M. Tech (Civil Engineering) : Syllabus Revision in 2018-19.

S. No	Course Code	Session 2017-18	Session 2018-19	Remark Syllabus Change/ new course
1	MTCEEV101	**Energy & Environment (MTCEEV101)** **UNIT 1** **Introduction** - Human Development, Socio-Economic Activities and Energy Needs; Introduction to Primary and Secondary Energy Resources; Introduction to Energy Conservation Technologies. Energy Needs (fuel types) of Domestic /Commercial Transport and Industrial Sectors; National and Global Energy Demand and Supply. **UNIT 2** **Environmental Implications of Energy Use** - Laws of Thermodynamics, Degradation of Energy; Fuel chain, Environmental Impacts at Different Stages of the Fuel Chain; Local, Regional and global Impacts; Waste Recycling and its impacts on Energy and Environment. Air Pollution from cooking Appliances, Vehicle and Power Plants, long term Emission Standards for Indian Industries and Transport Sector. **UNIT 3** **Pollution Control Technologies in Energy Sector** - Clean Fuels and Environmental Friendly Cooking and Heating Appliances, Emission Control from Diesel & Petrol Engines, New and Efficient Engines: Clean Combustion Technologies for Coal; Flue Gas Desulphurization & Recirculation; Advanced Burner Technology& Staged Firing; Selective Catalytic reduction. **UNIT 4**	**Energy & Environment (MTCEEV101)** **Syllabus** **UNIT 1** **Introduction -** Human Development, Socio-Economic Activities and Energy Needs; Introduction to Primary and Secondary Energy Resources; Introduction to Energy Conservation Technologies. Energy Needs (fuel types) of Domestic /Commercial Transport and Industrial Sectors; National and Global Energy Demand and Supply. **UNIT 2** **Environmental Implications of Energy Use -** Laws of Thermodynamics, Degradation of Energy; Fuel chain, Environmental Impacts at Different Stages of the Fuel Chain; Local, Regional and global Impacts; Waste Recycling and its impacts on Energy and Environment. Air Pollution from cooking Appliances, Vehicle and Power Plants, long term Emission Standards for Indian Industries and Transport Sector. **UNIT 3** **Pollution Control Technologies in Energy Sector -** Clean Fuels and Environmental Friendly Cooking and Heating Appliances, Emission Control from Diesel & Petrol Engines, New and Efficient Engines: Clean Combustion Technologies for Coal; Flue Gas Desulphurization & Recirculation; Advanced Burner Technology& Staged Firing; Selective Catalytic reduction. **UNIT 4** **Energy Environment Models -** Analysis and design of Environmental Policies; Decision Analysis, System Dynamics and Linear Programming Models for Designing Environmental Policies, Current Research on Energy environment Interactions. **UNIT 5** **Environmental Economics -** Environmental Benefits and cost of the use of various options including Fossil Fuels, Bio Gas, Solar and Wind Energy.	**NO CHANGE**

		Energy Environment Models - Analysis and design of Environmental Policies; Decision Analysis, System Dynamics and Linear Programming Models for Designing Environmental Policies, Current Research on Energy environment Interactions. **UNIT 5** **Environmental Economics -** Environmental Benefits and cost of the use of various options including Fossil Fuels, Bio Gas, Solar and Wind Energy.		
2	**MTCEEV103A / MTCEEV102**	**Advanced Water Treatment Technology (MTCEEV102)** **UNIT 1** Water Quality Parameter, potable water, Significant water quality parameters for Municipal Water Supplies.Standards and Guidelines of Water for drinking purposes. **UNIT2** Water Treatment: Settling, types of , Discrete particle settling, Flocculent Settling, Theory of Tube Settlers, Plate Settlers, Choice of Clarifires, Ideal sedimentation Tank Concept. Coagulation, Theory, Chemistry and Mechanism of Coagulants, Coagulant Aids, Flocculation, Orthokinetic, Perikinetic, Mean Velocity Gradient. Long Rectangular Basin, Circular Basin **UNIT 3** Design of Clariflocculators. Filtration, Theory of, Carman Kozeny equation, Filter Arrangement, Filter operation. **UNIT 4** Disinfection, Types of, Mechanisms of, Factors Influencing Efficiency of Disinfectants, Chlorine Chemistry, Chlorinator. Process and Application of Ion	**Advanced Waste Water Treatment Technology (MTCEEV102)** **Syllabus** **UNIT 1** Water Quality Parameter, potable water, Significant water quality parameters for Municipal Water Supplies. Standards and Guidelines of Water for drinking purposes. **UNIT2** Water Treatment: Settling, types of , Discrete particle settling, Flocculent Settling, Theory of Tube Settlers, Plate Settlers, Choice of Clarifires, Ideal sedimentation Tank Concept. Coagulation, Theory, Chemistry and Mechanism of Coagulants, Coagulant Aids, Flocculation, Orthokinetic, Perikinetic, Mean Velocity Gradient. Long Rectangular Basin, Circular Basin **UNIT 3** Design of Clariflocculators. Filtration, Theory of, Carman Kozeny equation, Filter Arrangement, Filter operation. **UNIT 4** Disinfection, Types of, Mechanisms of, Factors Influencing Efficiency of Disinfectants, Chlorine Chemistry, Chlorinator. Process and Application of Ion Exchange, Adsorption, Reverse Osmosis, Electrodialysis. Use of bleaching power **UNIT5** Water softening : introduction, necessity of water softening,removal of temporary hardness, removal of parmanent hardness, lime soda process, base exchange process, demineralisation process, study of water	COURSE CODE CHANGED

		Exchange, Adsorption, Reverse Osmosis, Electrodialysis. Use of bleaching power **UNIT5** Water softening : introduction, necessity of water softening,removal of temporary hardness, removal of parmanent hardness, lime soda process, base exchange process, demineralisation process, study of water softening plant	softening plant	
3	**MTCEEV102 / MTCEEV103**	**Advanced Waste Water Treatment Technology (MTCEEV103)** **UNIT 1** **Introduction and Reuses of waste water:** Waste Water Characteristics and their significance. B.O.D. Nitrification .Comparison of various methods of Determination of Organics. Screens, Grit Chamber, Floatation. Sedimentation, Zone Settling, Classification of biological Waste water Treatment Process, Aeration of Waste Water. Industrial, Agricultural and domestic reuses. Concept of Gray water and uses **UNIT 2** **Wastewater Treatment Fundamentals :**Flow sheets, Physico-chemical and biological processes. Screens comminutors. Grit chambers, Sedimentation, Equalization, Neutralization , Floatation and chemical treatment of waste waters. **UNIT 3** **Biological Treatment Processes:** Fundamentals of Monods Kinetics and application in bioreactor Design Aerobic and anaerobic, Suspended – growth and	**Advanced Water Treatment Technology (MTCEEV103A)** **Syllabus** **UNIT 1** **Introduction and Reuses of waste water:** Waste Water Characteristics and their significance. B.O.D. Nitrification .Comparison of various methods of Determination of Organics. Screens, Grit Chamber, Floatation. Sedimentation, Zone Settling, Classification of biological Waste water Treatment Process, Aeration of Waste Water. Industrial, Agricultural and domestic reuses. Concept of Gray water and uses **UNIT 2** **Wastewater Treatment Fundamentals :**Flow sheets, Physico-chemical and biological processes. Screens comminutors. Grit chambers, Sedimentation, Equalization, Neutralization Floatation and chemical treatment of waste waters. **UNIT 3** **Biological Treatment Processes:** Fundamentals of Monods Kinetics and application in bioreactor Design Aerobic and anaerobic, Suspended – growth and Attached – growth treatments, Types, Modifications, Activated – sludge unit, Trickling filters, Aerated lagoons, Stabilization ponds, Oxidation ditches, Aerators.Theory of sludge handling treatment and disposal. **UNIT 4** **Sludge Treatment:** Sludge Sources, Characteristics, Volume- Mass relationship, Sludge Stabilization, Conventional and High Rate Digesters, Gas Production, Collection, Disposal of Sludge.Treatment system Chemical	**COURSE CODE CHANGED**

		Attached – growth treatments, Types, Modifications, Activated – sludge unit, Trickling filters, Aerated lagoons, Stabilization ponds, Oxidation ditches, Aerators.Theory of sludge handling treatment and disposal. **UNIT 4** **Sludge Treatment :** Sludge Sources, Characteristics, Volume- Mass relationship, Sludge Stabilization, Conventional and High Rate Digesters, Gas Production, Collection, Disposal of Sludge.Treatment system Chemical ,Biological, Incineration and Disposal of sludge solids. **UNIT 5** **Advances in Wastewater Treatment :** Nitrification, Denitrification, Phosphorousand other neutrient removal treatment processes , Total dissolved solid removal methods Introduction Use members and nano-technological -processes for wastewater treatment.	,Biological, Incineration and Disposal of sludge solids. **UNIT 5** **Advances in Wastewater Treatment :** Nitrification, Denitrification, Phosphorousand other neutrient removal treatment processes , Total dissolved solid removal methods Introduction Use members and nano-technological -processes for wastewater treatment.	
4	**MTCEEV104A / MTCEEV103B**		**Statistical and Mathematical Techniques (MTCEEV103B)** **Syllabus** **UNIT 1** **Linear Programming:** Formulation of the Linear Programming problem, Graphical methods for solving LP problems, Simplex method, Big M-method and Two-Phase simplex method, Duality: Definition of the dual problem, relationship between the primal and dual solutions, Formulation of dual problem. **UNIT 2** Dual Simplex method, Formulation of a transportation problem, North-west corner rule, row or column Minima method, Lowest cost entry method, Vogel"s Approximation (or Penalty) method (VAM),Degeneracy in Transportation problems, Assignment problem. **UNIT 3**	**COURSE CODE CHANGED**

			Probability Distribution: Random variables (discrete & continuous random variables), Probability mass function and Probability density function, mean, variance of Binomial, Poisson, Normal, Exponential, Fitting of the distributions. **UNIT 4** **Regression and Correlation:** Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Lines of regression, Error of prediction. Method of least square-curve fitting of straight line, parabola, exponential curve **UNIT 5** **Statistical inference:** Types of sampling, standard error, sampling distribution of mean and variance. Testing of hypothesis, Level of significance (large samples), Confidence limits, Estimation of parameters of the population (point estimation & interval estimation), t-distribution, testing for difference between means of two small samples, Chi-square distribution, degree of freedom, goodness of fit, Fisher's Z-Distribution.	
5	**MTCEEV104C / MTCEEV103C**		**Environmental Geo-Technology (MTCEEV103C)** **Syllabus** **UNIT 1** **The Earth Systems and Biosphere:** Conservation of matter in various geo-spheres –lithosphere, hydrosphere, atmosphere and biosphere. Energy budget of the earth. Earth's thermal environment and seasons. Climates of India, Indian Monsoon, Climatic variability and climate change, earths process and geological metrological Hazardous, Natural hazardous and extreme weather events, Flood and droughts in introductory ideas about air pollutions and global warming. **UNIT 2** **Earth's Processes and Geological Hazards**: Earth's processes; concepts of residence, time and rate of natural cycles. Catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche. Perception of the hazards and adjustments to hazardous activities. **UNIT 3** **Mineral Resources and Environment**: Resources and Reserves, Minerals and population. Oceans and new areas for exploration of mineral resources. Ocean and recycling of resources. Environmental impact of exploitation, processing and smelting of	**COURSE CODE CHANGED**

			minerals. **UNIT 4** **Acid Mine Drainage:** Formation of AMD**,** Chemistry of AMD, Microbiology of AMD, Iron Oxidation**,** Effect of AMD. **UNIT 5** **Remote Sensing and GIS:** Principles of Remote Sensing and its application of Environmental Science. Application of GIS in Environmental Management.	
6	**MTCEEV104B / MTCEEV104A**	**Statistical and Mathematical Techniques (MTCEEV104A)** **UNIT 1** **Linear Programming:** Formulation of the Linear Programming problem, Graphical methods for solving LP problems, Simplex method, Big M-method and Two-Phase simplex method, Duality: Definition of the dual problem, relationship between the primal and dual solutions, Formulation of dual problem. **UNIT 2** Dual Simplex method, Formulation of a transportation problem, North-west corner rule, row or column Minima method, Lowest cost entry method, Vogel"s Approximation (or Penalty) method (VAM),Degeneracy in Transportation problems, Assignment problem. **UNIT 3** **Probability Distribution:** Random variables (discrete & continuous random variables), Probability mass function and Probability density function, mean, variance of Binomial, Poisson, Normal, Exponential, Fitting of the distributions.	**Noise and Thermal Pollution (MTCEEV104A)** **Syllabus** **UNIT 1** **Physics and effects of noise: -** sources of noise, Frequency and Sound Levels, Units of Noise based power ratio, Contours of Loudness. Effects on Human, Environment and Properties. **UNIT 2** **Sources and Monitoring of Noise Pollution: -** Natural and Anthropogenic Noise Sources, Measuring Instruments for Frequency and Noise levels, Masking of sound **UNIT 3** **Noise Sampling,** list of BIS code books on noise pollution, Impacts of noise on Annoyance, Physiological effects. Loss of hearing, human performance, Nervous system, Sleeplessness, Damage to material etc **Unit 4** **Control of Noise Pollution: -** Treatment of noise Control at source, Control in the transmission path, using protective equipment **UNIT 5** **Basics of Thermal Pollution:** Waste heats into Water and other environments Sources, Effects and Control, Effects on Environment, Macro and Micro aquatic organisms . Effects case studies, methods of Control: Cooling towers and nuclear reactor cooling systems.	COURSE CODE CHANGED

		UNIT 4 **Regression and Correlation:** Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Lines of regression, Error of prediction. Method of least square- curve fitting of straight line, parabola, exponential curve **UNIT 5** **Statistical inference:** Types of sampling, standard error, sampling distribution of mean and variance. Testing of hypothesis, Level of significance (large samples), Confidence limits, Estimation of parameters of the population (point estimation & interval estimation), t-distribution, testing for difference between means of two small samples, Chi-square distribution, degree of freedom, goodness of fit, Fisher's Z-Distribution.		
7	**MTCEEV104 B**	**Noise and Thermal Pollution (MTCEEV104B)** **UNIT 1** **Physics and effects of noise: -** sources of noise, Frequency and Sound Levels, Units of Noise based power ratio, Contours of Loudness. Effects on Human, Environment and Properties. **UNIT 2** **Sources and Monitoring of Noise Pollution: -** Natural and Anthropogenic Noise Sources, Measuring Instruments for Frequency and Noise levels, Masking of sound **UNIT 3** **Noise Sampling,** list of BIS code books on noise pollution, Impacts of noise on	**Environmental Hydraulics (MTCEEV104B)** **Syllabus** **UNIT 1** Properties of Fluid : Types of Fluid, Properties of Fluid, Fluid as a Continuum, Control Volume Concept Hydrostatics: Fluid Pressure at a point, Pressure-height relationship, Absolute, gauge and atmospheric pressure, Measurement of pressure using various types of manometer, Intensity of pressure, Centre of pressure, Pressure on horizontal, vertical and inclined surfaces, curved surface **UNIT 2** Basics of Fluid Kinetics & Dynamics: Different types of flow, Continuity Equation, Euler's Equation Bernoulli's Equation and its application, Flow measurement using pitot tube, venturi meter and pipe orifices Flow Through Pipes: Major and minor losses of energy in pipes , Hydraulic gradient and total energy line, Flow through pipes in series, in parallel, equivalent pipe Floe through branch pipe	**NEW COURSE**

		Annoyance, Physiological effects. Loss of hearing, human performance, Nervous system, Sleeplessness, Damage to material etc **Unit 4** **Control of Noise Pollution: -** Treatment of noise Control at source, Control in the transmission path, using protective equipment **UNIT 5** **Basics of Thermal Pollution:** Waste heats into Water and other environments Sources, Effects and Control, Effects on Environment, Macro and Micro aquatic organisms . Effects case studies, methods of Control: Cooling towers and nuclear reactor cooling systems.	**UNIT 3** Flow through orifice and Mouthpiece Classification of orifices & concept of venacontracta, Hydraulic Coefficient, Discharge through small orifice, large orifice, fully - submerged orifice & partially - submerged orifice, Time of emptying a tank through an orifice of rectangular tank, hemi-spherical tank and circular horizontal tank, Classification of mouthpieces,Discharge through an external cylindrical mouthpiece, convergent-divergent and an internal mouth piece **UNIT 4** Flow Through Notches and Weirs Classification of notches and weirs, Discharge through a rectangular notch or weir, triangular notch or weir, trapezoidal notch or weir and stepped notch, Velocity of approach , Empirical formula for discharge through rectangular weir, cipolletti weir or notch , Discharge over a broad-crested weir, narrow- crested weir and submerged weir Time emptying a tank with rectangular and triangular weir or notch **UNIT 5** Flow through open channel Types of open channel and types of flow, Empirical formula for determination of flow through open channel Most efficient cross section for rectangular channel, trapezoidal channel and triangular channel	
8	**MTCEEV204C / MTCEEV104C**	**Environmental Geo-technology (MTCEEV104C)** **UNIT 1** **The Earth Systems and Biosphere:** Conservation of matter in various geo-spheres –lithosphere, hydrosphere, atmosphere and biosphere. Energy budget of the earth. Earth's thermal environment and seasons. Climates of India, Indian Monsoon, Climatic variability and climate change, earths process and geological metrological Hazardous,Natural hazardous and extreme weather events, Flood and droughts in introductory ideas about air pollutions and global warming. **UNIT 2**	**Environmental Chemistry & Microbiology (MTCEEV104C)** **Syllabus** **UNIT 1** **Physical Chemistry**: Thermodynamics, Free Energy, osmosis, dialysis, law of mass action, chemical equilibrium, basic concepts of chemical kinetics. **UNIT 2** **Biochemistry**: Biochemistry of carbohydrates, proteins, fats and oils, Enzymes, buffers, EMP and TCA pathways, electron transport mechanism and oxidation phosphorylation, photosynthesis. **UNIT 3** **General Chemistry**: Henry's law, activity coefficients, ionization of weak bases, and acids, solubility product, Common ion effect, ways of shifting chemical equilibria, Adsorption isotherms.	**Course code Changed**

