:92, IRC:35, IRC:37, IRC:58, IRC:SP:89, IRC:SP:70, IRC:SP:76, IRC:81, IRC:67, IRC:SP:41, IRC:SP:84, IRC:SP:55, IRC:SP:88, IRC:SP:98.
3. MoRTH Specifications and Guidelines.

CIV3130: GEOTECHNICAL ENGINEERING LAB [0 0 2 1]

Determination of water content, specific gravity, particle size distribution of coarse and fine-grained soils. Atterberg's limits of soil; Determination of dry density of natural soil; Determination of relative density of coarse-grained soils. Determination of compaction characteristics of soils using standard Proctor and modified Proctor method; Determination of California Bearing Ratio (CBR) of soil in dry and wet conditions. Determination of Unconfined Compressive Strength (UCS) of soil; Determination of shear strength parameters of soil using direct shear test; Determination of shear strength of clay by using Vane shear test. Determination of the coefficient of permeability of soils by constant and falling head method. Determination of shear strength parameters of soils using Triaxial tests; Determination of compressibility characteristics of soil by using one-dimensional oedometer test.

Textbooks:

1. J. E. Bowles, *Engineering Properties of Soil and their Measurement*, 2e, McGraw-Hill Book Company, New York, 1986.
2. Relevant BIS codes.

Reference Books:

1. T. W. Lambe, *Soil Testing for Engineers*, 8e, John Wiley and Sons, Inc., 1964.
2. Liu Cheng and B. Evett Jack, *Soil properties Testing Measurement and Evaluation*, 5e, Prentice-Hall Inc., 2003
3. K. R. Arora, *Soil Mechanics and Foundation Engineering*, 7e, Standard Publishers Distributors, 2017.

CIV3131: HIGHWAY ENGINEERING LAB [0 0 2 1]

Determination of Penetration value, Ductility value, softening point, Flash and Fire point and Specific Gravity of Bitumen. Determination of Flakiness and Elongation index of aggregates. Determination of Abrasion value, Specific gravity and water absorption of aggregates. Determination of Marshall Stability and flow value of Hot Mix Asphalt (HMA). Determination of Optimum Binder Content (OBC) of HMA. Determination of Viscosity of Bitumen Using a Brookfield

Viscometer. Demonstration of Pavement maintenance management system (PMMS) using HDM-IV software. Demonstration of Highway Alignment using MXRoads software.

References:

1. S. K. Khanna, C. Justo, A. Veeraragavan. *Highway materials and pavement testing* (Laboratory Manual). Nemchand and Bros, Roorkee (2000).
2. IRC SP 057:2000- Guidelines on Quality Systems for Roads, Indian Roads Congress, New Delhi.

CIV3132: BUILDING DRAWING LAB [0 0 2 1]

Building layout plan, Foundations: Masonry foundations, RCC Footings - Isolated and Combined footings; Brick and stone masonry, Doors, Windows, and frame section; Introduction to building bylaws, Designing and working Drawing of Residential Buildings: Plan, Elevation and Sectional views using AutoCAD. Introduction to Revit.

Textbooks:

1. S. C Rangwala, Elementary and Advanced Building Construction, 2009.
2. V. B Sikka, A course in civil engineering drawing, S.K. Kataria & Sons, Reprint 2013.

Reference Books:

1. T. S. Balagopal Pabhu, K.V Paul and C Vijayan, Building Design of Civil Engg. Drawing, Spades Publishers, Calicut, 1999.
2. M. G Shah, C. M Kale, & S Patki, Building Drawing: with an integrated approach to built environment. Tata McGraw-Hill Education, 2002.

CIV3170: PROJECT BASED LEARNING-2 [0 0 6 3]

Students are required to work on projects relevant to Civil Engineering discipline under the guidance of mentors. Project work will be done in IV semester. The educational value of project-based learning is aimed to build students creative capacity to work through different scenario, commonly in small teams. Typically, project-based learning takes through the following phases or steps: identifying a problem and potential solution based on feedback from experts, instructors, and/or peers. Depending on the goals of the instructor, the size and scope of the project can vary accordingly.

Sixth Semester**CIV3202: DESIGN OF STEEL STRUCTURES [3 1 0 4]**

Scope and use of structural steel. Structural fasteners: Bolted and welded connections. Design of Tension Members. Sections with welded and bolted connections, lug angle. Design of compression member. Design of column splices. Design of column base. Design of beams- laterally supported and laterally unsupported compression flange. Plastic analysis. Design of Industrial Buildings.

Textbooks:

1. N. Subramanian, *Design of Steel Structures*, 2e, Oxford University Press, New Delhi, 2016.
2. S.K. Duggal, *Limit State Method of Design of Steel Structures*, 3e, Tata McGraw-Hill, New Delhi, 2019.
3. M.R. Shiyekar, *Limit State Design in Structural Steel*, 3e, PHI Learning Pvt. Ltd., 2017.
4. K.M. Ghosh, *Analysis and Design: Practice of Steel Structures*, 2e, PHI Learning Pvt. Ltd., 2014.

Reference Books:

1. BIS:800-2007, *General Construction in Steel - Code of Practice*, Amendment 2, Bureau of Indian Standards, New Delhi, 2024.
2. BIS:875(Part 1)-1987, *Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 1 Dead Loads*, Amendment 1, Bureau of Indian Standards, New Delhi, 2018.

3. BIS:875(Part 2)-1987, *Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 2 Imposed Loads*, Amendment 1, Bureau of Indian Standards, New Delhi, 2023.
4. BIS:875(Part 3)-1987, *Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 3 Wind Loads*, Amendment 3, Bureau of Indian Standards, New Delhi, 2020.
5. BIS:875(Part 4)-1987, *Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 4 Snow Loads*, Amendment 0, Bureau of Indian Standards, New Delhi, 2021.
6. BIS:875(Part 5)-1987, *Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 5 Special Loads and Combinations*, Amendment 1, Bureau of Indian Standards, New Delhi, 2023.

CIV3203: WATER RESOURCE ENGINEERING [3 0 0 3]

Introduction: Scope and need of the subject, Hydrology, rainfall and runoff process, infiltration. Flood studies and hydrographs, River Engineering, Methods of design of stable channels, Energy dissipation, Reservoir Planning, Design of Diversion and Storage works, River training works, Dams and basic principles of design. GIS application in Water Resources Engineering.

Textbooks:

1. K. Subramanya and P. J. Sharma, *Engineering Hydrology*, 6e, Tata McGraw-Hill Education, 2024.
2. S. K. Garg, *Irrigation Engineering and Hydraulic Structures*, 38e, Khanna Publishers, 2023.

Reference Books:

1. D. K. Todd and L W Mays, *Groundwater Hydrology*, 3e, Wiley, 2011.
2. P. N. Modi, *Irrigation, Water Resources and Waterpower Engineering*, 11e, Standard Book House, 2020.
3. H. M. Raghunath, *Hydrology: Principles, Analysis, Design*, 4e, New Age International Pvt Ltd, 2022.
4. W. Jr. Viessman and G L Lewis, *Introduction to Hydrology*, 5e, Pearson Education, 2002.
5. V. T. Chow, D. R. Maidment and L. W. Mays, *Applied Hydrology*, 1e, McGraw-Hill Education, 2017.

CIV3231: Computer Aided Design Lab [0 0 2 1]

Introduction to the Bentley software package. Modelling, analysing and designing continuous beams, plane trusses, plane frames, space frames, G+4 building using STAAD Pro.

Textbooks:

1. “STAAD.Pro V8i (SELECT series 4) Technical Reference Manual,” November 2012.

References:

1. M. N. S. Prakash and G. S. Suresh, *Reference book on computer aided design laboratory: civil engineering : application of C-Graphics and Excel included*. Laxmi Pub, 2006.
2. D. Rajendran, *Analysis & Design of a Multistorey Building using STAAD.Pro & E-TABS (with Manual Calculation)*, First Edition. Designtech Publishers, 2016.

CIV3232: ESTIMATION AND COSTING PRACTICE [0 0 6 2]

Estimation of Earthwork for building foundation, brickwork for masonry work, RCC work, Plastering work, painting and water proofing work. Anti-termite treatment, skirting, door and windows, staircase. Rate Analysis for earthwork, brickwork, RCC, flooring and plastering work. Bill of quantity.

Textbooks:

1. B. N. Dutta, *Estimating and Costing in Civil Engineering*, UBS Publishers' Distributors Ltd. Sixteenth reprint, 2000.

References:

1. M. Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Published by the Author, Sixteenth edition, 2003.

Seventh Semester

CIV4170: INTERNSHIP (INDUSTRY/ RESEARCH/ INDUSTRY CERTIFICATION) [0 0 0 2]

Students are required to work on projects relevant to the Civil Engineering discipline under the guidance of mentors or in the field for a minimum period of four weeks. The internship will be done during the summer vacation after the sixth semester. The educational value of this internship is to build students' creative capacity to work through different scenarios, as applicable in practice.

Eighth Semester

CIV4270: MAJOR PROJECT [0 0 24 12]

The Major Project is a 16-week compulsory project-based course for 8th semester students. The project may be undertaken as a field-based project, industry-oriented study, or in-house laboratory research project under the supervision of a faculty guide. Students shall identify a relevant civil engineering problem, conduct a literature review, define objectives and methodology, collect field/laboratory/analytical data, analyze and interpret results, and propose technically feasible solutions. The course shall include regular progress reviews, project documentation, technical report writing, presentations, and a final viva voce. The project should demonstrate application of engineering knowledge, problem-solving ability, use of modern tools, teamwork, professional ethics, and effective communication.

Programme Electives

CIV3141: ADVANCED CONCRETE TECHNOLOGY [3 0 0 3]

Microstructure of Concrete: Microstructure of aggregate phase, solids, voids and water in hydrated cement paste, interfacial transition zone, characterization techniques. Non-Destructive Testing (NDT): NDT techniques: Ultrasonic technique, Acoustic emission technique, Impact echo, Penetrative radar technique, Optical techniques, Non-contacting Resistivity Measurement Method. Durability of concrete: Definition, parameters affecting durability, deteriorating mechanisms, alkali aggregate reaction, freeze and thaw, carbonation, chloride attack, sulphate attack, corrosion of steel reinforcement. Mix Design: Design of Concrete mix using Ordinary Portland Cement and Pozzolanic materials, self-compacting concrete, and high-strength concrete by BIS methods, Overview of American and British methods.

References:

1. A. M. Neville, Properties of Concrete, Pearson Education India; 5 Edition, 2012.
2. M. S. Shetty, Concrete Technology, S. Chand & Company, 2015
3. A. R. Santha Kumar, Concrete Technology, Oxford University Press, 2006.
4. Mehta, P. K., and Monteiro, P. J. M., 'Concrete: Microstructure, Properties, and Materials,' Fourth Edition (Indian Edition), McGraw Hill, 2014.
5. V. M. Malhotra and N. J. Carino, Handbook on Non-destructive Testing of Concrete, 2nd Edition, CRC Press, 2004.
6. Zongjin Li, Advanced Concrete Technology, John Wiley & Sons, Inc., 2011.

CIV3146: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM [3 0 0 3]

Basics of remote sensing, spectral reflectance curve. Aerial photography and concept of scale. Satellite remote sensing, orbit types, data acquisition, digital image processing, ground-truthing,

spectro-radiometer and image resolution. Remote sensing satellites: INSAT series, IRS series, LANDSAT series, SPOT series, IKONOS Series, QUICKBIRD series and OCEANSAT. Active and passive remote sensing: Optical remote sensing, infrared, thermal and microwave remote sensing and sensors, image interpretation characters. Geographical Information Systems (GIS): Evolution, raster and vector data, database, analysis and management, digital elevation model, applications of GIS.

Textbooks:

1. Sabins, Jr. F. F. and Ellis, J. M. Remote Sensing: Principles, Interpretation, and Applications. Waveland Press, 4th Edition 524 p, 2020.
2. Campbell, J. B. and Wynne, R. H. Introduction to Remote Sensing. The Guilford Press, 5th Edition, 662 p, 2013.
3. Demers M. N., Fundamentals of Geographic Information Systems. John Wiley and Sons, 3rd Edition, 464 p, 2008.

Reference Books:

1. Weng, F., Passive Microwave Remote Sensing of the Earth: for Meteorological Applications, John Wiley and Sons, 384 p, 217.
2. Janssen, L. L. F. and Huurneman, G. C. (Eds.), Principles of Remote Sensing. ITC Educational Textbook Series, 2nd Edition, 41 p, 21.
3. Burrough P. A. and McDonnell, R. A., Principles of Geographical Information Systems. Oxford University Press, 2nd Edition 1998.