		Earth's Processes and Geological Hazards: Earth's processes; concepts of residence,time and rate of natural cycles. Catastrophic geological hazards. Study of floods, landslides,earthquakes, volcanism and avalanche. Perception of the hazards and adjustments to hazardous activities. **UNIT 3** **Mineral Resources and Environment**: Resources and Reserves, Minerals and population.Oceans and new areas for exploration of mineral resources. Ocean and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. **UNIT 4** **Acid Mine Drainage:** Formation of AMD**,** Chemistry of AMD, Microbiology of AMD, Iron Oxidation**,** Effect of AMD. **UNIT 5** **Remote Sensing and GIS:** Principles of Remote Sensing and its application of Environmental Science. Application of GIS in Environmental Management.	**UNIT 4** Microbiology: Morphology and classification of bacteria, algae, fungi and viruses, elements of microscopy, Microorganisms of various aerobic and anaerobic biological waste treatment units, culture media for microorganisms, sterilization. Culture of microorganisms in batch and continuous reactors, energy and kinetics of microbial growth and metabolism and biological fate of pollutants. **UNIT 5** Microbiology of water, soil and air, Water and air borne diseases and their causative organisms, concept of indicator organisms. Tests for coli- forms and streptococci and their significance, MPN and MF techniques, bacteriological standards.	
9	**MTCEEV105**	**Advanced Water Treatment Lab (MTCEEV105)** **List of Experiments** 1. To determine the pH of the given sample of water. 2. To determine the turbidity of the given sample of water 3. To determine Total Solids of the given water sample. 4. To determine the Total Dissolved Solids of the given water sample. 5. To find out conductivity of the given	**Research Methodology and IPR (MTCEEV105)** **Syllabus** **Unit 1:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. **Unit 2:** Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. **Unit 3:** Nature of Intellectual Property: Patents,	NEW COURSE

		water sample. 6. To determine hardness of the given water sample. 7. To find out chloride of the given water sample. 8. To determine alkalinity of the given water sample. 9. To find out acidity of the given water sample. 10. To determine the optimum dose of alum by Jar test. 12. To study various water supply Fittings	Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for Grants of patents, Patenting under PCT. **Unit 4:** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **Unit 5:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	
10	MTCEEV106		(MTCEEV106) **Enlightenment Skills**	NEW COURSE
11	**MTCEEV105 / MTCEEV107**		**Advanced Water Treatment Lab (MTCEEV107)** **Syllabus** 1. To determine the pH of the given sample of water. 2. To determine the turbidity of the given sample of water 3. To determine Total Solids of the given water sample. 4. To determine the Total Dissolved Solids of the given water sample. 5. To find out conductivity of the given water sample. 6. To determine hardness of the given water sample. 7. To find out chloride of the given water sample. 8. To determine alkalinity of the given water sample. 9. To find out acidity of the given water sample. 10. To determine the optimum dose of alum by Jar test. 12. To study various water supply Fittings	COURSE CODE CHANGED
12	**MTCEEV108**		**Sanitation Engineering Lab (MTCEEV108)**	NEW COURSE

			Syllabus 1. To determine the pH of the given sample of sewage. 2. To determine Total Solids of the given sewage sample. 3. To determine the Total Dissolved Solids of the given sewage sample. 4. To find out Total Settle-able Solids of the given sewage sample. 5. To determine Total Suspended Solids of the given sewage sample. 6. To find out the Quantity of Dissolved Oxygen present in the given water sample by Winkler's Method. 7. To determine Biochemical Oxygen Demand exerted by the given wastewater sample. 8. To find out Chemical Oxygen Demand of the waste water sample. 9. To study various Sanitary Fittings. 10. Design problems as per syllabus of theory.	

13	**MTCEEV201**	**Environmental Policies & Legislation (MTCEEV201)** **UNIT 1** **Introduction:** Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria. **UNIT 2** **Historical aspects**: major legislations: USEPA 1969 to Clean Water and Air Act. significant legislations in developing and developed countries. **UNIT 3** **Legislations in Indian context**: Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution. **UNIT 4** **Norms & Standards:** OHSHAS 18001 and its significance. ISO 14000 and its significance, other acts in ESE and case studies. Feasibility Studies and Management issues. **UNIT 5** **Related Issues:** Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy.	**Environmental Policies & Legislation (MTCEEV201)** **Syllabus** **UNIT 1** **Introduction:** Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria. **UNIT 2** **Historical aspects**: major legislations: USEPA 1969 to Clean Water and Air Act. significant legislations in developing and developed countries. **UNIT 3** **Legislations in Indian context**: Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution. **UNIT 4** **Norms & Standards:** OHSHAS 18001 and its significance. ISO 14000 and its significance, other acts in ESE and case studies. Feasibility Studies and Management issues. **UNIT 5** **Related Issues:** Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy.	NO CHANGE

14	**MTCEEV203/ MTCEEV202**	**Industrial Waste Treatment (MTCEEV202)** **Unit 1.** Comparative study of industrial waste water with municipal waste water, Industrial waste water problems in India: Effects of discharges of Industrial Waste of Receiving Bodies of Water, Land and Sewer. Effluent and Stream Standards. Historical Development of law related to environmental Protection, Salient feature of Water Act- 1974, Air Act 1981 and Environmental (Protection) Act 1986 **Unit 2.** Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting. **Unit 3** Specific Industrial Treatment Processes : Neutralization, Equalization and Proportioning, Volume and strength reduction. Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity. **Unit 4**. Raw materials, Water requirements, Process Characteristics, Composition, effects and treatment, flow sheet of Industrial Waste Waters generated from: Textile (Cotton and Synthetic), tannery, Pulp and Paper, Dairy, Metal Plating (Chromium and Cyanide problem), Slaughter house, Distillery, Dyeing and printing, Fertilizer, Copper & Cement	**Environmental Impact Assessment and Auditing (MTCEEV202)** **Syllabus** **Unit 1** **Introduction to Environmental Impact Analysis: Terms**-environment, Impact and assessment, concept of EIA, Environmental settings, Prediction and assessment of impact on physical, biological and socio-economic environment. **Unit 2** **Methods of Analysis of Impacts on Environment:** Adhoc, Checklist, Matrix, Network, environmental Media quality Index Method, Cost Benefit Analysis**.** **Unit 3** **Public Participation:** Concept, Public hearing procedure and guidelines. **Unit 4** **Location of Industries:** Environmental impacts of typical industries, power plants, large projects, present scenario of various government resolutions on selecting the location of industries, environmental point of view. **Unit 5** **Case Histories** of Engineering Projects like Energy Generation Projects both thermal and Hydal , Infra-structure projects , Power Transmission etc..	**Course code Changed**

		Industry. Provision of various Indian Standards for above Industries. **Unit5.** Potential of Wastewater Recycle and Reuse in Industries, Concept of Common Effluent Treatment Plants.		
15	**MTCEEV204A / MTCEEV203A**	**Environmental Impact Assessment and Auditing (MTCEEV203)** **Unit 1** **Introduction to Environmental Impact Analysis: Terms**-environment, Impact and assessment, concept of EIA, Environmental settings, Prediction and assessment of impact on physical, biological and socio-economic environment. **Unit 2** **Methods of Analysis of Impacts on Environment:** Adhoc, Checklist, Matrix, Network, environmental Media quality Index Method, Cost Benefit Analysis**.** **Unit 3** **Public Participation:** Concept, Public hearing procedure and guidelines. **Unit 4** **Location of Industries:** Environmental impacts of typical industries, power plants, large projects, present scenario of various government resolutions on selecting the location of industries, environmental point of view. **Unit 5** **Case Histories** of Engineering Projects like Energy Generation Projects both thermal and Hydal , Infra-structure projects , Power Transmission etc..	**Solid Waste Management (MTCEEV203A)** **Syllabus** **Unit 1** **Solid waste management:** Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. **Unit 2** **Solid waste generation rate:** Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles. **Unit 3** **Sorting and material recovery:** Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste. **Unit 4** **Composting of solid waste:** Principles, Methods, Factors affecting, Properties of compost Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. **Unit 5** **Landfills:** Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.	**Course code Changed**

16	**MTCEEV204B / MTCEEV203B**		**Hydrology and Applied Hydraulics (MTCEEV203B)** **Syllabus** **Unit 1** Evaporation and infiltration : measurement and estimation of evaporation from land and water surfaces. Infiltration, factors affecting infiltration. Surface runoff, overland flow, factors affecting runoff. Hydrograph analyses, Unit hydrograph, channel and storage routing. **Unit 2** Fundamentals of ground water flow : Occurrence of Ground Water, Vertical Distribution of Ground Water, Darcy's law, Permeability, Porosity, Anisotropic Aquifers, Differential equations of Ground water flow. **Unit 3** Ground Water Development : Well development, Artificial recharge, Salinity of Ground water, Ground water pollution, Infiltration Galleries. **Unit 4** Water and wastewater pumping : Classification, selection, installation, operation and maintenance of pumps for water and wastewater pumping, electrical motors, choice and installation, starters and other accessories **Unit 5** Rainfall intensity-duration –frequency curves. Design of drainage system elements, control of storm water pollution., Introduction to optimization of water distribution system, principles of sewers	**Course code Changed**
17	**MTCEEV304C / MTCEEV203C**		**Indoor Air Quality (MTCEEV203C)** **Syllabus** **UNIT 1.** Indoor activities of inhabitants - Levels of pollutants in indoor and outdoor air- Design and operation of buildings for improvements of public health- IAQ policy issues- sustainability. **UNIT 2.** Air pollutants in indoor environments- private residences- offices- schools-public buildingsventilation. **UNIT 3**. Control of several pollutant classes- radon-	**Course code Changed**

			toxic organic gases- combustion byproductsmicroorganisms such as molds and infectious bacteria. **UNIT 4.** Concepts and tools- exposure- material balance models- statistical models. **UNIT 5.** Indoor air pollution from outdoor sources- particulate matter and ozone- Combustion byproducts- Radon and its decay products- Volatile organic compounds- odors and sickbuilding syndrome- Humidity- Bio aerosols- infectious disease transmission- Special indoor environments- A/C units in indoor- Measurement methods- Control technologies- Control strategies.	
18	**MTCEEV202 / MTCEEV204 A**	**Solid Waste Management (MTCEEV204A)** **Unit 1** **Solid waste management:** Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. **Unit 2** **Solid waste generation rate:** Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles. **Unit 3** **Sorting and material recovery:** Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste. **Unit 4** **Composting of solid waste:** Principles,	**Industrial Waste Treatment (MTCEEV204A)** **Syllabus** **Unit 1.** Comparative study of industrial waste water with municipal waste water, Industrial waste water problems in India: Effects of discharges of Industrial Waste of Receiving Bodies of Water, Land and Sewer. Effluent and Stream Standards. Historical Development of law related to environmental Protection, Salient feature of Water Act- 1974, Air Act 1981 and Environmental (Protection) Act 1986 **Unit 2.** Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting. **Unit 3** Specific Industrial Treatment Processes : Neutralization, Equalization and Proportioning, Volume and strength reduction. Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity. **Unit 4**. Raw materials, Water requirements, Process Characteristics, Composition, effects and treatment, flow sheet of Industrial Waste Waters generated from: Textile (Cotton and Synthetic), tannery, Pulp and Paper, Dairy, Metal Plating (Chromium and Cyanide problem), Slaughter house, Distillery, Dyeing and printing, Fertilizer, Copper & Cement	**Course code Changed**

		Methods, Factors affecting, Properties of compost Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. **Unit 5** **Landfills:** Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.	Industry. Provision of various Indian Standards for above Industries. **Unit5.** Potential of Wastewater Recycle and Reuse in Industries, Concept of Common Effluent Treatment Plants.	
19	**MTCEEV204 B**	**Hydrology and Applied Hydraulics (MTCEEV204B)** **Unit 1** Evaporation and infiltration : measurement and estimation of evaporation from land and water surfaces. Infiltration, factors affecting infiltration. Surface runoff, overland flow, factors affecting runoff. Hydrograph analyses, Unit hydrograph, channel and storage routing. **Unit 2** Fundamentals of ground water flow : Occurrence of Ground Water, Vertical Distribution of Ground Water, Darcy's law, Permeability, Porosity, Anisotropic Aquifers, Differential equations of Ground water flow. **Unit 3** Ground Water Development : Well development, Artificial recharge, Salinity of Ground water, Ground water pollution, Infiltration Galleries. **Unit 4** Water and wastewater pumping :	**Hazardous Waste Treatment (MTCEEV204B)** **Syllabus** **Unit 1** **Hazardous Waste:** Definition, Magnitude of Problem, Public and Government awareness of Hazardous Waste, Definition of Hazardous Waste under RCRA. Basic idea of the Hazardous Waste (Management and Handling) Rules, 1989. **Unit 2** **Exposure and Risk Assessment:** Introduction, Hazard Identification, Process of Risk Assessment, Toxicity Assessment, Risk Characterization and Remediation. **Unit 3** **Environmental Legislation:** EPA obligations and Responsibilities. Hazardous Waste Management and Handling Rules. Environment Management Systems (EMS). **Unit 4** **Waste Minimization :** Introduction to Government Policy in Waste Reduction. Benefits of Hazardous Waste Reduction. Approaches to Hazardous Waste Reduction. Priorities in Hazardous Waste Management. **Unit 5** **Treatment :** Physical, Chemical and Biological Treatment of Hazardous Waste.	**New Course**

		Classification, selection, installation, operation and maintenance of pumps for water and wastewater pumping, electrical motors, choice and installation, starters and other accessories **Unit 5** Rainfall intensity-duration –frequency curves. Design of drainage system elements, control of storm water pollution., Introduction to optimization of water distribution system, principles of sewers		
20	**MTCEEV204 C**	**ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY (MTCEEV204C)** **UNIT 1** **Physical Chemistry**: Thermodynamics, Free Energy, osmosis, dialysis, law of mass action, chemical equilibrium, basic concepts of chemical kinetics. **UNIT 2** **Biochemistry**: Biochemistry of carbohydrates, proteins, fats and oils, Enzymes, buffers, EMP and TCA pathways, electron transport mechanism and oxidation phosphorylation, photosynthesis. **UNIT 3** **General Chemistry**: Henry's law, activity coefficients, ionization of weak bases, and acids, solubility product, Common ion effect, ways of shifting chemical equilibria, Adsorption isotherms. **UNIT 4**	**Ground Water Pollution (MTCEEV204C)** **Syllabus** **UNIT1.** WATER QUALITY: Natural occurrence of common solutes in water, Suspended & dissolved constituents, Principle chemical constituents in ground water, water quality criteria for drinking, Agricultural and Industrial uses, Quality of ground water resources. **UNIT 2** SOURCES OF POLLUTION Various sources & causes of ground water pollution. Activities generating contaminants, Types of contaminants & Mechanism of ground water pollution **UNIT 3** MOVEMENT OF POLLUTANTS: Principles of Pollutant movement (Darcy's law, Hydraulic Conductivity, Anisotropic Aquifer), Attenuation of pollution in the ground, Pollution dispersion in the ground. Ground water movement in saturated zone. Factors affecting Pathogen movement & Survival, Transportation equation, ground water remediation. **UNIT 4** PROBLEMS OF TOTAL DISSOLVED SOLIDS: Fluoride & Nitrate Pollution of ground water, Natural occurrence of Nitrates & sources related to man's activities. **UNIT 5** MONITORING GROUND WATER QUALITY General Principles, Monitoring Management of Ground Water Quality, Section	**New Course**