CIV3147: COMPUTATIONAL HYDRAULICS [3 0 0 3]

Ordinary and partial differential equations, Governing equations for ground water flow, Introduction to method of finite differences. Introduction to method of characteristics; Introduction to method of finite volumes; Stability, convergence and accuracy and consistency of numerical schemes; Explicit and implicit schemes; Alternate direction implicit-explicit scheme, Solution of trigonal/pentagonal matrix using Thomas algorithm, Crank Nicholson Scheme, Boundary conditions; Pneumann and Dirichlet boundary conditions Conservative and non-conservative formulations of conservation laws, Numerical schemes for solution of transport and diffusion equations in 1D; applications to steady and unsteady flows; St. Venant Equation, pollutant dispersion; flood wave propagation.

Textbooks:

1. Ioana Popescu., Computational Hydraulics, UNESCO-IHE Institute for Water Education, Delft The Netherlands, 2020.
2. Michael B. Abbott, David R. Basco, Computational Fluid Dynamics: An Introduction for Engineers, Longman Scientific & Technical, 2012.

Reference Books:

1. Cornelis B. Vreugdenhil., Computational Hydraulics: An Introduction, Springer Verlag, Germany; 1st ed. 1989 edition.
2. Brebbia C.A., Ferrante A.J., Computational Hydraulics, Butterworth & Co (Publishers) Lt1983, ISBN 9780408011532.

CIV3148: ENGINEERING GEOLOGY [3 0 0 3]

Geology in Civil Engineering, Internal structure of earth and composition. Plate tectonics, earthquake, seismic waves, characteristics of strong ground motions and attenuation. Identification of rock-forming minerals and Ores, their physical and engineering properties. Sources of rocks, classification of rocks, rock-cycle, Rock as building material. Structural geology: folds, joints,

faults, and unconformity. Weathering types, agencies, causes and products of weathering. Geomorphic features of river and wind. Geophysical techniques, Geological considerations in selection of sites for Dams, Reservoirs, Tunnels, Bridges and Highways. Demonstration of rocks and minerals.

Textbooks:

1. P. Singh, Engineering and General Geology, (8e), New Delhi, India: S. K. Kataria and Sons, 2013.
2. D. V. Reddy, Engineering Geology for Civil Engineering, New Delhi, India: Oxford and IBH Publishing Co. Pvt. Ltd., 2012.

Reference Book:

1. P. K. Mukherjee, A Textbook of Geology, Kolkata, India: World Press, 2005.

CIV3149: CLIMATE CHANGE SCIENCE [3 0 0 3]

Introduction, Weather and climate, blackbody radiation, spectral variation, Wien's law, emissivity, absorptivity and Kirchoff's law, greenhouse effect, Simple model for the global mean temperature, Radiative properties of gases and greenhouse effect GHG emission, Stability of the earth's climate, Feedback in the earth's climate system, Climate sensitivity, Effect of climate change in the past, clouds and climate change, Snowball earth, Runaway Greenhouse in Venus, Impact of climate change.

Textbooks:

1. José P. Peixoto and Abraham H. Oort, Physics of Climate, American Institute of Physics, New York, 1992.
2. Dennis L. Hartmann, Global Physical Climatology, 2nd Edition, Elsevier, Amsterdam, 2016.
3. Gary E. Thomas and Knut Stamnes, Radiative Transfer in the Atmosphere and Ocean, Cambridge University Press, Cambridge, 1999.
4. F. W. Taylor, Elementary Climate Physics, Oxford University Press, Oxford, 2005.
5. Michael A. Box and Allan C. Box, Physics of Radiation and Climate, Routledge, New York, 2016.

Reference Books:

1. Intergovernmental Panel on Climate Change (IPCC), Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, 2021.
2. Murry L. Salby, Physics of the Atmosphere and Climate, Cambridge University Press, Cambridge, 2012.

CIV3240: RAILWAYS AND AIRPORT ENGINEERING [3 0 0 3]

Introduction, gauges, resistance to traction and stresses in track. Permanent way: Types and requirements of rails, sleepers, ballasts, introduction to rail fastenings, tests and defects of rails. Geometric design: Right of way, Super elevation, curves, points and crossing, design of turn out, diamond and scissor crossing. Track Layout: Track layout, Introduction to signalling and interlocking Railway equipment (triangle and turntable), Introduction to Accident studies, High speed Railways. Airport engineering: Introduction, Technical terms relating to airways and airport, aircraft characteristics, site selection. Airport obstruction and runway design: Layout, obstructions and zoning laws, runway orientation and geometric design of runway. Taxi way design and navigational and landing aids: Exit taxiway, Apron, Drainage, Lighting system, Visual aids, and Air traffic control aids.

References:

1. S. Chandra, M. M. Agarwal, *Railway Engineering*, (4e), Oxford University Press, 2014
2. S. C. Rangwala, *Airport Engineering*, (7e), Charotar Publishing House, 2018
3. S. C. Saxena, S. P. Arora, *A Text Book of Railway Engineering*, (4e), Dhanpatrai Publication, 2004
4. S. K. Khaana, M. G. Arora, *Airport Planning and Design*, (4e), Nem Chand & Bros, 2000

5. H. Robert, Mc. K. Francis, *Planning and Design of Airport*, (5e), McGraw-Hill, 2010.

CIV3242: REAL ESTATE VALUATION [2 1 0 3]

Introduction: Purposes of Valuation, Secured Lending, Financial Reporting, Capital Gains, Rent Fixation, Govt. Department Penalties. Roles, Functions and Duties of a Valuer, Registration of Valuer. Valuation of real estate: Bases of Value, Basis of Value, Premise of Value. Valuation approaches and methods: Income approach to Value: income approach sale analysis techniques, rate of interest from sale transaction, rate of capitalization, reversionary value of land, Case studies. Market approach to Value: market comparison techniques, automated sales analysis, Data collection, surveys, enquiries and investigations, analysis, and Case studies. The cost approach to Value: land characteristics, hypothetical plotting scheme, hypothetical building scheme, replacement cost new, reproduction cost, reinstatement value, estimating the cost of construction using building cost indices; Various forms of obsolescence including depreciation, physical obsolescence, functional obsolescence, economical obsolescence; Reporting; Case studies.