		Microbiology: Morphology and classification of bacteria, algae, fungi and viruses, elements of microscopy, Microorganisms of various aerobic and anaerobic biological waste treatment units, culture media for microorganisms, sterilization. Culture of microorganisms in batch and continuous reactors, energy and kinetics of microbial growth and metabolism and biological fate of pollutants. **UNIT 5** Microbiology of water, soil and air, Water and air borne diseases and their causative organisms, concept of indicator organisms. Tests for coli- forms and streptococci and their significance, MPN and MF techniques, bacteriological standards.	of Parameters for Monitoring. Economic considerations in ground water quality management.	
21	MTCEEV205	**Industrial Waste Treatment Lab (MTCEEV205)** **List of Experiments:-** 1. To determine the pH of the given sample of Industrial Waste. 2. To determine Total Solids of the given Industrial Waste sample. 3. To determine the Total Dissolved Solids of the given Industrial Waste sample. 4. To find out Total Settle-able Solids of the given Industrial Waste sample. 5. To determine Total Suspended Solids of the given Industrial Waste sample. 6. To find out the Quantity of Dissolved Oxygen present in the given Industrial Waste sample by Winkler's Method.	MTCEEV205 **Enlightenment Skills**	**New Course**

		7. To determine Biochemical Oxygen Demand exerted by the given Industrial Waste water sample. 8. To find out Chemical Oxygen Demand of the Industrial Waste water sample. 9. To study various Sanitary Fittings. 10. Design problems as per syllabus of theory		
22	MTCEEV205 / **MTCEEV206**		**Industrial Waste Treatment Lab (MTCEEV206)** **Syllabus** 1. To determine the pH of the given sample of Industrial Waste. 2. To determine Total Solids of the given Industrial Waste sample. 3. To determine the Total Dissolved Solids of the given Industrial Waste sample. 4. To find out Total Settle-able Solids of the given Industrial Waste sample. 5. To determine Total Suspended Solids of the given Industrial Waste sample. 6. To find out the Quantity of Dissolved Oxygen present in the given Industrial Waste sample by Winkler's Method. 7. To determine Biochemical Oxygen Demand exerted by the given Industrial Waste water sample. 8. To find out Chemical Oxygen Demand of the Industrial Waste water sample. 9. To study various Sanitary Fittings.	**COURSE CODE CHANGED**

			10. Design problems as per syllabus of theory	
23	**MTCEEV207**		**Air Quality Testing Lab (MTCEEV207)** **Syllabus** 1. Monitoring of respirable particulate matter 2. Monitoring of gases and particulates in ambient air 3. Indoor air quality monitors 4. Measurement of meteorological parameters 5. Bioaerosol sampling	**NEW COURSE**
24	**MTCEEV208**		**Mini Project with Seminar (MTCEEV208)**	**New Course**
25	**MTCEEV301 / MTCEEV301**	**Air Pollution and It's Control** **(MTCEEV301)** **Unit 1** **Sources and classification :** Classification of aerosols, gases vapors, natural air pollutants, properties of air pollutants. **Unit 2** **Meteorology :** Factors influencing air pollution, wind roses, plume behavior, estimation of plume rise. **Unit 3** **Air pollution modeling** : Dispersion models – Basquill model, ASME model, Gaussian plume model assumptions, limitations. **Unit 4** **Effects of Air Pollutants :** Effect on man, material, vegetation, art treasurers. Air pollution disasters, Economic effects. **Unit 5** **Global effects of Air Pollutants** : Green house effect, acid rains, ozone hole, heat islands. **Air pollution due to automobiles :**	**Air Pollution and Its Control** **(MTCEEV301A)** **Syllabus** **Unit 1** **Sources and classification:** Classification of aerosols, gases vapors, natural air pollutants, properties of air pollutants. **Unit 2** **Meteorology:** Factors influencing air pollution, wind roses, plume behavior, estimation of plume rise. **Unit 3** **Air pollution modeling:** Dispersion models – Basquill model, ASME model, Gaussian plume model assumptions, limitations. **Unit 4** **Effects of Air Pollutants:** Effect on man, material, vegetation, art treasurers. Air pollution disasters, Economic effects. **Unit 5** **Global effects of Air Pollutants:** Green house effect, acid rains, ozone hole, heat islands. **Air pollution due to automobiles:** Vehicular emissions, motor fuel combustion, automobile emission control, general concepts of transport planning for prevention of air pollution.	**COURSE CODE CHANGED**

		Vehicular emissions, motor fuel combustion, automobile emission control, general concepts of transport planning for prevention of air pollution.		
26	**MTCEEV301 B**		**Environmental Aspects of Industries (MTCEEV301B)** **Syllabus** **Unit 1** Environmental laws related to Various Industries. Mineral production, history of environmental problems. Mining Methods- Opencast and underground mining. Unit operations: Site clearance, drilling, blasting, transportation, reclamation, mine closure, etc. Mineral beneficiation and their environmental impacts. **Unit 2** Metallurgical Industries and their Environmental Aspects: Unit operations, sources and Management of pollution in integrated steel plants, ferrous and non-ferrous metals. **Unit 3** Thermal Power Plants: Introduction: site selection, layout and unit operations; Fuel and fuel handling -types of fuels, solid, liquid and gaseous. Fuel burning equipments; Pollution control devices- ash handling, management and its utilization. Environmental management for captive power plants. Environmental problems in cement industries. **Unit 4** Petroleum Industry: Production and consumption of the oil and gas, unit operations involved in exploration and production of petroleum and natural gas; Major environmental problems in on-land and off-shore exploration; petrochemical plants. **Unit 5**	**NEW COURSE**

			R&R, industrial disasters, industrial safety. Environmental laws related to industrial production. Safety audit; Occupational Health & Safety Management System; Risk Assessment, Hazard and Operability Studies (HAZOP) and analysis; Disaster Management.	
27	**MTCEEV303 / MTCEEV301 C**		**Environment & Health (MTCEEV301C)** **Syllabus** **Unit1** Dimensions of environmental health, causative agents of diseases, social factors, urban problems, housing and health, economy and health, climate and other atmospheric elements, violence, crime and mental health, family health practice, health care planning and delivery, chronic and communicable disease, worldwide nutrition and population control. **Unit 2** Industrial and agricultural pollutants, occupational health, epidemiological data, occupational health hazards, environmental exposure and diseases, industrial toxicants, hazardous wastes, preventing exposure to unhealthy and unsafe working conditions, vector control. **Unit 3** Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability. Foodborne and waterborne diseases outbreaks, controlling stress of life, epidemiology **Unit 4** Nuclear energy and environmental health, concerns and uncertainties about nuclear power, , nuclear power plants, safety. Environmental health planning, need for planning, the planning process **Unit5** Environmental health services, various agencies, International efforts, role of industry, voluntary health agencies, Law and human welfare, constitutional right to healthy environment, environmental education.	**COURSE CODE CHANGED**
28	**MTCEEV302**	**Hazardous Waste Treatment (MTCEEV302)**	**Business Analytics (MTCEEV302A)**	**New Course**

		Unit 1 **Hazardous Waste:** Definition, Magnitude of Problem, Public and Government awareness of Hazardous Waste, Definition of Hazardous Waste under RCRA. Basic idea of the Hazardous Waste (Management and Handling) Rules, 1989. **Unit 2** **Exposure and Risk Assessment:** Introduction, Hazard Identification, Process of Risk Assessment, Toxicity Assessment, Risk Characterization and Remediation. **Unit 3** **Environmental Legislation:** EPA obligations and Responsibilities. Hazardous Waste Management and Handling Rules. Environment Management Systems (EMS). **Unit 4** **Waste Minimization :** Introduction to Government Policy in Waste Reduction. Benefits of Hazardous Waste Reduction. Approaches to Hazardous Waste Reduction. Priorities in Hazardous Waste Management. **Unit 5** **Treatment :** Physical, Chemical and Biological Treatment of Hazardous Waste.	**Syllabus** **Unit-I:** Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview. **Unit-II:** Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. **Unit-III:** Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization. **Unit-IV:** Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model. **Unit-V:** Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. **Unit-VI:** Recent Trends in: Embedded and collaborative business intelligence,	

			Visual data recovery, Data Storytelling and Data journalism.	
29	**MTCEEV302B**		**Industrial Safety (MTCEEV302B)** **Syllabus** **Unit-I:** Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. **Unit-II:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. **Unit-III:** Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **Unit-IV:** Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. **Unit-V:** Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive	**NEW COURSE**

			maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	
30	**MTCEEV302C**		**Operations Research** **(MTCEEV302C)** **Syllabus** **Unit 1**: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models **Unit 2** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming **Unit 3**: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT **Unit 4** Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. **Unit 5** Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**NEW COURSE**

31	**MTCEEV302D**		**Cost Management of Engineering Projects (MTCEEV302D)** **Syllabus** Unit 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Unit 4: Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	**NEW COURSE**

32	**MTCEEV302E**		**Composite Materials (MTCEEV302E)** **Syllabus** **UNIT–I**: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. **UNIT – II**: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. **UNIT – III:** Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. **UNIT–IV:** Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications. **UNIT – V:** Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria,	**NEW COURSE**

			maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	
33	**MTCEEV302F**		**Waste to Energy (MTCEEV302F)** **Syllabus** **Unit-I:** Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors **Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. **Unit-III:** Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation. **Unit-IV:** Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors. **Unit-V:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion -	**NEW COURSE**

			Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	
34	**MTCEEV303**	**Environment & Health (MTCEEV303)** **Unit1** Dimensions of environmental health, causative agents of diseases, social factors, urban problems, housing and health, economy and health, climate and other atmospheric elements, violence, crime and mental health, family health practice, health care planning and delivery, chronic and communicable disease, worldwide nutrition and population control. **Unit 2** Industrial and agricultural pollutants, occupational health, epidemiological data, occupational health hazards, environmental exposure and diseases, industrial toxicants, hazardous wastes, preventing exposure to unhealthy and unsafe working conditions ,vector control. **Unit 3** Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability. Foodborne and waterborne diseases outbreaks, controlling stress of life, epidemiology **Unit 4** Nuclear energy and environmental health, concerns and uncertainties about nuclear power, , nuclear power plants, safety. Environmental health planning, need for	**Dissertation-I / Industrial Project (MTCEEV303)** **Syllabus** **Mid Sem Evaluation weightage - 30%** **End Sem Evaluation weightage - 70%** **Dissertation-I**: will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.	**New Course**

		planning, the planning process **Unit5** Environmental health services, various agencies, International efforts, role of industry, voluntary health agencies, Law and human welfare, constitutional right to healthy environment, environmental education.		
35	**MTCEEV304A**	**Ground Water Pollution (MTCEEV304A)** **UNIT1.** WATER QUALITY: Natural occurrence of common solutes in water, Suspended & dissolved constituents,Principle chemical constituents in ground water, water quality criteria for drinking,Agricultural and Industrial uses, Quality of ground water resources. **UNIT 2** SOURCES OF POLLUTION Various sources & causes of ground water pollution. Activities generating contaminants, Types		

		of contaminants & Mechanism of ground water pollution **UNIT 3** MOVEMENT OF POLLUTANTS: Principles of Pollutant movement (Darcy's law, Hydraulic Conductivity, Anisotropic Aquifer), Attenuation of pollution in the ground, Pollution dispersion in the ground. Ground water movement in saturated zone. Factors affecting Pathogen movement & Survival, Transportation equation, ground water remediation. **UNIT 4** PROBLEMS OF TOTAL DISSOLVED SOLIDS: Fluoride & Nitrate Pollution of ground water, Natural occurrence of Nitrates & sources related to man's activities. **UNIT 5** MONITORING GROUND WATER QUALITY General principles, Monitoring Management of Ground Water Quality, Section of Parameters for Monitoring. Economic considerations in ground water quality management.		
36	**MTCEEV304B**	**Planning and Design of Environmental Facilities (MTCEEV304B)** **Unit 1** Environmental Engineering hydraulic design: Water distribution systems- Design of distribution systems- Hydraulic analysis – Distribution system components – Storage tanks– Equivalent Pipe method **UNIT 2**		

		Types of sewerage system —Design of various sewer appurtenances - Design of sanitary and storm water sewers – Structural requirement of sewer under various conditions – Design of surface and subsurface drainage – Roadways and Airport drainage **UNIT 3** Design of water treatment units – Clarifiers, Flocculators, Filter House, Hopper Bottom Tanks, Digesters **UNIT 4** Design of waste water treatment units – Design of screens, Grit chamber, Sedimentation tank, Activated sludge process, Trickling filter, Aerated lagoons, Stabilization ponds, Oxidation ditch, Septic tank, Imhoff tank, Sequencing batch reactor, Sludge digestion tank. **Unit 5** Underground Tanks, Retaining Wall and floor Junctions. Rectangular and Circular Tanks in R.C.C. and Steel, Intz Tanks, Steel and Concrete Staging		
37	**MTCEEV304C**	**INDOOR AIR QUALITY (MTCEEV304C)** **UNIT 1.** Indoor activities of inhabitants - Levels of pollutants in indoor and outdoor air- Design and operation of buildings for improvements of public health- IAQ policy issues- sustainability. **UNIT 2.** Air pollutants in indoor environments- private residences- offices- schools-public		

		buildingsventilation. **UNIT 3**. Control of several pollutant classes-radon- toxic organic gases- combustion byproductsmicroorganisms such as molds and infectious bacteria. **UNIT 4.** Concepts and tools- exposure- material balance models- statistical models. **UNIT 5.** Indoor air pollution from outdoor sources-particulate matter and ozone- Combustion byproducts- Radon and its decay products- Volatile organic compounds-odors and sickbuilding syndrome- Humidity- Bio aerosols-infectious disease transmission- Special indoor environments- A/C units in indoor-Measurement methods- Control technologies- Control strategies.		
38	**MTCEEV305**	**SEMINAR (MTCEEV305)**		
39	**MTCEEV401**	**Dissertation (MTCEEV401)**	**Dissertation-II (MTCEEV401)** **Syllabus** **Dissertation – II:** will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.	**Course Name Changed** **Content Changed**

M.TECH (TRANSPORTATION ENGINEERING) : Syllabus Revision (Session 2017-18 and 2018-19)

S. No	Course Code	Session 2017-18	Session 2018-19	Remark Syllabus Change/ new course
1	MTCETE101	**Traffic Engineering-I (MTCETE101)** **UNIT: 1. Scope of Traffic Engineering & Study of its elements**: Introduction, Objectives and Scope of Traffic Engineering; Components of Road Traffic – Vehicle, Driver and Road; Road User and Vehicle Characteristics and their effect on Road Traffic; Traffic Manoeuvers. Traffic Stream Characteristics- Relationship between Speed, Flow and Density **UNIT :2. Traffic Engineering Studies and Analysis**: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment, Data Collection, Analysis and Interpretation (including Case Studies) of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accidents. **UNIT :3. Design of Traffic Engineering Facilities**: Control of Traffic Movements	**Traffic Engineering-I (MTCETE101)** **Syllabus** **UNIT: 1. Scope of Traffic Engineering & Study of its elements**: Introduction, Objectives and Scope of Traffic Engineering; Components of Road Traffic – Vehicle, Driver and Road; Road User and Vehicle Characteristics and their effect on Road Traffic; Traffic Manoeuvers. Traffic Stream Characteristics- Relationship between Speed, Flow and Density **UNIT :2. Traffic Engineering Studies and Analysis**: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment, Data Collection, Analysis and Interpretation (including Case Studies) of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accidents. **UNIT :3. Design of Traffic Engineering Facilities**: Control of Traffic Movements through Time Sharing and Space Sharing Concepts; Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design, Design of Road Lighting **UNIT : 4. Traffic Control Devices:** Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal	**NO CHANGE**

		through Time Sharing and Space Sharing Concepts; Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design, Design of Road Lighting **UNIT : 4**. **Traffic Control Devices:** Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals sincluding Case Studies; Signal System and Coordination. **UNIT : 5 Traffic Regulations and Control:** General regulations; Regulations on Speed, Vehicles, drivers and flow; other regulations and control. Traffic management; noise and air pollution due to road traffic and method of control.	Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination. **UNIT : 5 Traffic Regulations and Control:** General regulations; Regulations on Speed, Vehicles, drivers and flow; other regulations and control. Traffic management; noise and air pollution due to road traffic and method of control.	
2	**MTCETE102**	**Highway Materials (MTCETE102)** **UNIT : 1**. **Aggregates:** Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates. **UNIT : 2**. **Soil:** Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization, Characteristics and use of Fly Ash, Bottom ash and Pond Ash.	**Highway Materials (MTCETE102)** **Syllabus** **UNIT :1**. **Aggregates:** Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates. **UNIT : 2**. **Soil:** Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization, Characteristics and use of Fly Ash, Bottom ash and Pond Ash. **UNIT :3**. **Bitumen:** Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of bitumen, Tests on bitumen, Emulsions, Tar – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen. **UNIT : 4. Bituminous Mixes:** Desirable	NO CHANGE

		UNIT :3. Bitumen: Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of bitumen, Tests on bitumen, Emulsions, Tar – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen. **UNIT :4. Bituminous Mixes:** Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications. Marshall, Hubbard Field & Hveam Methods. **UNIT :5. Cement Concrete:** Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes for DLC and PQC with appropriate admixtures like flyash and high range water reducing admixtures etc.	properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications. Marshall, Hubbard Field & Hveam Methods. **UNIT : 5. Cement Concrete:** Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes for DLC and PQC with appropriate admixtures like flyash and high range water reducing admixtures etc.	
3	**MTCETE103 / MTCETE103A**	**PAVEMENT ANALYSIS AND DESIGN (MTCETE103)** **UNIT : 1. Types and Component parts of Pavements and Subgrade** **Types and Component parts of Pavements:** Flexible, rigid and semi-rigid pavements Factors affecting design and performance of Pavements - Influence of environment on pavement - Frost, Sub grade moisture **Subgrade:** Functions and significance of subgrade properties - Methods ofassessment of subgrade strength - Soil classification - Subgrade stabilization – Wheel loads – ESWL – EWLF	**Pavement Analysis and Design (MTCETE103A)** **Syllabus** **UNIT : 1. Types and Component parts of Pavements and Subgrade** **Types and Component parts of Pavements:** Flexible, rigid and semi-rigid pavements Factors affecting design and performance of Pavements - Influence of environment on pavement - Frost, Sub grade moisture **Subgrade:** Functions and significance of subgrade properties - Methods ofassessment of subgrade strength - Soil classification - Subgrade stabilization –Wheel loads – ESWL – EWLF **UNIT : 2. Flexible pavement design** **Flexible pavement design**: Analysis of Stresses in Flexible Pavements -Empirical, Semi-empirical and Theoretical Methods of Flexible Pavement Design– Problems	**COURSE CODE CHANGED**

		UNIT : 2. Flexible pavement design **Flexible pavement design**: Analysis of Stresses in Flexible Pavements -Empirical, Semi-empirical and Theoretical Methods of Flexible Pavement Design– Problems **UNIT : 3. Rigid pavement design** **Rigid pavement design:** Types, Causes and Analysis of Stresses in Rigid pavements - Types, Functions and Spacing of Joints in Cement Concrete Pavements - Design of Slab Thickness and Joint Details **UNIT : 4. Pavement evaluation and rehabilitation** **Pavement evaluation and rehabilitation:** surface characteristics – skid resistance– pavement roughness - pavement distress - Strengthening of existing pavements - Flexible and Rigid Overlays – Recycling of Pavements - Systems approach to maintenance (PMS). **UNIT : 5. Road Construction:** Bituminous road construction procedures and specifications, Quality control requirements. Concrete Road construction: Construction methods, Quality control requirements, Joints in cement concrete pavements, reinforced cement concrete road construction. IRC & MORTH recommendations for construction of Bituminous and Concreteroads. Present practices being followed for quality assurance and speedy construction in the country like by NHAI.	**UNIT : 3. Rigid pavement design** **Rigid pavement design:** Types, Causes and Analysis of Stresses in Rigid pavements - Types, Functions and Spacing of Joints in Cement Concrete Pavements - Design of Slab Thickness and Joint Details **UNIT : 4. Pavement evaluation and rehabilitation** **Pavement evaluation and rehabilitation:** surface characteristics – skid resistance– pavement roughness - pavement distress - Strengthening of existing pavements -Flexible and Rigid Overlays – Recycling of Pavements - Systems approach to maintenance (PMS). **UNIT : 5. Road Construction:** Bituminous road construction procedures and specifications, Quality control requirements. Concrete Road construction: Construction methods, Quality control requirements, Joints in cement concrete pavements, reinforced cement concrete road construction. IRC & MORTH recommendations for construction of Bituminous and Concrete roads. Present practices being followed for quality assurance and speedy construction in the country like by NHAI.	
4	**MTCETE104A / MTCETE1**		**Statistical and Mathematical Techniques (MTCETE103B)**	**COURSE CODE CHANGED**

	03B		**Syllabus** **UNIT 1** **Linear Programming:** Formulation of the Linear Programming problem, Graphical methods for solving LP problems, Simplex method, Big M-method and Two-Phase simplex method, Duality: Definition of the dual problem, relationship between the primal and dual solutions, Formulation of dual problem. **UNIT 2** Dual Simplex method, Formulation of a transportation problem, North-west corner rule, row or column Minima method, Lowest cost entry method, Vogel's Approximation (or Penalty) method (VAM),Degeneracy in Transportation problems, Assignment problem. **UNIT 3** **Probability Distribution:** Random variables (discrete & continuous random variables), Probability mass function and Probability density function, mean, variance of Binomial, Poisson, Normal, Exponential, Fitting of the distributions. **UNIT 4** **Regression and Correlation:** Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Lines of regression, Error of prediction. Method of least square-curve fitting of straight line, parabola, exponential curve **UNIT 5** **Statistical inference:** Types of sampling, standard error, sampling distribution of mean and variance. Testing of hypothesis, Level of significance (large samples), Confidence limits, Estimation of parameters of the population (point estimation & interval estimation), t-distribution, testing for difference between means of two small samples, Chi-square distribution, degree of freedom, goodness of fit, Fisher's Z-Distribution.	
5	**MTCETE103C**		**Transportation Planning (MTCETE103C)** **Syllabus** **UNIT1: Introduction to transportation planning:** Fields of transportation Engineering; System- Environment Ensemble; Transportation planning process; Transportation problems and problem solving process. **UNIT2: Transportation data and survey methods:** Type of Transportation data and its sources, Data quantity and quality, Accuracy and Precision, Sampling techniques, sample sizes, Transportation Planning surveys –	**NEW COURSE**

			Documentation searches, Person surveys, Household surveys, In-transit surveys, Road-side surveys, etc. **UNIT 3: Transportation Modes and Technologies**: Technologies of Transport and System Components, Network Analysis; Minimum Path Algorithms, Path Characteristics, Path-Vehicle Interaction – Discrete Flows and Continuous Flows, Vehicle and its Performance, System Performance, Vehicle and Container, Weight to Volume relation, Terminal Planning, Operational Planning **UNIT 4: Four-stage Sequential Planning:** Urban transportation planning process; trip generation, correlation analysis and regression analysis; trip distribution, Growth factor methods and Synthetic methods; modal split models, first generation, second generation, behavioural models; minimum travel path computations; Trip assignments, route assignment, multiple assignment and network assignment. **UNIT 5: Land use–Transportation Planning:** Urban Forms, mobility and activity hierarchy; accessibility-based early-era models; Lowery's model and its derivatives; Modern era models.	
6	**MTCETE104B / MTCETE104A**	**Statistical and Mathematical Techniques** **(MTCETE104A)** **UNIT 1** **Linear Programming:** Formulation of the Linear Programming problem, Graphical methods for solving LP problems, Simplex method, Big M-method and Two-Phase simplex method, Duality: Definition of the dual problem, relationship between the primal and dual solutions, Formulation of dual problem. **UNIT 2** Dual Simplex method, Formulation of a transportation problem, North-west corner rule, row or column Minima method, Lowest cost entry method, Vogel"s Approximation (or Penalty) method (VAM),Degeneracy in Transportation	**Ground Improvement Techniques** **(MTCETE104A)** **Syllabus** **UNIT 1: Introduction** Need for engineered ground improvement, classification of ground modification techniques; suitability, feasibility and desirability of ground improvement technique; objectives of improving soil. **UNIT 2: In-situ densification methods in granular soils & Cohesive soils** Introduction, Vibration at the ground surface, impact at the ground surface, vibration at depth, impact at depth. Introduction, preloading, sand drains, sand wicks, band drains, stone and lime columns. **UNIT 3: Mechanical Stabilization** Soil aggregate mixtures, properties and proportioning techniques, soft aggregate stabilization, compaction, field compaction control. **Cement Stabilization** Mechanism, factors affecting and properties, use of additives, design of soilcement mixtures, construction techniques. **Lime and Bituminous Stabilization** Type of admixtures, mechanism, factors affecting, design of mixtures, construction methods.	**COURSE CODE CHANGED**

		problems, Assignment problem. **UNIT 3** **Probability Distribution:** Random variables (discrete & continuous random variables), Probability mass function and Probability density function, mean, variance of Binomial, Poisson, Normal, Exponential, Fitting of the distributions. **UNIT 4** **Regression and Correlation:** Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Lines of regression, Error of prediction. Method of least square-curve fitting of straight line, parabola, exponential curve **UNIT 5** **Statistical inference:** Types of sampling, standard error, sampling distribution of mean and variance. Testing of hypothesis, Level of significance (large samples), Confidence limits, Estimation of parameters of the population (point estimation & interval estimation), t-distribution, testing for difference between means of two small samples, Chi-square distribution, degree of freedom, goodness of fit, Fisher's Z-Distribution.	**UNIT 4: Reinforced earth** Principles, components of reinforced earth, governing design of reinforced earth walls, design principles of reinforced earth walls. **UNIT 5: Geotextiles** Introduction, types of geotextiles, functions and their applications, tests for geotextiles, geogrids and its functions.	
7	**MTCETE104C / MTCETE104B**	**Ground Improvement Techniques** **(MTCETE104B)** **UNIT I Introduction** Need for engineered ground improvement, classification of ground modification	**Intelligent Transportation System** **(MTCETE104B)** **Syllabus** **UNIT 1: Introduction of Travel Management :** System Architecture, Standards, Database – Tracking Database – Commercial Vehicle	**Course Code Changed**

		techniques; suitability, feasibility and desirability of ground improvement technique; objectives of improving soil. **UNIT II In-situ densification methods in granular soils & Cohesive soils** Introduction, Vibration at the ground surface, impact at the ground surface,vibration at depth, impact at depth. Introduction, preloading, sand drains, sand wicks, band drains, stone and lime columns. **UNIT III Mechanical Stabilization** Soil aggregate mixtures, properties and proportioning techniques, soft aggregate stabilization, compaction, field compaction control. **Cement Stabilization** Mechanism, factors affecting and properties, use of additives, design of soilcement mixtures, construction techniques. **Lime and Bituminous Stabilization** Type of admixtures, mechanism, factors affecting, design of mixtures,construction methods. **UNIT IV Reinforced earth** Principles, components of reinforced earth, governing design of reinforced earth walls, design principles of reinforced earth walls. **UNIT V Geotextiles** Introduction, types of geotextiles, functions and their applications, tests for geotextiles, geogrids and its functions.	Operations – Intelligent Vehicle Initiative - Metropolitan ITS – Rural ITS – ITS for Rail network. **UNIT 2: ITS Designs ITS Designs:** Modelling and Simulation Techniques - Peer – to – Peer Program – ITS for Road Network – System Design – Mobile Navigation Assistant – Traffic Information Center – Public Safety Program. **UNIT 3: Automated Highway Systems** **Automated Highway Systems:** Evolution of AHS and Current Vehicle Trends - Vehicles in Platoons – Aerodynamic Benefits - Integration of Automated Highway Systems – System Configurations - Step by Step to an Automated Highway System. **UNIT 4: Spacing and Capacity for Different AHS Concepts** **Spacing and Capacity for Different AHS Concepts –** Communication Technologies for AHS - The Effects of AHS on the Environment – Regional Mobility - Impact Assessment of Highway Automation. **UNIT 5: ITS Travel Management:** Autonomous Route Guidance System – Infrastructure based systems – Telecommunications – Vehicle – Road side communication – Vehicle Positioning System – Electronic Toll Collection – Electronic Car Parking.	
8	**MTCETE104C**	**Intelligent Transportation system (MTCETE104C)** **UNIT 1: Introduction of Travel**	**Pavement Maintenance System (MTCETE104C)** **Syllabus** **UNIT 1:**	**New Course**

		Management : System Architecture, Standards, Database – Tracking Database – Commercial Vehicle Operations – Intelligent Vehicle Initiative - Metropolitan ITS – Rural ITS – ITS for Rail network. **UNIT 2: ITS Designs ITS Designs:** Modelling and Simulation Techniques - Peer – to – Peer Program – ITS for Road Network – System Design – Mobile Navigation Assistant – Traffic Information Center – Public Safety Program. **UNIT 3: Automated Highway Systems** **Automated Highway Systems:** Evolution of AHS and Current Vehicle Trends - Vehicles in Platoons – Aerodynamic Benefits - Integration of Automated Highway Systems – System Configurations - Step by Step to an Automated Highway System. **UNIT 4: Spacing and Capacity for Different AHS Concepts** **Spacing and Capacity for Different AHS Concepts –** Communication Technologies for AHS - The Effects of AHS on the Environment – Regional Mobility - Impact Assessment of Highway Automation. **UNIT 5: ITS Travel Management:** Autonomous Route Guidance System – Infrastructure based systems – Telecommunications – Vehicle – Road side communication – Vehicle Positioning System – Electronic Toll Collection – Electronic Car Parking	Pavement Evaluation and Performance: General concept of pavement evaluation, evaluation of pavement performance, evaluation of pavement structural capacity, evaluation of pavement distress, evaluation of pavement safety. **UNIT 2:** Types of Distress: Structural and functional, serviceability, fatigue cracking, pavement deformation and behaviour in flexible and rigid pavements. Low temperature shrinkage cracking.,Factors affecting performance, relation between performance and distress. **UNIT 3:** Pavement Evaluation & Measuring Equipments: Functional & Structural Evaluation,Functions Parameters such as Roughness, Distress, Rutting, Skid Resistance etc. Structural Parameters such as Structural Capacity. Benkelman Beam, Bump Integrators of various types, dynaflect. Demonstration of equipments for dynamic testing of pavements. Digital ultrasonic concrete tester. Radiographic and infra red testing.Pavement skid resistance measuring equipments, fatigue testing equipments, on-site and on- line testing with sensors, strain-gages LVDTs and data acquisition system. **UNIT 4:** Pavement Overlays: Flexible overlays and determination of overlay thickness. Rigid overlays and determination of overlay thickness including thin toppings. Design of Overlay by Benkelman Beam and Falling Weight Deflectometer. **UNIT 5:** Design Alternatives – Analysis, Evaluation and Selection: Framework for pavement design, design objectives and constraints, Basic structural response models, characterization of physical design inputs, Generating alternative pavement design strategies. Economic evaluation of alternative pavement design strategies, analysis of alternative design strategies. Predicting distress, predicting performance, selection of optimal design strategies.	
9	**MTCETE105**	**Ground Improvement Techniques Lab**	**MTCETE105: Research Methodology and**	NEW COURSE

		(MTCETE105) 1. To determine shear strength parameters of the given soil sample by Direct Shear Test. 2. To find the shear of the soil by Undrained Triaxial Test. 3. To determine the settlements due to primary consolidation of soil by conducting one dimensional test . 4. Wetting And Drying, And Freezing And Thawing Tests For Compacted Soil-Cement Mixtures. 5. Determination Of Lime Content Of Lime Stabilized Soils. 6. Standard Test Method For Determining Short-Term Compression Behavior of Geosynthetics. 7.To determine the liquid limit of a given soil sample. 8. To determine the plastic limit of a given soil sample. 9. To determine the plasticity index of a given soil sample. 10. Visual classification of soil.	**IPR** **Syllabus** **Unit 1:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. **Unit 2:** Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. **Unit 3:** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for Grants of patents, Patenting under PCT. **Unit 4:** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **Unit 5:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	
10	MTCETE106		**(MTCETE106) Enlightenment Skills**	NEW COURSE
11	**MTCETE105 / MTCETE107**		**Ground Improvement Techniques Lab (MTCETE107)** **Syllabus** 1. To determine shear strength parameters of the given soil sample by Direct Shear Test. 2. To find the shear of the soil by Undrained Triaxial Test. 3. To determine the settlements due to primary consolidation of soil by conducting one dimensional test . 4. Wetting and Drying and Freezing and Thawing Tests For Compacted Soil-Cement Mixtures. 5. Determination of Lime Content Of Lime Stabilized Soils. 6. Standard Test Method for Determining Short-	COURSE CODE CHANGED