Textbooks:

1. Rangwala R. C., *Valuation of Buildings*, (11e), Charotar Publishing House Pvt. Ltd., 2024.
2. *International Valuation Standards 2024*, International Valuation Standards Council (IVSC), 2024
3. Savla H., *Real Estate Valuation*, (1e), Notion Press, 2021.
4. Scarrett D. and Osborn S., *Property Valuation: The Five Methods*, (1e), Routledge, 2014.
5. Banerjee D. N., *Principles and Practice of Valuation*, (6e), Eastern Law House, 2015.
6. Budhabhatti K. P., *Real Estate Valuation in Practice*, (1e), Kirti P Budhabhatti, 2012.

References:

1. Betts R. M. and Ely S.J., *Basic Real Estate Appraisal: Principles and Procedures*, (7e), Thomson South-Western, 2008.
2. Namavati R. H., *Theory and Practice of Valuation*, (4e), Bombay Lakhani Book, 2010.
3. Natarajan K. and Nedunchezhiyan B., *Indian Real Estate Law 2016*, Notion Press, 2016.
4. Ratterman M. R., *The Student Handbook to The Appraisal of Real Estate*, (15e), Appraisal Institute, 2020.

CIV3243: APPLIED GEOTECHNICAL ENGINEERING [3 0 0 3]

Stress Distribution in Soils: Elastic theories of stress distributions in soils, Pressure distribution diagram, Contact Pressure. Consolidation of soils: Terzaghi's one dimension consolidation theory, Normally, under and over consolidated soils Compressibility characteristics, determination of void ratio, Coefficient of volume change, Coefficient of consolidation and settlement, Estimation of pre-consolidation pressure, Time factor, Degree of consolidation, and Factors influencing compressibility behaviours of soils. Earth Pressure: Theories of earth pressure, active and passive earth pressure with illustrations with cohesive and non-cohesive backfills including horizontal, layered and slopy backfills. Shallow Foundations: Bearing capacity and its types, Types of foundations, Terzaghi and Meyerhoff's theory for bearing capacity, Skempton's method for cohesive soil, Effect of eccentricity and water table on bearing capacity. Deep Foundations: Types of piles, Load carrying capacity of piles, Static and dynamic formulae; Group behaviour of piles; Negative skin friction and Pile testing. Site Investigations: Methods of explorations; Plate load and Penetration tests for determining bearing capacity, Geophysical tests, Exposure to relevant software. Qualitative structural analysis: The principle of virtual work and applications, Compatibility of deformation

Textbooks:

1. B.C. Punmia, A.K. Jain and A. K. Jain, *Soil Mechanics and Foundations*, 18e, Laxmi Publications, 2023.

2. V. N. S. Murthy, *Textbook Of Soil Mechanics and Foundation Engineering*, 1e, CBS Publishers and Distributors Pvt Ltd, 2018.
3. K. R. Arora, *Soil Mechanics and Foundation Engineering*, 7e, Standard Publishers Distributors, 2017.

Reference Books:

1. K. Terzaghi, R. B. Peck and M. Gholamreza, *Soil Mechanics in Engineering Practice*, 3e, John Wiley and Sons, Inc., 1996
2. T. W Lambe and R. V. Whitman, *Soil Mechanics*, John Wiley and Sons, Inc., 1991.

CIV3244: ADVANCED REINFORCED CONCRETE DESIGN [3 0 0 3]

Introduction, Design of Continuous Beams. Design of single span and continuous deep beams with and without opening, Design of Silo and bunker. Design of retaining walls, water tanks (elevated and underground). Introduction to types of trusses and a design example of trusses. Design of curved beam. Various types of stresses and the design of a chimney.

Textbooks:

1. S. U. Pillai and D. Menon, *Reinforced Concrete Design*, 3rd Edition, 2009, Tata McGraw-Hill
2. J. Wight and J.G. MacGregor, *Reinforced Concrete - Mechanics & Design*, 6th Edition, Prentice-Hall, 2011
3. A Nilson, D Darwin, C Dolan, *Design of Concrete Structures*, McGraw-Hill Education; 14th Edition.
4. J. N. Bandyopadhyay, *Design of Concrete Structures*, Prentice Hall of India, New Delhi, 2008.
5. S. S Bhavikatti, *Advanced RCC Design*, (Vol II), New Age International Publishers, 2016.

Reference Books:

1. P. C. Verghese, *Advanced Reinforced Concrete*, Prentice Hall India, New Delhi, 2010.
2. N. Krishna Raju, *Design of Reinforced Structures*, CBS Publishers & Distributors, 2016.
3. P. C. Verghese, *Limit State Design of Reinforced Concrete*, Prentice Hall of India, New Delhi, 2009.

CIV3246: CONTRACT MANAGEMENT AND ARBITRATION [3 0 0 3]

Introduction: Types of contracts, tendering procedures, Inviting bids, Evaluation of bids, Prerequisites in an agreement, various types of bonds, Negotiation, Contract agreement. Contract administration; Duties and responsibilities of parties; important site documents. International contracts: law of torts, International Competitive Bidding, Domestic Preference, FIDIC Conditions. Breach of Contract: Types of breach, Remedies for breach of contract, Termination of a contract, Discharge of Contract, Agreement to discharge the contract, Vitiating Factors, Privity of Contract. Dispute resolution: Sources of claims and disputes, construction claims procedure, methods of dispute resolution, alternative dispute resolution method, Arbitration Law: Definition, Types of Arbitration, Arbitration clauses, Arbitration Procedure, Challenge and enforcement of awards, Role of Courts in Arbitration, International Commercial Arbitration, Recognition and enforcement of foreign awards, Alternative Dispute Resolution, Mediation and conciliation, Hybrid dispute resolution methods, Case Studies.

Textbooks:

1. Patil, B. S., & Woolhouse, S. P., *BS Patil's Building and Engineering Contracts*, CRC Press, 2019
2. Bhatt, V. and Vyas, P., *Laws for Engineers (Contract, Arbitration, Evidence, Limitations)*. (2e), Procare, 2015.
3. Hinze J.W., *Construction Contracts*, (3e), McGraw Hill Education, 2013.
4. Bockrath, J. T., *Contracts and the Legal Environment for Engineers and Architects*, (7e), McGraw Hill Education, 2013.

5. Fenn, P., *Commercial Conflict Management and Dispute Resolution*, (1e), Routledge, 2012.

Reference Books:

1. Arbitration and Conciliation Act, 1996

CIV3248: PHOTOGRAMMETRY [2 0 2 3]

Introduction, Principles of aerial photography, Relief and tilt displacement, Planning for aerial photographs. Fundamentals of aerial photo interpretation, Geometry of aerial photos, mosaics and types of mosaics, stereoscopy, image displacement due to relief, concepts of stereo-photogrammetry, normal vision, depth perception and vertical exaggeration. Principles and applications of aerial photography. Digital photogrammetry and interpretation techniques: Creation of digital images, automatic measurements, aerial triangulations, and digital photogrammetric workstation. Satellite Photogrammetry. Use of ERDAS Leica Photogrammetry Suite in terrain analysis. Principal keys to the interpretation of aerial photographs. Qualitative and quantitative determination of resource data. Elements of photo interpretation: Aerial photo interpretation in resource evaluation- geomorphology, lithology, geological structures, Case studies: Railway lines and land records.

Textbooks:

1. D. P. Paine and J. D. Kiser, *Aerial Photography and Image Interpretation*, 3e, John Wiley & Sons Inc., 2012.
2. P. Wolf, B. DeWitt and B. Wilkinson, *Elements of Photogrammetry with Application in GIS*, 4e, McGraw-Hill Education, 2014.
3. M. Edward, E. M. Mikhail, S. James, J. S. Bethel and J. C. Chris McGlone, *Introduction to Modern Photogrammetry*, Wiley, 2001.

Reference Books:

1. M. Edward, E. M. Mikhail, S. James, J. S. Bethel and J. C. Chris McGlone, *Introduction to Modern Photogrammetry*, Wiley, 2001.

CIV3249: REMOTE SENSING AND GIS FOR RURAL DEVELOPMENT [2 0 2 3]

Rural development: concepts, issues, and linkages to water & food security; Geospatial technology (RS & GIS) in rural development; Open-source software for RS & GIS (QGIS); GIS - vector data operations; GIS - raster data operations; Remote sensing image processing - georeferencing & map data; Remote sensing image processing - DEM & land use/land cover analysis; RS & GIS for rural water resources (surface & groundwater); RS & GIS for agriculture & soil management; RS & GIS for rural healthcare, education & communication; RS & GIS for impact assessment of schemes; Case studies in RS & GIS for rural development.

Textbooks:

1. V. Singh, *Applications of Remote Sensing and GIS in Geosciences*, NIPA, 2025.
2. S. Surwase, P. Deshmukh, P. Kadu, and S. K. Singh, *Foundations and Applications of Remote Sensing and GIS*, Book Publisher International, 2025.

Reference Books:

1. G. S. Bhunia, U. Chatterjee, G. K. Panda, and P. K. Shit, *Remote Sensing and GIS in Natural Resource Management*, Rawat Publications, 2022.
2. A. Simhachalam and R. Murugesan, *Geo-Spatial Technologies in Rural Development*, Today & Tomorrow's Printers and Publishers, 2022.

CIV3250: ENVIRONMENTAL IMPACT ASSESSMENT [3 0 0 3]

Definition, Role of EIA for SDG, Evolution of EIA; Environmental legislations in India; Environmental standards for water, air and noise quality; EIA Notification 2006. Environmental clearance process in India: Appraisal Form1: Category of projects; Generic structure of EIA report; Terms of Reference (ToR), Types of EIA: strategic, regional, sectoral, project level: Rapid EIA and Comprehensive EIA, Initial Environmental Examination (IEE). EIA methodologies: Ad hoc, checklist, matrix, network and overlay- Impact Prediction, Evaluation and Mitigation-Prediction and assessment of the impact on physical, biological and Socio-economic components. Environmental Management Plan (EMP): Goal and purpose, Importance, Content - Role of environmental monitoring program, Environment Audit: need for audit- audit types and benefits- environmental audit procedure ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits. EIA case studies (Indian)- a highway project, a hydroelectric power plant, an airport project, a quarry mining project and a solid waste management project.

Textbooks:

1. Anjaneyulu Y. and Valli M., *Environmental Impact Assessment*, (3e), B.S Publications, 2021.
2. Yerramilli A. and Manickam V., *Environmental Impact Assessment Methodologies*, (3e), B S Publications, 2020
3. David A, *Environmental Impact Assessment: Ultimate Tools, Techniques and Technology to Natural Resource Management*, (1e), Notion Press, 2024.
4. Khitoliya R. K. and Khitoliya S., *Environmental Impact Assessment and Management*, (1e), Discovery Publishing House, 2017.

Reference Books:

1. Eccleston C. H., *Environmental Impact Assessment A Guide to Best Professional Practices SIE* 2023, (1e), CRC Press, 2023.
2. Fonseca A., *Handbook of Environmental Impact Assessment*, Edward Elgar Publishing, 2022.

CIV3251: REPAIR AND REHABILITATION OF STRUCTURES [2 1 0 3]

Introduction: Maintenance, rehabilitation, repair, retrofit and strengthening, need for rehabilitation of structures. Distress and Deterioration in structures: Types of distress and deterioration in concrete structures, causes and effects. Repair materials: material selection, compatibility between the repair material and the existing concrete. Condition Assessment of Concrete Structures: Visual inspection, Non-destructive and Semi-Destructive Testing for assessing strength, voids, flaws, density, moisture content, cover depth, rebar corrosion and bond strength. Repair Strategies and Techniques: Rust eliminators and polymer coatings for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion-resistant steels, coatings and cathodic protection. Retrofitting of RC Structures: Global Retrofitting Methods, Non-Conventional Methods, Member or Local Retrofit Methods, and Jacketing/Confinement. Seismic evaluation and strengthening of existing reinforced concrete buildings.

Textbooks:

1. R. N. Krishna and A. R. Santhakumar, *Repair and rehabilitation of structures*, 1e, Standard Book House, 2022.
2. P. K. Guha, *Maintenance and Repairs of Buildings*, 2e, New Central Book Agency (P) Ltd, 2011.
3. P. I. Modi, C. N. Patel, *Repair and Rehabilitation of Concrete Structures*, 1e, PHI Learning, India, 2015.
4. P. H. Emmons, *Concrete Repair and Maintenance Illustrated*, 1e, John Wiley and Sons, 1992.

References:

1. Handbook on repair and rehabilitation of RCC buildings, CPWD, Government of India.

2. BIS 15988:2013. *Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings - Guidelines*, Bureau of Indian Standards, New Delhi, India, 2013.
3. J.H.Bungey, S.G.Millard and M.G.Grantham, *Testing of Concrete in Structures*, 4e, Taylor & Francis, London & New York, 2006.