			Term Compression Behavior of Geosynthetics. 7. To determine the liquid limit of a given soil sample. 8. To determine the plastic limit of a given soil sample. 9. To determine the plasticity index of a given soil sample. 10. Visual classification of soil.	
12	**MTCETE108**		**Pavement Analysis and Design Lab (MTCETE108)** **Syllabus** Problems as per the subject/course	NEW COURSE
13	**MTCETE201**	**Traffic Engineering II (MTCETE201)** **UNIT 1: Traffic Forecast:** General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection. .**UNIT 2: Highway Capacity and Accident Analysis** **Highway Capacity:** Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalized intersections. Problems in Mixed Traffic flow; Case studies. **Accident Analysis:** Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions. **UNIT 3: Traffic Flow Theory and Probabilistic Aspects of Traffic Flow** **Traffic Flow Theory:** Fundamental flow	**Traffic Engineering-II (MTCETE201)** **Syllabus** **UNIT 1: Traffic Forecast:** General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection. .**UNIT 2: Highway Capacity and Accident Analysis** **Highway Capacity:** Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalized intersections. Problems in Mixed Traffic flow; Case studies. **Accident Analysis:** Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions. **UNIT 3: Traffic Flow Theory and Probabilistic Aspects of Traffic Flow** **Traffic Flow Theory:** Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications. **Probabilistic Aspects of Traffic Flow:** Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications. **UNIT 4: Simulation** **Simulation:** Fundamental principle, application of simulation techniques in traffic engineering, general simulation process, formulation of simulation models, physical, analog and symbolic models, measure of effectiveness,	NO CHANGE

		relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications. **Probabilistic Aspects of Traffic Flow:** Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications. **UNIT 4: Simulation** **Simulation:** Fundamental principle, application of simulation techniques in traffic engineering, general simulation process, formulation of simulation models, physical, analog and symbolic models, measure of effectiveness, analytical, numerical and Monte Carlo techniques, representation and scanning, physical and memorandum, comparison, applications. **UNIT 5: Design Hourly Volume for Varying Demand Conditions**: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept.	analytical, numerical and Monte Carlo techniques, representation and scanning, physical and memorandum, comparison, applications. **UNIT 5: Design Hourly Volume for Varying Demand Conditions**: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept.	
14	**MTCETE202**	**Urban Transportation Planning I (MTCETE202)** **UNIT 1: Urban Transportation Problems and Planning Process** **Urban Transportation Problems and Planning Process:** Role of transportation and change in concerns of society in transportation planning; Transportation problems and problem domain; objectives and constraints; flow chart for transportation planning process, inventory, model building, forecasting and evaluation	**Urban Transportation Planning-I (MTCETE202)** **Syllabus** **UNIT 1: Urban Transportation Problems and Planning Process** **Urban Transportation Problems and Planning Process:** Role of transportation and change in concerns of society in transportation planning; Transportation problems and problem domain; objectives and constraints; flow chart for transportation planning process, inventory, model building, forecasting and evaluation stages **UNIT 2: Data Collections and inventories** **Data Collections and inventories:** Definition of study area; zoning, types and sources of data, methods of O-D Survey- passenger, goods; sampling techniques, expansion factors,	**NO CHANGE**

		stages **UNIT 2: Data Collections and inventories** **Data Collections and inventories:** Definition of study area; zoning, types and sources of data, methods of O-D Survey- passenger, goods; sampling techniques, expansion factors, accuracy checks; use of secondary data. Sufficiency and deficiency studies by screen lines **UNIT 3: UTPS Approach** **UTPS Approach:** Trip Generation- Zonal models, category analysis, household models, trip attraction of work centres and commercial trips, Trip Distribution-Growth factor models, Gravity models and opportunity models. Model split analysis- Mode choice behaviour, competing models, mode split models, probabilistic and two stage mode split analysis. Route split analysis- traffic assignment, basic elements of transportation networks, coding, diversion curves, minimum path trees, all- ornothing assignments, capacity restraint techniques **UNIT 4: Landuse and its interaction** **Landuse and its interaction:** Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Ekistics - Science of human settlements - Characteristics of urban structure. Town planning concepts - Neighbourhood planning. **UNIT 5: Transit Networks and System Analysis:** Transit networks – types and their characteristics; transfers in transit networks; system analysis in transit – conceptual models, modeling procedures; terminal or station location planning – issues, objectives, station spacing decisions.	accuracy checks; use of secondary data. Sufficiency and deficiency studies by screen lines **UNIT 3: UTPS Approach** **UTPS Approach:** Trip Generation- Zonal models, category analysis, household models, trip attraction of work centres and commercial trips, Trip Distribution-Growth factor models, Gravity models and opportunity models. Model split analysis- Mode choice behaviour, competing models, mode split models, probabilistic and two stage mode split analysis. Route split analysis- traffic assignment, basic elements of transportation networks, coding, diversion curves, minimum path trees, all- or nothing assignments, capacity restraint techniques **UNIT 4: Landuse and its interaction** **Landuse and its interaction:** Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Ekistics - Science of human settlements - Characteristics of urban structure. Town planning concepts – Neighbourhood planning. **UNIT 5: Transit Networks and System Analysis:** Transit networks – types and their characteristics; transfers in transit networks; system analysis in transit – conceptual models, modeling procedures; terminal or station location planning – issues, objectives, station spacing decisions.	

15	**MTCETE203 / MTCETE203A**	**Highway Geometric Design (MTCETE203)** **UNIT 1: Design Elements-I** **Design Elements:** Objectives and requirements of highway geometric design, highway classification, terrain classification, importance of traffic data in geometric design, design hour volume, directional distribution of traffic, traffic composition, traffic forecasting, design vehicle, design speed, highway capacity, level of service. **UNIT 2: Design Elements-II** **Design Elements:** Sight distances - types, analysis, factors affecting, measurements, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems. **UNIT 3: Cross Section Elements** **Cross Section Elements:** Right of way and width considerations, roadway, shoulders, kerbs, camber, side slope, lateral and vertical clearance, control of access, traffic barriers, medians, frontage roads; Pavement surface characteristics - types, cross slope, skid resistance, unevenness. **UNIT 4: Design of Intersections** **Design of Intersections:** Characteristics and design considerations of at-grade	**Highway Geometric Design (MTCETE203A)** **Syllabus** **UNIT 1: Design Elements-I** **Design Elements:** Objectives and requirements of highway geometric design, highway classification, terrain classification, importance of traffic data in geometric design, design hour volume, directional distribution of traffic, traffic composition, traffic forecasting, design vehicle, design speed, highway capacity, level of service. **UNIT 2: Design Elements-II** **Design Elements:** Sight distances - types, analysis, factors affecting, measurements, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems. **UNIT 3: Cross Section Elements** **Cross Section Elements:** Right of way and width considerations, roadway, shoulders, kerbs, camber, side slope, lateral and vertical clearance, control of access, traffic barriers, medians, frontage roads; Pavement surface characteristics - types, cross slope, skid resistance, unevenness. **UNIT 4: Design of Intersections** **Design of Intersections:** Characteristics and design considerations of at-grade intersections; Different types of islands, channelization; median openings; design of rotary intersections; Grade separations and interchanges - types, warrants, adaptability and design details; Interchanges - different types, ramps. **UNIT 5: Design of Parking lots** **Design of Parking lots** - Factors, design elements, different types of parking, design of ramps and other elements of multistoried parking lots.	**Course code Changed**

		intersections; Different types of islands, channelization; median openings; design of rotary intersections; Grade separations and interchanges - types, warrants, adaptability and design details; Interchanges - different types, ramps. **UNIT 5: Design of Parking lots** **Design of Parking lots** - Factors, design elements, different types of parking, design of ramps and other elements of multistoried parking lots.		
16	**MTCETE204C / MTCETE203B**		**Highway Construction (MTCETE203B)** **Syllabus** **UNIT 1: Equipment in Highway Construction and Sub grade** Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement, stabilised soil road construction. Subgrade: Earthwork grading, compaction and construction of embankments and cuts for roads, problems in embankment construction on weak and compressible foundation, Preparation of subgrade, quality control tests as per MoRTH specifications **UNIT 2: Flexible Pavements Layers** Flexible Pavements: Specifications of materials, construction method and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice. **UNIT 3: Cement Concrete Pavement Layers** Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Compaction of interlocking block pavements, Quality control tests; Construction of various types of joints. **UNIT 4: Soil Stabilized Pavement Layers and drainage** Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and	**COURSE CODE CHANGED**

			soil-lime stabilization methods. Use of additives, Numerical problems on mix design and application of Rothfutch method. Drainage: Design and construction of surface and sub-surface drainage system for highways and airports. Drainage materials, design procedures and IRC Guidelines for Drainage of Urban Roads. **UNIT 5: Maintenance and Hill Roads** Maintenance: Methods of Maintenance of different types of pavements; Special problems in high rainfall areas and wet /water logging condition, maintenance of drainage system. Hill Roads: Special problems in construction and maintenance of hill roads; land slides, causes, investigation and remedial measures, protection of embankment and cut slopes, Numerical problems on slope stability.	
17	**MTCETE304A / MTCETE203C**		**GIS Application in Transportation Engineering (MTCETE203C)** **Syllabus** **UNIT :1. Introduction: Definitions of GIS** – Components of GIS – Geographic data presentation: maps – mapping process – coordinate systems – transformations – map projections – geo referencing - data acquisition. **UNIT :2. Geographic Data Representation, Storage, Quality and Standards**: Storage – Digital representation of data – Data structures and database management systems – Raster data representation – Vector data representation – Concepts and definitions of data quality – Components of data quality – Assessment of data quality – Managing data errors – Geographic data standards. **UNIT :3. GIS Data Processing, Analysis and Modeling**: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts and nearest neighbour analysis – Network analysis – Surface modeling – DTM. **UNIT :4. GIS Applications**: Applications of GIS in Environment monitoring – Natural hazard management, Transport Planning, Analysis and monitoring. Use of softwares related to GIS applications in Transportation Engineering. **UNIT :5. Structure of GIS:** Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data	**COURSE CODE CHANGED**

			errors, Geographic data standards	
18	**MTCETE204A**	**Bridge Engineering (MTCETE204A)** **UNIT 1: History of Bridge Development** **History of Bridge Development:** Classification of bridges, Selection of bridge sites, Bridge alignment, Sub-surface investigations, Bridge Hydrology, Flood discharge, waterways, scour depth, depth of foundation, standards of loadings, types of loads, impact effect, wind loads, seismic forces, buoyancy, earth pressure, loadings on various bridges, traffic requirements, types of low cost bridges. **UNIT 2: Bridge Super structure** **Bridge Super structure:** Superstructure elements, Bridge flooring, design of slab bridges & girder bridges, Bridge bearings, joins in bridges, bridge superstructures.\ **UNIT 3: Bridge Foundation** **Bridge Foundation:** Settlements, Allowable soil pressures, types of foundations, foundation failures, foundation setting, piers, abutments, wing walls and approaches, and cofferdams. **UNIT 4: Bridge Construction** **Bridge Construction:** Erection of steel girder bridges, truss bridges, suspension bridges, maintenance of bridges, bridge testing for safe carrying capacity, strengthening of bridges, aesthetical treatments. **UNIT 5: Standard specifications for Bridges** – IRC loadings for road bridges – standards for railway bridges – design of RC slab, skew slab and box culverts. Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges, fly overs.	**Bridge Engineering (MTCETE204A)** **Syllabus** **UNIT 1: History of Bridge Development** **History of Bridge Development:** Classification of bridges, Selection of bridge sites, Bridge alignment, Sub-surface investigations, Bridge Hydrology, Flood discharge, waterways, scour depth, depth of foundation, standards of loadings, types of loads, impact effect, wind loads, seismic forces, buoyancy, earth pressure, loadings on various bridges, traffic requirements, types of low cost bridges. **UNIT 2: Bridge Super structure** **Bridge Super structure:** Superstructure elements, Bridge flooring, design of slab bridges & girder bridges, Bridge bearings, joins in bridges, bridge superstructures.\ **UNIT 3: Bridge Foundation** **Bridge Foundation:** Settlements, Allowable soil pressures, types of foundations, foundation failures, foundation setting, piers, abutments, wing walls and approaches, and cofferdams. **UNIT 4: Bridge Construction** **Bridge Construction:** Erection of steel girder bridges, truss bridges, suspension bridges, maintenance of bridges, bridge testing for safe carrying capacity, strengthening of bridges, aesthetical treatments. **UNIT 5: Standard specifications for Bridges** – IRC loadings for road bridges – standards for railway bridges – design of RC slab, skew slab and box culverts. Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges, fly overs.	**NO CHANGE**

19	**MTCETE204 B**	**Transportation Planning (MTCETE204B)** **UNIT1: Introduction to transportation planning:** Fields of transportation Engineering; System- Environment Ensemble; Transportation planning process; Transportation problems and problem solving process. **UNIT2: Transportation data and survey methods:** Type of Transportation data and its sources, Data quantity and quality, Accuracy and Precision, Sampling techniques, sample sizes, Transportation Planning surveys – Documentation searches, Person surveys, Household surveys, In-transit surveys, Road-side surveys, etc. **UNIT 3: Transportation Modes and Technologies**: Technologies of Transport and System Components, Network Analysis; Minimum Path Algorithms, Path Characteristics, Path-Vehicle Interaction – Discrete Flows and Continuous Flows, Vehicle and its Performance, System Performance, Vehicle and Container, Weight to Volume relation, Terminal Planning, Operational Planning **UNIT 4: Four-stage Sequential Planning:** Urban transportation planning process; trip generation, correlation analysis and regression analysis; trip distribution, Growth factor methods and Synthetic methods; modal split models, first generation, second generation, behavioural models; minimum travel path computations; Trip assignments, route assignment, multiple assignment and network assignment. **UNIT 5: Land use–Transportation Planning:**	**Transportation Facility Design (MTCETE204B)** **Syllabus** **UNIT 1: Introduction** **Introduction:** Design of highways, design of at-grade intersections, design of signalized intersection, design of grade separated intersection, terminal design, and design of facilities for non-motorised transport. **UNIT 2: Terminal Planning & Design Terminal Planning & Design:** Terminal functions, analysis of terminals, process flow charts of passenger & goods terminals, terminal processing time, waiting time, capacity & level of service concept, study of typical facilities of highway, transit, airport and waterway terminals, concept of inland port. **UNIT 3: Design of Highways** **Design of Highways:** Hierarchy of highway system, functions, design designations, concepts in horizontal & vertical alignment, integration, optical design, geometrical standards for mobility & accessibility components, landscaping and safety considerations, evaluation and design of existing geometrics. **UNIT 4: Design of Intersections** **Design of Intersections**: Review of design of at-grade intersections, signal coordination – graphic methods & computer techniques, grade separated intersections – warrants for selection, different types & geometric standards, spacing & space controls, ramps & gore area design. **UNIT 5: Energy Issues in Transportation:** Energy consumption, alternate transportation fuels, energy conservation, energy contingency strategies, energy analysis information and methods, Transportation alternatives.	**NEW COURSE**

		Urban Forms, mobility and activity hierarchy; accessibility-based early-era models; Lowery's model and its derivatives; Modern era models.		
20	**MTCETE204C**	**Highway Construction (MTCETE204C)** **UNIT 1: Equipment in Highway Construction and Sub grade** Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement, stabilised soil road construction. Subgrade: Earthwork grading, compaction and construction of embankments and cuts for roads, problems in embankment construction on weak and compressible foundation, Preparation of subgrade, quality control tests as per MoRTH specifications **UNIT 2: Flexible Pavements Layers** Flexible Pavements: Specifications of materials, construction method and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice. **UNIT 3: Cement Concrete Pavement Layers** Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Compaction of interlocking block pavements, Quality control tests; Construction of various types of joints.	**Quantitative Techniques for Transportation Engineering (MTCETE204C)** **Syllabus** **UNIT 1:** **Sampling And Survey Methods:** Types of Random Sample – Central Limit Theorem – Sampling Distribution – Estimation of sample size – Sampling error – Design of Survey Questionnaire - Data collection – Data Processing and Analysis – Application in Transportation Engineering **UNIT 2:** **Probability Distributions :**Probability Distributions – Discrete and Continuous Distribution – Binomial - Poisson – Normal – Exponential Distributions – Application in Traffic Engineering – Grouping of data – Presentation **UNIT 3: Significance Testing:** Hypotheses testing – Types of error – One tailed and two tailed test – Small sample and large sample test – Selection of significance level - Chi square test **UNIT4:** **Linear Regression Models:** Simple and Multiple Linear Regression – Coefficient of correlation – Stepwise regression – Tests on significance of the regression – T and F tests, ANOVA, Poisson Regression – GLM – Basics and Significance of Non-linear regression analysis **UNIT5:** **Advanced Techniques:** Network Flow Problems – Transportation and Assignment Problems – Maximal flow Shortest Route Delphi Technique, Brain Storming, Neural Network – Application in Transportation Network Planning	**New Course**

		UNIT 4: Soil Stabilized Pavement Layers and drainage Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and application of Rothfutch method. Drainage: Design and construction of surface and sub-surface drainage system for highways and airports. Drainage materials, design procedures and IRC Guidelines for Drainage of Urban Roads. **UNIT 5: Maintenance and Hill Roads** Maintenance: Methods of Maintenance of different types of pavements; Special problems in highrainfall areas and wet /water logging condition, maintenance of drainage system.Hill Roads: Special problems in construction and maintenance of hill roads; land slides, causes, investigation and remedial measures, protection of embankment and cut slopes, Numerical problems on slope stability.		
21	MTCETE205	**Highway Material Testing Lab** **(MTCETE205)** **1.** Aggregate impact test. **2.** Aggregate crushing value test. 3. Loss angels abrasion testing machine. 4. To determine elongation index and	(MTCETE205)**Enlightenment Skills**	**New Course**

		flakiness index for a given sample of aggregate. 5. To determine flakiness index for a given sample of aggregate. 6. To determine fineness modulus of a given sample of coarse aggregate. **7.** Marshall stability test. 8. Ductility test on bitumen. 9. Softening test of bitumen. 10. Standard tar viscometer test.		
22	**MTCETE205 / MTCETE206**		**Highway Material Testing Lab (MTCETE206)** **Syllabus** **1.** Aggregate impact test. **2.** Aggregate crushing value test. 3. Loss angels abrasion testing machine. 4. To determine elongation index and flakiness index for a given sample of aggregate. 5. To determine flakiness index for a given sample of aggregate. 6. To determine fineness modulus of a given sample of coarse aggregate. **7.** Marshall stability test. 8. Ductility test on bitumen. 9. Softening test of bitumen. 10. Standard tar viscometer test.	**COURSE CODE CHANGED**
23	**MTCETE207**		**CAD for Transportation Engineering (MTECTE207)** **Syllabus** Formulation and evaluation of the following Transportation Projects. i. Rotary Design ii. Traffic signal Design iii. Multi level / Surface level Parking Design iv. Public transport route evaluation v. Transport Planning for a small area	**NEW COURSE**

24	**MTCETE208**		**MTCETE208: Mini Project with Seminar**	**NEW COURSE**
25	**MTCETE301**	**Pavement Management System** **(MTCETE301)** **UNIT 1: Introduction and Ranking and Optimisation Methodologies** **Introduction:** Components of pavement management systems, pavement maintenance measures, planning investment, research management. **Ranking and Optimisation Methodologies**: Recent developments, sample size selection, economic optimisation of pavement maintenance and rehabilitation. **UNIT 2: Pavement Performance Prediction** **Pavement Performance Prediction:** Concepts, modelling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. Functional condition deterioration models, unevenness prediction models and other models, comparison. Modelling in rehabilitation budget planning, case studies. **UNIT 3: Design Alternatives and Selection** **Design Alternatives and Selection:** design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, Reliability concepts in pavement engineering, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies.Road Asset Management, Pavement Preservation Programmes, Techniques and Tools	**Pavement Management System** **(MTCETE301A)** **Syllabus** **UNIT 1:** Introduction and Ranking and Optimization Methodologies Introduction: Components of pavement management systems, pavement maintenance measures, planning investment, research management. Ranking and Optimisation Methodologies: Recent developments, sample size selection, economic optimisation of pavement maintenance and rehabilitation. **UNIT 2:** Pavement Performance Prediction Pavement Performance Prediction: Concepts, modelling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. Functional condition deterioration models, unevenness prediction models and other models, comparison. Modelling in rehabilitation budget planning, case studies. **UNIT 3:** Design Alternatives and Selection Design Alternatives and Selection: design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, Reliability concepts in pavement engineering, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Road Asset Management, Pavement Preservation Programmes, Techniques and Tools **UNIT 4:** Expert Systems and Pavement Management Expert Systems and Pavement Management: Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies. Implementation of pavement management systems. **UNIT 5:** Types of Distress: Structural and functional, serviceability, fatigue cracking, pavement deformation and behaviour in flexible and rigid pavements. Low temperature shrinkage cracking, Factors affecting performance, relation between performance and distress.	**NO CHANGE**

		UNIT 4: Expert Systems and Pavement Management **Expert Systems and Pavement Management:** Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies. Implementation of pavement management systems. **UNIT 5: Types of Distress:** Structural and functional, serviceability, fatigue cracking, pavement deformation and behaviour in flexible and rigid pavements. Low temperature shrinkage cracking., Factors affecting performance, relation between performance and distress.		
26	**MTCETE301 B**		**Mass Transit System Planning (MTCETE301B)** **Syllabus** **UNIT 1: Transit System And Issues**: Introduction to Mass Transport – Role of various modes of Mass Transport – Problems and their Impact – Transport System Performance at National, State, Local and International levels – National Transport Policy. **UNIT 2: Public Transit System**: Urban Transport System – Public Transport System Re-genesis and Technology – Physical performance of Public Transport System – Public Transport and Urban Development Strategies - Characteristics of Rail Transit – Vehicle Characteristics, ITS. **UNIT 3: Bus Transit Planning And Scheduling**: Route Planning and Scheduling – Bus Transport System – Performance and Evaluation – Scheduling – Conceptual patterns of bus service – Network Planning and Analysis – Bus Transport System Pricing – Bus Transit System Integration – Analytical Tools and Techniques for Operation and Management – Bus Rapid Transit Systems – Case Studies. **UNIT 4: Rail Transit Terminals And Performance Evaluation:** Performance Evaluation – Efficiency, Capacity, Productivity and Utilisation – Performance Evaluation Techniques and Application – System Network Performance – Transit Terminal Planning and	**NEW COURSE**

			Design. **UNIT 5: Impact Of Transit**: Policies and Strategies for Mass Transport – Need for Integrated Approach – Unified Transport Authorities – Institutional arrangement – Urban Transport Fund – Parking Policies - Private Sector in Mass Transport – Bus and Rail Integration – Co-ordination of Feeder Services – Transit Oriented Land Use Development – Case Studies - Urban Transportation and Land use – Impact of Transport Development on Environment – Remedial measures – Policy Decisions – Recent Trends in Mass Transportation Planning and Management.	
27	**MTCETE303 / MTCETE301C**		**Traffic Flow Theory (MTCETE301C)** **Syllabus** **UNIT 1:** Traffic stream characteristics and Description using distributions: Measurement, Microscopic and Macroscopic study of Traffic Stream Characteristics Goodness of Fit Tests - Flow, speed and concentration; Use of counting, Interval and Translated Distributions for describing Vehicle Arrivals, Headways, Speeds, Gaps and Lags; Fitting of Distributions **UNIT 2:** Traffic Stream Models : Fundamental Equation of Traffic flow, Speed-Flow-Concentration Relationships, Normalised relationships, Fluid Flow Analogy Approach, shock Wave Theory, Platoon Diffusion and Boltzman like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non linear Car Following Models, Acceleration Noise **UNIT 3:** Queuing Analysis: Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings **UNIT 4:** Highway Capacity and Level- of – Service Studies: Concepts, Factors affecting Capacity and Level of Service, Capacity Analysis of Different Highway Facilities, Passenger Car Units, Problems in Mixed Traffic Flow **UNIT 5:** Simulation Models : Philosophy of Simulation Modelling, Formulation of Simulation Model, Methodology of System Simulation, Simulation Languages, Generation of Random Numbers, Generation of Inputs-Vehicle Arrivals, Vehicle Characteristics, Road Geometrics, Design of computer Simulation Experiments, Analysis of Simulation Data, Formulation of Simulation Problems in Traffic Engineering and Validation.	**COURSE CODE CHANGED**

28	**MTCETE302**	**Urban Transportation Planning II (MTCETE302)** **UNIT 1: Land use Activities and Spatial standards** **Land use Activities:** Analysis and prediction of important land use activities like population, employment, housing, shopping, leisure, transport. **Spatial standards:** Spatial standards for residential, industrial, commercial and recreational areas, space standards for facility areas and utilities, Process of implementation, Provisions of Town Planning Act, zoning, subdivision practice, metro region concept. **UNIT 2: Techniques of Preparation of Base Maps:** Drawing size, scale, format, orientation, reduction and enlargement of base maps. **UNIT 3: Urban Renewal** **Urban Renewal:** Meaning, significance, scope and limitations, urban renewal as a part of metropolitan plan, the process of urban renewal, identification of renewal areas, renewal policies and strategies and management of renewal areas, central areas and their renewal. **UNIT 4: Concept of New Towns** **Concept of New Towns:** Meaning, role and functions: Special planning and development considerations, scope and limitations of new town development, Indian and British experience of planning and development of new towns. Recent Trends & Practices: In planning and development system in India, Outline of planning and development system in U.K., U.S.A. and U.S.S.R..	**Business Analytics (MTCETE302A)** **Syllabus** **Unit-I:** Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview. **Unit-II:** Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. **Unit-III:** Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization. **Unit-IV:** Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model. **Unit-V:** Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision	**New Course**

		UNIT 5: Techniques of Preparation of Town Development Plan: Scope, contents and preparation. A case study of development plan, scope, content and preparation of zonal development plans, plan implementation - organizational legal and financial aspects, public participation in plan formulation and implementation.	Making. **Unit-VI:** Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	
29	**MTCETE302 B**		**Industrial Safety (MTCETE302B)** **Syllabus** **Unit-I:** Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. **Unit-II:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. **Unit-III:** Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **Unit-IV:** Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and	**New Course**

			their general causes. **Unit-V:** Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	
30	**MTCETE302C**		**Operations Research (MTCETE302C)** **Syllabus** **Unit 1**: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models **Unit 2** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming **Unit 3**: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT **Unit 4** Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**New Course**

			Unit 5 Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	
31	**MTCETE302D**		**Cost Management of Engineering Projects (MTCETE302D)** **Syllabus** Unit 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Unit 4: Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	**New Course**

			Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	
32	**MTCETE302E**		**Composite Materials (MTCETE302E)** **Syllabus** **UNIT–I**: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. **UNIT – II**: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. **UNIT – III:** Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. **UNIT–IV:** Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression	**New Course**

			moulding – Reaction injection moulding. Properties and applications. **UNIT – V:** Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	
33	**MTCETE302F**		**Waste to Energy (MTCETE302F)** **Syllabus** **Unit-I:** Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors **Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. **Unit-III:** Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation. **Unit-IV:** Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors. **Unit-V:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and	**New Course**

			their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	
34	**MTCETE303**	**Traffic Flow Theory (MTCETE303)** **UNIT 1: Traffic stream characteristics and Description using distributions:** Measurement, Microscopic and Macroscopic study of Traffic Stream Characteristics Goodness of Fit Tests - Flow, speed and concentration; Use of counting, Interval and Translated Distributions for describing Vehicle Arrivals, Headways, Speeds, Gaps and Lags; Fitting of Distributions **UNIT 2: Traffic Stream Models :** Fundamental Equation of Traffic flow, Speed-Flow- Concentration Relationships, Normalised relationships, Fluid Flow Analogy Approach, shock Wave Theory, Platoon Diffusion and Boltzman like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non linear Car Following Models, Acceleration Noise **UNIT 3: Queuing Analysis Queuing Analysis** : Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings	**MTCETE303 Dissertation-I /Industrial Project** **Dissertation-I**: will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Semester and End Semester will be monitored by the departmental committee.	**New Course**

		UNIT 4: Highway Capacity and Level- of – Service Studies Highway Capacity and Level- of – Service Studies: Concepts, Factors affecting Capacity and Level of Service, Capacity Analysis of Different Highway Facilities, Passenger Car Units, Problems in Mixed Traffic Flow **UNIT 5 : Simulation Models Simulation Models** : Philosophy of Simulation Modelling, Formulation of Simulation Model, Methodology of System Simulation, Simulation Languages, Generation of Random Numbers, Generation of Inputs- Vehicle Arrivals, Vehicle Characteristics, Road Geometrics, Design of computer Simulation Experiments, Analysis of Simulation Data, Formulation of Simulation Problems in Traffic Engineering and Validation.		
35	**MTCETE304 A**	**GIS Application in Transportation Engineering (MTCETE304A)** **UNIT :1**. **Introduction: Definitions of GIS** – Components of GIS – Geographic data presentation: maps – mapping process – coordinate systems – transformations – map projections – geo referencing - data acquisition. **UNIT :2. Geographic Data Representation, Storage, Quality and Standards**: Storage – Digital representation of data – Data structures and database management systems – Raster data representation –		

		Vector data representation – Concepts and definitions of data quality – Components of data quality – Assessment of data quality – Managing data errors – Geographic data standards. **UNIT :3**. **GIS Data Processing, Analysis and Modeling**: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts and nearest neighbour analysis – Network analysis – Surface modeling – DTM. **UNIT :4**. **GIS Applications**: Applications of GIS in Environment monitoring – Natural hazard management, Transport Planning, Analysis and monitoring. Use of softwares related to GIS applications in Transportation Engineering. **UNIT :5. Structure of GIS:** Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data errors, Geographic data standards.		
36	**MTCETE304 B**	**Transportation Facility Design (MTCETE304B)** **UNIT 1: Introduction** **Introduction:** Design of highways, design of at-grade intersections, design of signalized intersection, design of grade separated intersection, terminal design, and design of facilities for non-motorised transport.		

		UNIT 2: Terminal Planning & Design **Terminal Planning & Design:** Terminal functions, analysis of terminals, process flow charts of passenger & goods terminals, terminal processing time, waiting time, capacity & level of service concept, study of typical facilities of highway, transit, airport and waterway terminals, concept of inland port. **UNIT 3: Design of Highways** **Design of Highways:** Hierarchy of highway system, functions, design designations, concepts in horizontal & vertical alignment, integration, optical design, geometrical standards for mobility & accessibility components, landscaping and safety considerations, evaluation and design of existing geometrics. **UNIT 4: Design of IntersectionsS** **Design of Intersections**: Review of design of at-grade intersections, signal coordination – graphic methods & computer techniques, grade separated intersections – warrants for selection, different types & geometric standards, spacing & space controls, ramps & gore area design. **UNIT 5: Energy Issues in Transportation:** Energy consumption, alternate transportation fuels, energy conservation, energy contingency strategies, energy analysis information and methods, Transportation alternatives.		
37	**MTCETE304C**	**INTELLIGENT TRANSPORT SYSTEMS** **(MTCETE304C)** **UNIT-I**		

		Fundamentals of ITS:Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS. **UNIT-2**. Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies;Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques –Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection. **UNIT-3.** TS User Needs and ServicesandFunctional areas–Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). **UNIT-4.** ITS Architecture –Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning		

		and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning. **UNIT-5.** TS applications:Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems-Vehicles inPlatoons –Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.		
38	**MTCETE305**	**Seminar (MTCETE305)**		
39	**MTCETE401**	**Dissertation (MTCETE401)**	**MTCETE401 Dissertation II** **Dissertation – II:** will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.	**Course Name Changed content changed**

M.TECH (STRUCTURE ENGINEERING) : Syllabus Revision (Session 2017-18 and 2018-19)

S. No	Course Code	Session 2017-18	Session 2018-19	Remark Syllabus Change/ new course
1	MTCESE101	**THEORY OF ELASTICITY AND PLASTICITY (MTCESE101)** **UNIT 1** **ELASTICITY :** Analysis of stress and strain, stress strain relationship. Generalized Hookes Law. Plane stress and plane strain. **UNIT 2** **ELASTICITY SOLUTION :** Two – dimensional problems in Cartesian and polar coordinates for simple problems. **UNIT 3** **TORSION OF NON – CIRCULAR SECTION :** Methods of analysis – membrane analogy – torsion of thin rectangular section and hollow thin walled sections. **UNIT 4** **ENERGY METHODS :** Principle of virtual work – energy theorem – Rayleigh Ritz methods – Finite Difference method. **UNIT 5** **PLASTICITY:** Physical assumption – criterion of yielding, yield surface, Flow rule (plastic stress strain relationship). Elastic plastic problems in bending – torsion and thick cylinder.	**MTCESE101: Advanced Structural Analysis** **Syllabus** **UNIT1: Influence Coefficients:** Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach. **Stiffness Method applied to Large Frames:** Local Coordinates and Global Coordinates. UNIT2: **Stiffness Matrix Assembly of Structures:** Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces. UNIT3: **Applications to Simple Problems:** Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach. UNIT4: **Boundary Value Problems** (BVP): Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method UNIT5: **Linear Element:** Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.	**New Course**
2	MTCESE102	**ASEISMIC DESIGN (MTCESE102)** **UNIT 1**	**MTCESE102: Advanced Solid Mechanics** **Syllabus**	**New Course**

		ELEMENTS OF EARTHQUAKE ENGINEERING : Elements of Engineering Seismology – Causes of earthquakes, Seismic waves, magnitude and intensity – Performance of structures under past earthquakes, Lessons learnt from past earthquakes. **UNIT 2** **SEISMIC BEHAVIOUR OF STRUCTURAL ELEMANTS :** Behavior of RCC, steel, timber, Masonry and Prestressed Concrete elements under cyclic loading – Seismic behavior of Soil and liquefaction. **UNIT 3** **SESMIC DESIGN PHILISOPHY AND CODAL PROVISIONS :** Seismic design philosophy – Provisions of Seismic Code IS 1893:2002 (Part I)- Determination of earthquake forces Seismic coefficient and Response Spectrum methods- Structural Configuration – Design and Detailing of Frames and Shear Walls – Provisions of IS – 13920. **UNIT 4** **NON ENGINEERED CONSTRUCTION :** Design of Non Engineered construction – Seismic evaluation and strengthening of building – Design Provisions for Bridges and Dams. **UNIT 5** **BASE ISOLATION TECHNIQUES :** Concepts of base isolation and energy dissipation devices, Modern Concepts – Adaptive systems – Case Studies.	**UNIT1: Introduction to Elasticity:** Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity. UNIT2: **Strain and Stress Field:** Elementary Concept of Strain, Strain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components. UNIT3: **Equations of Elasticity:** Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions. UNIT4: **Two-Dimensional Problems of Elasticity:** Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates. UNIT5: **Torsion of Prismatic Bars:** Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes. **Plastic Deformation:** Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	