CIV3252: FUNDAMENTALS OF AI AND ML IN CIVIL ENGINEERING [2 1 0 3]

Overview of AI - Introduction to AI, what is data, information, knowledge and intelligence. Knowledge and problem-solving in AI - Knowledge representations and Search Approaches. Learning - Forms of Learning, Supervised Learning, Learning Decision Trees, and Regression. Artificial Neural Networks (ANN) - Fundamentals of ANN, Back propagation ANN, Variation and Applications. Fuzzy Systems - Fuzzy Set theory, Fuzzy Systems, Applications. Capstone Projects - Application, Implementation of Civil Engineering projects.

Textbooks:

1. S. J.Russell, P. Norvig, *Artificial Intelligence: A Modern Approach*, 4e, Pearson Education, Inc., UK, 2022.
2. C.S. Krishnamoorthy, S. Rajeev, *Artificial Intelligence and Expert Systems for Engineers*, CRC Press, India 2018.
3. Samui, P., Kothari, D. P., *Artificial Intelligence in Civil Engineering*, Lap Lambert Academic Publishing, India, 2012.
4. S. Rajasekaran, G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms Synthesis and Applications*, PHI Learning Pvt. Ltd, India, 2003.

Reference Books:

1. Jeff Heaton, *Artificial Intelligence for Humans: Fundamental Algorithms*, Heaton Research Incorporated, United States, 2013.
2. Amit Konar, *Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modelling of the Human Brain*, CRC Press, India, 2018.

CIV3253: ADVANCED STRUCTURAL ANALYSIS [2 1 0 3]

Qualitative structural analysis: The principle of virtual work and applications, Compatibility of deformation, Analysis of three-hinged, two-hinged, and fixed arches, Settlement, and temperature effects. Influence lines for indeterminate beams: Muller Breslau's principle, Influence line for Shearing force, Bending Moment, and support reaction of a propped cantilever, continuous beams, and fixed beams. Plastic analysis of statically indeterminate beams and frames: Plastic theory, Plastic moment of resistance, Plastic modulus, Shape factor, Load factor, Plastic hinge and mechanism, collapse load, Static and kinematic methods, Upper and lower bound theorems of plasticity. Matrix method of analysis: flexibility and stiffness method, Application to simple trusses and beams. Computational modelling using SAP2000 software: Modelling, defining materials and elements, boundary conditions, load cases, assigning loads, analysis, and visualising results.

Textbooks:

1. Wang C. K., *Indeterminate Structural Analysis*, Indian Ed., McGraw Hill Education, 2017.
2. Hibbler R. C., *Structural Analysis*, (9e), Pearsons Education, 2017.
3. Reddy C. S., *Basic Structural Analysis*, (3e), McGraw Hill Education, 2017.
4. Menon D., *Advanced Structural Analysis*, (1e), Narosa Publishing House, 2015.
5. Pandit G. S. and Gupta S. P., *Structural Analysis: A Matrix Approach*, (2e), McGraw Hill Education, 2008.

Reference Books:

1. Ramamrutham S. and Narayan R., *Theory of Structures*, (9e), Dhanpat Rai Publishing House, 2014.
2. Karnovsky I. A. and Lebed O., *Advanced Methods of Structural Analysis*, Springer, 2010.

3. Williams A., *Structural Analysis in Theory and Practice*, Butterworth-Heinemann Ltd (Elsevier), 2009.
4. CSI Analysis Reference Manual, SAP 2000, Integrated Solution for Structural Analysis and Design, Computers & Structure, v19, 2016.

CIV3254: TRAFFIC SYSTEMS AND ENGINEERING [2 1 0 3]

Road Characteristics - Road user characteristics - PIEV theory - Vehicle Performance characteristics- Fundamentals of Traffic Flow - Urban Traffic problems in India - Integrated planning of town, country, regional and all urban infrastructure - towards a sustainable approach. - land use & transport and modal integration. Traffic Surveys - Speed, journey time and delay surveys - Vehicles Volume Survey including non-motorized transports - Methods and interpretation - Origin Destination Survey - Methods and presentation - Parking Survey - Accident analyses -Methods, interpretation and presentation - Statistical applications in traffic studies and traffic forecasting - Level of service - Concept, applications and significance. Intersection Design - channelization, Rotary intersection design - Signal design - Coordination of signals- Grade separation - Traffic signs including VMS and road markings - Significant roles of traffic control personnel - Networking pedestrian facilities & cycle tracks. Road accidents - Causes, effect, prevention, and cost - Street lighting - Traffic and environment hazards - Air and Noise Pollution, causes, abatement measures - Promotion and integration of public transportation - Promotion of non-motorized transport. Area Traffic Management System - Traffic System Management (TSM) with IRC standards -- Traffic Regulatory Measures-Travel Demand Management (TDM) - Direct and indirect methods - Congestion and parking pricing - All segregation methods- Coordination among different agencies - Intelligent Transport System for traffic management, enforcement and education.

Textbooks:

1. L. R. Kadiyali, *Traffic Engineering and Transport Planning*, Khanna Publishers, Delhi, 2013.
2. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, *Principles of Highway Engineering and Traffic Analysis*, Wiley India Pvt. Ltd., New Delhi, 2011.

Reference Books:

1. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
2. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994.
3. C. Jotin Khisty, B. Kent Lal, *Transportation Engineering*, 3rd edition

CIV4141: DESIGN OF PRE-STRESSED CONCRETE STRUCTURES [2 1 0 3]

Prestressing concepts, materials, prestressing systems and losses. Analysis of prestress and bending stresses. Analysis for flexural strength, shear and torsional resistance of prestressed concrete sections. Calculations of Deflection. Transmission of Prestress. End block design. Limit state design criteria and design of prestressed concrete members.

Textbooks:

1. N. K. Raju, *Pre-stressed Concrete*, 6e, Tata McGraw Hill, New Delhi, 2018.
2. P. Dayaratnam, *Pre-stressed Concrete Structures*, 7e., Oxford and IBH Publications, New Delhi, 2018.
3. G. S. Pandit, S. P. Gupta, *Pre-stressed Concrete*, CBS Publishers & Distributors Pvt. Ltd., 2019.
4. T.Y. Lin and N.H. Burns, *Design of Prestressed Concrete Structures*, 3e., Wiley, New York, 1981.