3	MTCESE103	**PRESTRESSED CONCRETE (MTCESE103)** **UNIT 1** **INTRODUCTION – THEORY AND BEHAVIOUR :** Principles of Prestressing Types of prestressing systems – Materials – Systems and devices – Behavior of prestressed concrete elements – General concept of Prestress – Force transmitted by pretensioned and post tensioned systems – losses in prestress – analysis for Ultimate Strength – Comparison of codal **UNIT 2** **DESIGN FOR FLEXURE :** Concept of Limit State design –Limit state of Collapse and serviceability – Design using allowable stresses – Stress range approach – Lins approach – Magnels approacg. **UNIT 3** **DESIGN FOR SHEAR, TORSION AND ANCHORAGE ZONE :** Shear resistance in beams- Design for shear in rectangular and flanged beams – Behavior under torsion – Modes of failure –Design for torsion, shear and bending Anchorage Zone – analysis and design of pretension and post tensioned end blocks – IS code provisions – Comparison of other codes. **UNIT 4** **STATICALLY INDETERMINATE STRUCTURES :**Analysis of indeterminate structures – Continuous beam – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles. **UNIT 5** **PSC SPECIAL STRUCTURES:** Concept of circular prestressing – Design of	**MTCESE103A: Theory of Thin Plates and Shells** **Syllabus** **UNIT-1:Introduction:** Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions. **UNIT-2: Static Analysis of Plates**: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions. **UNIT-3: Circular Plates:** Analysis under Axis-Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates. **UNIT-4: Static Analysis of Shells: Membrane Theory of Shells** - Cylindrical, Conical and Spherical Shells. **UNIT-5: Shells of Revolution: with Bending Resistance** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels. **Thermal Stresses in Plate/ Shell.**	**New Course**

		prestressed concrete pipes and cylindrical water tanks – Composite construction types, behavior, flexural stresses, longitudinal shear transfer, transverse shear – Compression members – Design of poles and piles – Partial pre stressing – Principles , analysis and design concepts.		
4	**MTCESE103 B**		**MTCESE103B: Theory and Applications of Cement Composites** **Syllabus** **UNIT-1: Introduction:** Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina. **UNIT-2: Mechanical Behaviour:** Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness. **UNIT-3: Cement Composites:** Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete – Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing. **UNIT-4: Mechanical Properties of Cement Composites**: Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion. **UNIT-5: Application of Cement Composites:** FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants. **Analysis and Design of Cement Composite Structural Elements -** Ferrocement, SIFCON and Fibre Reinforced Concrete.	**New Course**
5	**MTCESE103 C**		**MTCESE103C: Theory of Structural Stability**	**New Course**

			Syllabus **UNIT-1**: **Criteria for Design of Structures:** Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behavior. **UNIT-2**: **Stability of Columns:** Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling. **UNIT-3: Stability of Frames:** Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members. **UNIT-4**: **Stability of Beams:** lateral torsion buckling. **Introduction to Inelastic Buckling** and Dynamic Stability. **UNIT-5**: **Stability of Plates:** axial flexural buckling, shear flexural buckling, buckling under combined loads.	
6	**MTCESE104 A**	**APPLIED MATHEMATICS (MTCESE104A)** **UNIT 1** **TRANSFORM METHODS :** Laplace transform methods for one-dimensional wave equation Displacements in a long string-longitudinal vibration of an elastic bar – Fourier transforms methods for one-dimensional heat conduction problems in infinite and semi infinite rod. **UNIT 2** **ELLIPTIC EQUATIONS:** Laplace equation – Properties of harmonic functions – Fourier transform methods for Laplace equation. **UNIT 3** **CALCULUS OF VARIATIONS:** Variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependent on functions of several independent variables – some applications – Direct methods. **UNIT 4** **PROBABILITY AND RANDOM VARIABLES:** Probability Random variables Moments – Moment Generating Function Standard	**MTCESE104A: Analytical and Numerical Methods for Structural Engineering** **Syllabus** **UNIT-1: Fundamentals of Numerical Methods:** Error Analysis, Polynomial Approximations and Interpolations, **Curve Fitting;** Interpolation and extrapolation. **UNIT-2: Solution of Nonlinear Algebraic and Transcendental Equations** **UNIT-3: Elements of Matrix Algebra**: Solution of Systems of Linear Equations, Eigen Value Problems. **UNIT-4: Numerical Differentiation & Integration:** Solution of Ordinary and Partial Differential Equations. **Finite Difference scheme**: Implicit & Explicit scheme. **UNIT-5: Computer Algorithms:** Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.	**New Course**

		Distributions – Functions of random variables – Two dimensional random variables. **UNIT 5** **ESTIMATION THEORY:** Principals of least squares – Multiple and partial correlation and regression –Estimation of Parameters – Maximum Likelihood Estimates – Method of moments.		
7	**MTCESE104 B**	**GROUND IMPROVEMENT TECHNIQUES (MTCESE104B)** **UNIT 1** **Introduction :** Need for engineered ground improvement, classification of ground modification techniques; suitability, feasibility and desirability of ground improvement technique; objectives of improving soil. **UNIT 2** **In-situ densification methods in granular soils & Cohesive soils:** Introduction, Vibration at the ground surface, impact at the ground surface, vibration at depth, impact at depth. Introduction, preloading, sand drains, sand wicks, band drains, stone and lime columns. **UNIT 3** **Mechanical Stabilization:** Soil aggregate mixtures, properties and proportioning techniques, soft aggregate stabilization, compaction, field compaction control. **Cement Stabilization:**Mechanism, factors	**MTCESE104B: Structural Health Monitoring** **Syllabus** **UNIT-1: Structural Health:** Factors affecting Health of Structures, Causes of Distress, and Regular Maintenance. **Structural Health Monitoring:** Concepts, Various Measures, Structural Safety in Alteration. **UNIT-2: Structural Audit:** Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures. **UNIT-3: Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. **UNIT-4: Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring. **UNIT-5: Introduction to Repairs and Rehabilitations of Structures:** Case Studies (Site Visits), piezo-electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	**New Course**

		affecting and properties, use of additives, design of soil cement mixtures, construction techniques. **Lime and Bituminous Stabilization :** Type of admixtures, mechanism, factors affecting, design of mixtures,construction methods. **UNIT 4** **Reinforced earth:** Principles, components of reinforced earth, governing design of reinforced earth walls, design principles of reinforced earth walls. **UNIT 5** **Geotextiles :** Introduction, types of geotextiles, functions and their applications, tests for geotextiles, geogrids and its functions.		
8	**MTCESE104 C**	**STRUCTURAL DYNAMICS (MTCESE104C)** **UNIT 1** **Introduction:**Objectives − types of dynamic problems − degree of freedom - D' Alemberts Principle − principle of virtual displacement − Hamilton's principle. **UNIT 2** **Single Degree of Freedom System :**Undamped and damped free and forced vibrations −critical damping − over damping – under damping − logarithmic decrement . **UNIT 3** Response to harmonic loading , evaluation of damping, vibration isolation , transmissibility , response to periodic forces- vibration measuring equipments. Duhamel integral for undamped system-Response to impulsive loads. **UNIT 4** **Multidegree Freedom Systems and**	**MTCESE104C: Seismic Design of Structures** **Syllabus** **UNIT 1** **ELEMENTS OF EARTHQUAKE ENGINEERING:** Elements of Engineering Seismology – Causes of earthquakes, Seismic waves, magnitude and intensity – Performance of structures under past earthquakes, Lessons learnt from past earthquakes. **UNIT 2** **SEISMIC BEHAVIOUR OF STRUCTURAL ELEMENTS:** Behavior of RCC, steel, timber, Masonry and Prestressed Concrete elements under cyclic loading – Seismic behavior of Soil and liquefaction. **UNIT 3** **SESMIC DESIGN PHILISOPHY AND CODAL PROVISIONS :** Seismic design philosophy – Provisions of Seismic Code IS 1893:2002 (Part I)- Determination of earthquake forces Seismic coefficient and Response Spectrum methods- Structural Configuration – Design and Detailing of Frames and Shear Walls – Provisions of IS – 13920. **UNIT 4** **NON ENGINEERED CONSTRUCTION :** Design of Non Engineered construction – Seismic	**New Course**

		Continuous systems : Natural modes – orthogonality conditions – modal Analysis – free and harmonic vibration – Free longitudinal vibration of bars – flexural vibration of beams with different end conditions – forced vibration. **UNIT 5** **Approximate methods:** Rayleigh's method ,Dunkerley's method , Stodola's method , Rayleigh ,Ritz method , Matrix method.	evaluation and strengthening of building – Design Provisions for Bridges and Dams. **UNIT 5** **BASE ISOLATION TECHNIQUES :** Concepts of base isolation and energy dissipation devices, Modern Concepts – Adaptive systems – Case Studies.	
9	**MTCESE105**	**GROUND IMPROVEMENT TECHNIQUES LAB (MTCESE105)/ (MTCETE105)** **List of Experiments :-** 1. To determine shear strength parameters of the given soil sample by Direct Shear Test. 2. To find the shear of the soil by Undrained Triaxial Test. 3. To determine the settlements due to primary consolidation of soil by conducting one dimensional test . 4. Wetting And Drying, And Freezing And Thawing Tests For Compacted Soil- Cement Mixtures. 5. Determination Of Lime Content Of Lime Stabilized Soils. 6. Standard Test Method For Determining Short-Term Compression Behavior of Geosynthetics. 7.To determine the liquid limit of a given soil sample. 8. To determine the plastic limit of a given soil sample. 9. To determine the plasticity index of a given soil sample. 10. Visual classification of soil.	**MTCOMRS105: Research Methodology and IPR** **Syllabus** **Unit 1:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. **Unit 2:** Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. **Unit 3:** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for Grants of patents, Patenting under PCT. **Unit 4:** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **Unit 5:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	**New Course**
10	MTCESE10		(MTCESE106) Enlightenment Skills	**New Course**

	6			
11	**MTCESE107**		**MTCESE107: Structural Design Lab** **Syllabus** Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.	**New Course**
12	**MTCESE108**		**MTCESE108: Advanced Concrete Lab** **Syllabus** 1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder . 2. Strength, split tensile strength and modulus of rupture. 3. Effect of cyclic loading on steel. 4. Non-Destructive testing of existing concrete members. 5. Behavior of Beams under flexure, Shear and Torsion.	**New Course**
13	**MTCESE201**	**ADVANCED CONCRETE DESIGN** **(MTCESE201)** **UNIT 1** **DESIGN OF BEAMS:** Behavior of RCC beams under combined shear torsion and Bending –Modes of failures-Inter action effects-Analysis and design of beams circular in plan-Design for serviceability Limit states-calculation of deflections and crack width according to IS 456-2000 **UNIT 2** **DESIGN OF SLENDER COLUMNS :**Behaviour of slender RCC Columns- Failure modes and interaction curves Additional Moment method-Comparison of codal provisions-calculation of design moments for braced and unbraced columns-Principles of Moment magnification method-design of slender columns. **UNIT 3** **DESIGN OF SPECIAL RCC ELEMENTS:**Design and detailing of concrete	**MTCESE201: Finite Element Method in Structural Engineering** **Syllabus** **UNIT-1: Introduction:** History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress. **UNIT-2: Beam Elements:** Flexure Element, Element Stiffness Matrix, And Element Load Vector. **Method of Weighted Residuals**: GalerkinFinite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications. **UNIT-3: Types:** Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, And Gaussian Quadrature. **UNIT-4: Application to Solid Mechanics**: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi-Symmetric Stress Analysis, Strain and Stress Computations. **UNIT-5: Computer Implementation** of FEM procedure, Pre-Processing, Solution, Post-	**New Course**

		braced and unbraced wall according to BIS code-classification of shear walls, design and detailing of Corbels-Desing and detailing of Deep beams –Approximate analysis and design of Grid floors. **UNIT 4** **DESIGN OF FLAT SLABS AND FLAT PLATES:**Yield line theory of slabs – Hilerberg method of design of slabs-Design of Flat slabs and flat plates according to BIS method-Shear in Flat slabs and Flat plates. **UNIT 5** **INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND FRAMES:**Inelastic behaviour of concrete beams-moment – rotation curves-moment redistribution-Bakers method of analysis and design-Design of cast-in-situ joints in frames. Detailing requirments for ductility, durability and fire resistance.	Processing, Use of Commercial FEA Software.	
14	**MTCESE202**	**ADVANCED STEEL STRUCTURES (MTCESE202)** **UNIT 1** **ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS:**Review of loads on structures-dead, live wind and Seismic loads as per National standard-Analysis and Design of Industrial building and bents Sway and non-sway frames design of Purlins, lovuver rails, gable column and Gable wind girder-Analysis and design of Gable frames. **UNIT 2** **BEHAVIOUR AND DESIGN OF CONNNECTIONS:**Connection behavior-Design requirements of Bolted and welded connections-unstiffened and stiffened seat	**MTCESE202: Structural Dynamics** **Syllabus** **UNIT-1: Introduction:** Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems. **Single Degree of Freedom System:** Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier analysis for Periodic Loading, State Space Solution for Response. **UNIT-2:** Numerical Solution to Response using Newmark _ Method and Wilson _ Method, Numerical Solution for State Space Response using Direct Integration. **UNIT-3: Multiple Degree of Freedom System (Lumped parameter):** Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.	**New Course**

		connections-framed connection-connections for force and moment transmission – tee stub and end plate connections stiffeners and other reinforcement – principles of semi rigid connections. **UNIT 3** **ANALYSIS AND DESIGN OF COLD-FORMED STEEL STRUCTURES:**Types of cross sections concepts of local buckling and Effective width – Design of compression and tension members-concepts of lateral bucking – Design of Beams, deflection of beams and design of beam webs- Combined stresses and connections – Empirical design of Z-purlins with lips and wall studs. **UNIT 4** **ANALYSIS AND DESIGN OF SPECIAL STRUCTURES:**Analysis and design of steel water tanks-cylindrical pressed steel tanks-design of supporting chimney (lined and unlined) and Guyed steel stacks-Stresses due to wind and earthquake forces-Design of foundation along with loads calculations-Guest factor Method. **UNIT 5** **PLASTIC ANALYSIS OF STRUCTURES:**Concepts of plastic design-introduction-shape factor-Moment redistribution –static, concepts and uniqueness theorems-combined mechanism-Analysis of single bay and two bay portal frames-methods of plastic moment distribution – Effects of axial force and shear force on plastic moments resisting connection-design of continuous beams.	**UNIT-4: Multiple Degree of Freedom System (Distributed Mass and Load):** Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System. **UNIT-5: Special Topics in Structural Dynamics (Concepts only):** Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.	