Reference Books:

1. Guyan, *Limit State Design of Prestressed Concrete*, Applied Science Publishers, 1972
2. IS: 1343-1980, *Code of Practice for Prestressed Concrete*, Bureau of Indian Standards, New Delhi, 1981.

3. SP16:1980, *Design Aids for Reinforced Concrete*, Bureau of Indian Standards, New Delhi, 1992.

CIV4143: BRIDGE ENGINEERING [2 1 0 3]

Introduction: Definitions, Components of a bridge, Classification, Importance and standard specifications; Investigation for bridge: Site selection, Data drawing, Design discharge linear Water way, Economical span, Location of piers and abutments, Vertical clearance above HFL, Scour depth; Traffic Projection, Investigation Report, Choice of Bridge Type. Standard Specifications for Road Bridge: IRC bridge code, Determination of dead loads and live loads, Wind loads, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current buoyancy effect, Earth pressure, Temperature effect, Deformation stresses, Secondary stresses, Erection stresses, Seismic forces; Culverts: RCC slab culvert, Pipe culverts and box culvert; Concrete Bridges: T-beam Reinforced Concrete Bridges and Pre Stressed Concrete Bridges, Continuous bridges, Cantilever bridges; Substructures: Different types of bridge bearings, Piers and masonry abutments, Different types of foundations and their choices, Wing walls. Introduction to computer-aided modelling to determine the bridge member forces (deck, bidders, pier, and foundation): A finite element approach

Textbooks:

1. D. J. Victor, *Essentials of Bridge Engineering*, 6th Ed., Oxford & IBH Publishing Co. Pvt. Ltd., 2007.
2. N. Rajagopalan, *Bridge Superstructure*, Narosa Publishing House Pvt. Ltd., 2006.

Reference Books:

1. IRC 5, IRC 6, IRC 112, Indian Roads Congress
2. IRS Bridge Rules, IRS Concrete Bridge Code, Research Designs and Standards Organization, Indian Railways .
3. S. Ponnuswamy, *Bridge Engineering*, Tata McGraw-Hill Publishing Company Limited, 1986.
4. V. K. Raina, *Concrete Bridge Practice and Analysis*, Design and Economics, 2nd Ed., Tata McGraw-Hill Pub., 1994.
5. C. S. Surana and R. Agarwal, *Grillage Analogy in Bridge Deck Analysis*, Narosa Publishing House Pvt. Ltd., 1998.
6. Hambly, E.C., *Bridge Deck Behaviour*, 2nd Ed., E & FN Spon (Chapman & Hall), 1991.

CIV4144: FINITE ELEMENT METHOD [2 1 0 3]

Introduction to finite element analysis: Basic concept, theory of elasticity - constitutive relationships - plane stress and plane strain. Concept of an element, types of elements, displacement models - compatibility and convergence requirements, displacement models by generalised coordinates, Lagrangian polynomials and Hermitian polynomials. Variational method of formulation; application of the Finite element method to pin-jointed and rigid-jointed structures; application to plane stress and plane strain problems. Soil structure interaction: spring elements, boundary conditions, computer-aided tools

Textbooks:

1. C. S. Krishnamoorthy, *Finite Element Analysis Theory and Programming*, Tata McGraw-Hill, 2017.
2. J. Chaskalovic, *Finite Element Methods for Engineering Sciences*, Springer Verlag, 2008.

Reference Books:

1. K. J. Bathe, *Numerical methods in Finite Element Analysis*, Prentice-Hall, 1976.
2. D. Robert, C. David, S. Malkus, *Concepts and applications of Finite Element Analysis*, 1987.
3. O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, *The Finite Element Method: Its Basis and Fundamentals*, Butterworth-Heinemann, 2005.

CIV4145: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES [2 1 0 3]

Introduction to structural dynamics: Single Degree of Freedom (SDOF) Systems, Formulation of equations of motion - Undamped and damped free vibration, Damped - Force vibrations, Response to harmonic excitation, Concept of response spectrum. Multi-Degrees of Freedom (MDOF) Systems: Formulation of equations of motion-free vibration, Determination of natural frequencies of vibration and mode shapes, Orthogonal properties of normal modes, Mode superposition method of obtaining response. Earthquake Engineering: Engineering Seismology, Earthquake phenomenon, Elastic Rebound Theory, Magnitude and intensity of earthquakes, Classification of earthquakes, Seismic waves, Seismic zones, Seismic Zoning Map of India, Seismograms and Accelerograms. Numerical Method of analysis: Earthquake design philosophy, provisions for buildings based on latest Indian seismic code IS:1893 - 2016 (Part-I), Equivalent static method (IS 1893); Seismic Coefficient method Analysis by seismic coefficient and response spectrum methods, Analysis of a multi-storeyed building using Seismic Coefficient method, Earthquake resistant design practice in construction as per IS: 4326 (2013) and IS: 13920 (2016) Provisions for ductile detailing of RC buildings - Beam, column and joints. Effect of structural irregularities on the performance: Plan irregularities, Torsion Irregularities, Re-entrant corners, non-parallel systems, Diaphragm Discontinuity, Vertical Discontinuities in the load path, Irregularity in strength and stiffness, Mass Irregularities, Vertical Geometric Irregularity, Proximity of Adjacent Buildings.

Textbooks:

1. Pankaj A. and Manish S., *Earthquake Resistant Design of Structures*, (5e), Prentice Hall of India, 2009.
2. Chopra A. K., *Dynamics of Structures*, (5e), Pearson Education, 2020.
3. Duggal S. K., *Earthquake Resistant Design of Structures*, (2e), Oxford University Press, 2013.
4. Clough & Penzien, *Dynamics of Structures*, (4e), McGraw Hill Education, 2008.
5. Mario P., *Structural Dynamics - Theory and Computations*, (6e), Springer-Verlag New York Inc., 2004.
6. Jai Krishna A.R, Chandrasekharan A.R and Chandra B., *Elements of Earthquake Engineering*, (2e), South Asian Publishers, 2001.

Reference Books:

1. IS Codes: IS: 1893, IS: 4326 and IS:13920, Bureau of Indian Standards, New Delhi.
2. Jain A. K., *Dynamics of Structures with MATLAB application*, (1e), Pearson Education, 2016.
3. Newmark N. M. and Rosenblueth E., *Fundamentals of Earthquake Engineering*, Prentice Hall, 1971.

CIV4147: BUILDING INFORMATION MODELLING [2 0 2 3]

Introduction to BIM: Evolution from 2D drawings to BIM Model. Limitations of Isometric views and the concept of 3D-Modeling. Introduction to BIM process as per ISO 19650. Fundamentals of Discipline-Based Modelling. Workflow of design coordination and review in BIM. Visualization and Clash Detection in BIM: Different views and visualization modes in BIM Model. Concept of viewpoints, sectioning, and visualization through various devices. Introduction to Clash Check - types, avoidance process, detection process, and report generation. Documentation, CDE, and LOD: Generation of 2D drawings from BIM Model. Introduction to Cloud Computing and CDE. Concept of LOD and preparation of LOD matrix and progression matrix. 4D/Field BIM and its Applications: Introduction to 4D BIM and project scheduling. Application of Field BIM/4D BIM in coordination, site utilization planning, and construction analysis. Other applications of Field BIM/4D BIM in safety, disaster and risk analysis, digital fabrication, and scan to BIM. 5D BIM, AIM, and Beyond BIM: Introduction to 5D BIM and Quantity Take Off with UoM. Introduction to Asset Information Model (AIM) and COBie structures. Emerging trends in BIM: Industrialization, IoT, Big Data, Data Analytics. Future scope of BIM Applications: Smart Infrastructure, Digital twins, and their applications in diverse industries.

Textbooks:

1. Eastman C., Teicholz P., Sacks R. and Liston K., *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*, (1e), Wiley Publications, 2011.
2. Hardin B. and McCool D., *BIM and Construction Management: Proven Tools, Methods, and Workflows*, (1e), Wiley Publications, 2015.
3. Mordue S., Swaddle P. and Philp D., *Building Information Modeling for Dummies*, (1e), Wiley Publications, 2016.
4. Autodesk software (Revit, Navisworks and BIM 360 student version)

Reference Books:

1. Holzer D., *The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction*, (1e), Wiley Publications, 2016.

CIV4148: LEAN CONSTRUCTION TECHNOLOGY [3 0 0 3]

Lean Construction fundamentals, Lean Theory, Lean v/s traditional construction, Toyota Production System (TPS). Productivity: Productivity, Production, Productivity Measurement System, Value Stream Mapping, Productivity Measurement and Improvement, Construction Productivity, Profit, Return on Capital Employed (ROCE), Influences on Operational Productivity, Productivity levels, Measuring Output - Level of Effort (LOE), Productivity and Production Calculations. Work sampling: the relationship between WS Categories and Productivity, Tour-based Work Sampling Approach, Crew-based Work Sampling Approach, Foreman delay survey, Value Stream, Value Stream Mapping (VSM), Swim-lane diagrams. Lean Tools: 5S, Applications of 5S through Case Study, Collaborative Planning System (CPS), Last Planner™ System (LPS), Collaborative Pull Planning, Constraint Analysis, Percentage Plan Completed (PPC), Big Room Approach, Applications of Big Room Approach through Case Studies. Implementation of BIM and Lean.

Textbooks:

1. Forbes L. and Ahmed S., *Modern Construction - Lean Project Delivery and Integrated Practices*, CRC Press, Taylor & Francis Group, 2011.
2. Tzortzopoulos P., Kagioglou M., and Koskela I., *Lean Construction - Core Concepts and New Frontiers*, Routledge by Taylor & Francis Group, 2020.
3. Liker J. and Meier D., *The Toyota Way*, McGraw-Hill Education, 2006.

References:

1. Varghese K. and Raghavan n., *Introduction to Lean Construction*, NPTEL course by IIT Madras, Available: [<https://archive.nptel.ac.in/courses/105/106/105106213/>].

CIV4150: ADMIXTURES AND SPECIAL CONCRETES [3 0 0 3]

Overview of cement chemistry and concrete performance. Chemical Admixtures: Water reducers; Set controlling agents; Air entrainers; Viscosity modifying agents; Corrosion inhibitors; Other chemicals for special concretes. Mineral Admixtures: Fly ash, Ground granulated blast furnace slag, and other types of slag. Silica fume, Calcined clays including metakaolin, Agricultural ashes, Limestone as a supplementary material; Ternary blended binder system. Mixture proportioning, performance requirements, and properties of special concretes: Fibre-reinforced concrete, high-density concrete, Lightweight concrete, Mass concrete, Concrete for low temperature applications, Recycled concrete, sprayed concrete, Underwater concrete, Grouts and grouting.

TEXTBOOKS

1. A. M. Neville, *Properties of Concrete*, 5e, Longman Scientific and General, 2012.
2. P. K. Mehta and P. J. M. Monteiro, *Concrete: Microstructure, Properties, and Materials*, 4e, McGraw Hill, 2014.

REFERENCES

1. A. M. Neville and J. J. Brookes, *Concrete Technology*, 2e, Pearson Education, 2010.
2. A. R. Shantakumar, *Concrete Technology*, 2e, Oxford University Press, New Delhi, 2000.
3. N. Krishna Raju, *Design of Concrete Mixes*, 2e, CBS Publishers and Distributors, 2009.

CIV4151: ESSENTIALS OF BIOMIMETICS FOR CONSTRUCTION ENGINEERING [2 1 0 3]

Foundations of Biomimetics -Origins and scope of biomimetic; Natural models and their relevance to construction; Introduction to biophilic cities and adaptive urban environments. Materials and Energy Systems Recent advancements in biomimetic construction materials; Photobioreactors (PhBR) in the built environment; Nature-inspired adaptive façades and self-healing materials. Structural and Infrastructure Applications Bio-inspired bridge design: stationary vs. movable forms; Flexible and lightweight structural systems; Case study on translating natural movement into engineered solutions. Monitoring Techniques Principles of structural health monitoring (SHM); Bio-inspired image processing for crack detection and system maintenance.

Textbooks:

1. Fernando Pacheco Torgal et al., *Biotechnologies and Biomimetics for Civil Engineering*, Springer International Publishing Switzerland, 2015.
2. Wole Soboyejo et al., *Bioinspired Structures and Design*, Cambridge University Press, United Kingdom, 2020.

Reference Books:

1. Janine M Benyus, *Biomimicry: Innovation Inspired by Nature*, Mariner Books, USA, 2002.
2. Xin-She Yang et al., *Bio-Inspired Computation and Applications in Image Processing*, Academic Press, 2016.