15	**MTCESE202 / MTCESE203**	**DESIGN OF BRIDGES (MTCESE203)** **UNIT 1** **INTRODUCTION:** Classification, investigations and planning, choice of type, I.R.C. specification For road bridges, standard live loads, others forces acting on bridges, general Design consideration. **UNIT 2** **SHORT SPAN BRIDGES:** Load distribution theories , analysis and design of slab culverts, tee beam and Slab bridges **UNIT 3** **LONG SPAN BRIDGES:** Design principles of continuous bridges, box girder bridges, and balanced Cantilever bridges **UNIT 4** **PRESTRESSED CONCRETE BRIDGES:** Design of pre stressed concrete bridges – preliminary dimensions – flexural And tensional parameters – Clubroom's theory – distribution coefficient by exact Analysis – design of girder section - maximum and minimum prestressing Forces – eccentricity – live load and dead load shear forces – cable zone in Girder – check for stresses at various sections – check for diagonal tension, Diaphragms – End block – short term and long term deflection. **UNIT 5** **DESIGN OF PLATE GIRGER BRIDGES:** Design of plate girder bridges – loading standards – road and rail	**MTCESE203A: Advanced Steel Design** **Syllabus** **UNIT-1: Properties of Steel:** Mechanical Properties, Hysteresis, And Ductility. **Hot Rolled Sections:** compactness and non-compactness, slenderness, residual stresses. **UNIT-2: Design of Steel Structures**: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, and Drift. **Stability of Beams:** Local Buckling of Compression Flange &Web, Lateral Tensional Buckling. **UNIT-3: Stability of Columns:** Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column About Weak Axis. **UNIT-4: Method of Designs:** Allowable Stress Design, Plastic Design, Load and Resistance Factor Design. **Strength Criteria:** Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones. **UNIT-5: Drift Criteria**: P Effect, Deformation Based Design; **Connections:** Welded, Bolted, Location Beam Column, Column Foundation, Splices.	**Course code changed**

16	**MTCESE203 B**		**MTCESE203B: Design of Formwork** **Syllabus** **UNIT-1: Formwork Materials-** Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. **UNIT-2: Formwork Design:** Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams. **UNIT-3: Formwork Design for Special Structures:** Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges. **UNIT-4: Flying Formwork:** Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award. **UNIT-5: Formwork Failures:** Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.	**New Course**
17	**MTCESE203 C**		**MTCESE203C Design of High Rise Structures** **Syllabus** **UNIT-1: Design of transmission/ TV tower,** Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads. **UNIT-2: Analysis and Design of RC and Steel Chimney**, Foundation design for varied soil strata. **UNIT-3: Tall Buildings**: Structural Concept, Configurations, various systems, Wind and Seismic loads. **UNIT-4:** Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions. **UNIT-5: Application** of software in analysis and design.	**New Course**

18	**MTCESE203 D**		**MTCESE203D: Design of Masonry Structures** **Syllabus** **UNIT-1: Introduction:** Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces. **UNIT-2:** Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading. **UNIT-3: Interactions:** Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation. Shear Strength and Ductility of Reinforced Masonry Members. **UNIT-4:** Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams. **UNIT-5:** Elastic and Inelastic Analysis, Modelling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.	**New Course**
19	**MTCESE204 A**	**MAINTENANCE AND REHABILITATION OF STRUCTURES (MTCESE204A)** **UNIT 1** **MAINTENANCE AND REPAIP STRATEGIES :**Definitions: Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance, Assessment procedure for evaluating a damaged structure, Various aspects of inspection, Destructive and non – destructive testing techniques. **UNIT 2** **CAUSES FOR FAILURES:** Effects due to	**MTCESE204A: Design of Advanced Concrete Structures** **Syllabus** **UNIT-1: Design philosophy,** Modeling of Loads, Material Characteristics. **UNIT-2: Reinforced Concrete** - P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beam. And Corbel. **UNIT-3:** Design of Shear Walls, Compression Field Theory for Shear Design, Design against Torsion; IS, ACI and Euro code. **UNIT-4: Steel Structures** -- Stability Design, Tensional Buckling - Pure, Flexural and Lateral. **UNIT-5:** Design of Beam-Columns, Fatigue Resistant Design, IS code, AISC Standards and Euro code.	**New Course**

		climate, temperature, chemicals, wear and erosion, Design and construction errors, Corrosion – Mechanism, causes, consequences and remedial measures, Effect of cover thickness and cracking on durability of concrete. **UNIT 3** **MATERIALS FOR REPAIR:**Special concretes and mortar, concrete chemicals, Epoxy, Special elements for accelerated strength gain, Expansive cement, Polymer concrete composites, Ferro cement, Fiber reinforced concrete, Fiber reinforced polymer composites, Methods of corrosion protection inhibitors, protective coating materials for rebar and concrete, corrosion resistant steel, cathodic protection, micro concrete. **UNIT 4** **TECHNIQUES FOR REPAIR:**Rust converters and polymer coating for rebars during repair, Repair mortar for cracks, Bonding agents, Epoxy injection, Guniting and Shotcrete, FRP and Ferro cement Jacketing, vacuum concreting, Bonding plates, Overlays, Protective coatings, Shoring and underpinning. **UNIT 5** **CASE STUDIES:** Repairs to overcome low member strength, Deflection, Cracking, Chemical attack, Damage due to wear, leakage, fire, marine exposure and corrosion. Engineered demolition techniques for dilapidated structures – case studies.		
20	**MTCESE204 B**	**ADVANCED THEORY OF CONCRETE STRUCTURES (MTCESE204B)**	**MTCESE204B: Advanced Design of Foundations** **Syllabus**	**New Course**

		UNIT 1 The nature of concrete, stress–strain relationships of concrete, stress–strain relationships of reinforcing steel, stress block parameters. Failure criteria for concrete. **UNIT 2** Behaviour of concrete flexural members, general equations for calculation of moment capacities at ultimate limit state and at limit state of local damage, flexural rigidity, calculation of deflection, redistribution of moments, design examples. **UNIT 3** Axially loaded compression members, combined axial load and uniaxial bending. Interaction diagrams, combined axial load and biaxial bending, slender compression members, design example using I.S.456–2000. **UNIT 4** Shear cracking of ordinary reinforced concrete members, web reinforcement, design examples, shear in tapered beams. Development length of reinforcement, anchorage. Significance of Torsion, Torsional resistance of concrete beams, reinforcement for torsion, design examples using I.S. 456-2000. **UNIT 5** General principles of detailing of reinforcement, effective depth, design of main reinforcement, design of transverse reinforcement, conditions at loads and at supports.	**UNIT-1: Planning of Soil Exploration** for Different Projects, Methods of Subsurface Exploration, and Methods of Borings along with Various Penetration Tests. **UNIT-2: Shallow Foundations**, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws. **UNIT-3: Pile Foundations**, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles. **UNIT-4:** Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods. **Tunnels** and Arching in Soils, Pressure Computations around Tunnels. **UNIT-5: Open Cuts**, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types **Coffer Dams**, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction	

21	**MTCESE204C**	**DESIGN OF SUBSTRUCTURES (MTCESE204C)** **UNIT 1** **SUB SURFACE EXPLORATION:** Purpose , Programme and Procedures interpretation of bore logs, soil data and exploration reports. **UNIT 2** **SHALLOW FOUNDATIONS:** Types of foundation and their specific application – depth of foundation –bearing capacity and settlements estimates-structural design of isolated, strip, rectangular, trapezoidal and combined footings – strap-balanced footings-raft foundation-Approximate flexible method of raft design-Compensated foundation. **UNIT 3** **DEEP FOUNDATIONS:** Types of piles and their application-load capacity – settlements-group action-design of piles & pile caps-Lateral load capacity of piles. **UNIT 4** **FOUNDATIONS FOR BRIDGES AND OTHER MISCELLANEOUS STRUCTURES :** Drilled shaft foundation and caissons for bridges , Foundations for towers – Chimneys – Silos **UINT 5** **MACHINE FOUNDATIONS:** Types, General requirements and design criteria-General analysis of machine foundation-soil system-stiffness and damping parameters-Tests for design parameters-Guide lines for design of reciprocating engines, impacts types machines, rotary type machines, framed foundation.	**MTCESE204C: Soil Structure Interaction** **Syllabus** **UNIT-1:** Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction. Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method. **UNIT-2:** Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics. **UNIT-3:** Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc. **UNIT-4:** Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics. **UNIT-5:** Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.	**New Course**
22	**MTCESE204**		**MTCESE204D: Design of Industrial**	**New Course**

	D		**Structures** **Syllabus** **UNIT: I** Planning and functional requirements - classification of industries and industrial structures - planning for layout - requirements regarding lighting ventilation and fire safety - protection against noise and vibrations **UNIT: II** Industrial buildings - roofs for industrial buildings (Steel) - design of gantry girder - design of corbels and nibs - machine foundations **UNIT: III** Design of Pre Engineered Buildings **UNIT: IV** Power plant structures - Bunkers and silos - chimney and cooling towers - Nuclear containment structures **UNIT: V** Power transmission structures - transmission line towers - tower foundations - testing towers	
23	MTCESE205	**Non-destructive testing Lab (MTCESE205)** **(MTCEBT205)** 1. To study of destructive testing techniques. 2. To study of Non- destructive testing techniques. 3. To determine the quality of concrete by ultrasonic pluse velocity. 4. To determine the compressive strength of concrete by rebound hammer test. 5. To determine the corrosion of steel by half cell potential test. 6. To determine the in-situ compressive strength of concrete core by core drilling method. 7. To study about chemical effect on hardand concrete. 8. To study about fiber reinforced concrete.	(MTCESE205)Enlightenment Skills	**New Course**

		9. Determine of cover on reinforcement bars. 10. To study of Repair techniques for concrete structure.		
24	**MTCESE206**		**MTCESE206: Model TESTING LAB** • **Syllabus** 1. Response of structures and its elements against extreme loading events. 2. Model Testing: Static - testing of plates, shells, and frames models. 3. Model Testing: Free and forced vibrations, Evaluation of dynamic modulus. 4. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain Study. 5. Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.	**New Course**
25	**MTCESE207**		**MTCESE207: Numerical Analysis Lab** **Syllabus** 1. Find the Roots of Non-Linear Equation Using Bisection Method. 2. Find the Roots of Non-Linear Equation Using Newton's Method. 3. Curve Fitting by Least Square Approximations. 4. Solve the System of Linear Equations Using Gauss - Elimination Method. 5. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method. 6. Solve the System of Linear Equations Using Gauss - Jorden Method. 7. Integrate numerically using Trapezoidal Rule.	**New Course**

			8. Integrate numerically using Simpson's Rules. 9. Numerical Solution of Ordinary Differential Equations By Euler's Method. 10. Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.	
26	**MTCESE208**		**MTCESE208: Mini Project with Seminar**	**New Course**
27	**MTCESE301**	**DISASTER MITIGATION AND MANAGEMENT (MTCESE301)** **UNIT 1** **ENVIRONMENTAL HAZARDS & DISASTERS:**Environmental hazards, Environmental Disasters and Environmental stress- Meaning and concepts. Vulnerability and disaster preparedness **UNIT 2** **TYPES OF ENVIRONMENTAL HAZARDS & DISASTERS:** Natural hazards and Disasters – Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire. **UNIT 3** **DISASTER MANAGEMENT:**Emerging approaches in Disaster Management – Preparing hazard zonation maps, Predictability/forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication.Disaster resistant house construction, Population reduction in vulnerable areas, Awareness Rescue training for search & operation at national & regional level immediate relief, Assessment surveys, Political Administrative Aspect, Social Aspect, Economic Aspect, Environmental Aspect. **UNIT 4** **NATURAL DISASTER REDUCTION &**	**MTCESE301A: Design of Pre-stressed Concrete Structures** **Syllabus** **UNIT-1: Introduction to prestressed concrete**: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions. **UNIT-2: Statically determinate PSC beams**: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions. **UNIT-3: Transmission of prestress** in pretensioned members; Anchorage zone stresses for post tensioned members. **Analysis and design** of prestressed concrete pipes, columns with moments. **UNIT-4: Statically indeterminate structures** - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy. **UNIT-5: Composite construction** with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial pre-stressing - principles, analysis and design concepts, crack width calculations.	**New Course**

		MANAGEMENT: Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards **UNIT 5** **ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA:** A regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hill with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development A Remedy to Disaster, Role of Panchayats in Disaster mitigation, Environmental policies & programmers' in India – Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.		
28	**MTCESE301B**		**MTCESE301B: Analysis of Laminated Composite Plates** **Syllabus** **UNIT-1:** Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending Of Rectangular Laminated Plates using CLPT. **UNIT-2**: Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions. **UNIT-3**: Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT. Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT. **UNIT-4:** Introduction to Finite Element Method, Rectangular Elements, Formation of	**New Course**

			Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses. Finite Element Solutions for bending of Rectangular Laminated Plates using FSDT. **UNIT-5:** Analysis of Rectangular Composite Plates using Analytical Methods. Finite Element Model, C0 Element Formulation, Post Computation of Stresses.	
29	**MTCESE301C**		**MTCESE301C: Fracture Mechanics of Concrete Structures** **Syllabus** **UNIT-1: Introduction:** Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and Crack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted Cracking, Service Failure Analysis. **UNIT-2: Stress at Crack Tip:** Stress at Crack Tip, Linear Elastic Fracture Mechanics, and Griffith's Criteria. **UNIT-3:** Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, and R curves, Compliance, J Integral, Concept of CTOD and CMD. **UNIT-4: Material Models**: General Concepts, Crack Models, Band Models, Models based on Continuum. **UNIT-5:** Damage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling.	**New Course**
30	**MTCESE301D**		**MTCESE301D: Design of Plates and Shells** **Syllabus** **UNIT-1:** Prismatic folded Plate Systems. **UNIT-2:** Shell Equations. **UNIT-3:** Approximate Solutions. **UNIT-4:** Analyse and Design of Cylindrical Shells. **UNIT-5:** Approximate Design methods for Doubly Curved Shells.	**New Course**
31	**MTCESE302A**	**CONSTRUCTION TECHNIQUES AND MANAGEMENT (MTCESE302)** **UNIT 1** **CONSTRUCTION TECHNIQUES :** Construction planning-Construction	**MTCESE302A: Business Analytics** **Syllabus** **Unit-I:** Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive	**New Course**

		facilities, Schedules, Layout of Plant utilities, Construction methods **UNIT 2** **EXCAVATION TECHNIQUES:** Excavation and handling of Earth and Rock; Production and handling of Aggregates and Concrete **UNIT 3** **DRAINAGE TREATMENTS :** cooling of concrete in dams, Drainage treatment of aquifers/sub-terrainean reservoirs **UNIT 4** **TUNNELING :** Tunneling, Tunneling in soft rocks- Grouting , chimney formation, etc **UNIT 5** **CONSTRUCTION MANAGEMENT :** Construction control and management- CPM/PERT, Human Factors, Organization.	advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview. **Unit-II:** Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. **Unit-III:** Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization. **Unit-IV:** Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model. **Unit-V:** Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. **Unit-VI:** Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	

32	**MTCESE302B**		**MTCESE302B: Industrial Safety** **Syllabus** **Unit-I:** Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. **Unit-II:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. **Unit-III:** Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **Unit-IV:** Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. **Unit-V:** Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical	**New Course**

			equipment, advantages of preventive maintenance. Repair cycle concept and importance.	

33	**MTCESE302C**		**MTCESE302C: Operations Research** **Syllabus** **Unit 1**: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models **Unit 2** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming **Unit 3**: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT **Unit 4** Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. **Unit 5** Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**New Course**

34	**MTCESE302D**		**MTCESE302D: Cost Management of Engineering Projects** **Syllabus** Unit 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Unit 4: Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	**New Course**

35	**MTCESE302E**		**MTCESE302E: Composite Materials** **Syllabus** **UNIT–I**: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. **UNIT – II**: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. **UNIT – III:** Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. **UNIT–IV:** Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications. **UNIT – V:** Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria,	**New Course**

			hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	

36	**MTCESE302F**		**MTCESE302F: Waste to Energy** **Syllabus** **Unit-I:** Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors **Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. **Unit-III:** Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation. **Unit-IV:** Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors. **Unit-V:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	**New Course**

37	**MTCESE303**	**ADVANCED CONCRETE TECHNOLOGY** **(MTCESE303)** **UNIT 1** **MICROSTRUCTURE CONCRETE:** Microstructure of concrete, deterioration mechanisms, assessment and control of corrosion in concrete structures **UNIT 2** **SPECIAL CONCRETE :** Introduction to Special concretes, their specific properties & applications: Ready Mixed Concrete, Reactive powder concrete, Bacterial concrete, Light Weight concrete, High density concrete & its application for Radiation shielding. **UNIT 3** **FIBER REINFORCED CONCRETE :** Fiber reinforced concrete - Fiber materials, mix content, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fiber reinforced concrete **UNIT 4** **MECHANICAL PROPERTIES :** mechanical properties, crack arrest and toughening mechanism, applications. High strength concrete – constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. **UNIT 5** **HIGH PERFORMANCE CONCRETE :** High performance concrete and self compacting concrete: Materials, mix design, techniques for performance measurement	**MTCESE303 Dissertation-I /Industrial Project** **Syllabus** **Mid Sem Evaluation weightage - 30%** **End Sem Evaluation weightage - 70%** **Dissertation-I**: will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.	**New Course**
38	**MTCESE304A**	**HIGH RISE STRUCTURES** **(MTCESE304A)**		

		UNIT 1 **MULTISTOREY BUILDINGS :** Introduction, Structural Systems For Buildings, Load Bearing Masonry Buildings, Framed Buildings, Selection Of Structural System, Types Of Floors, One-Way Slab Systems, Two Way Slab Systems, Flat Slab Systems, Flat Plate Systems, Grids **UNIT 2** **TYPES OF STAIRS :** Introduction, Common Types Of Stairs, Central-Wall Type Stairs, Central-Column Type Stairs, Slab less Stairs, Helicoidal Stairs, Free Standing Stairs **UNIT 3** **MASONRY BUILDINGS :** Introduction, Brick Wall Design Under Vertical Loads, Brick Wall Under Horizontal Loads, Resistance To Earthquake Forces By Wall Boxes, Loads, Multistory Buildings, Response Reduction Factor, 2d Analysis, 3d Analysis, Analysis For Vertical Loads **UNIT 4** **FRAMED BUILDINGS UNDER VERTICAL LOADS :** Introduction, Frame Analysis Under Vertical Loads, Approximate Analysis By Substitute Frame Method, Interaction At Junction Of Reinforced Concrete Elements, Exact Column Loads And Moments, Approximate Methods For Column Loads And Moments, Analysis For Lateral Loads, Analysis For Lateral Loads **UNIT 5** **FRAMED BUILDING UNDER HORIZONTAL LOADS :** Introduction, Allocation Analysis, Frame Analysis, Torsion In Buildings, Multistory Buildings Shear walled buildings under horizontal loads Introduction, Allocation Analysis, Response Of Structure, Effect Of Joint Width, Monolitihic Beam or		

		Column Joints Foundations Introduction, Shallow Foundations, Deep Foundations		
39	**MTCESE304B**	**THEORY OF PLATES AND SHELLS (MTCESE304B)** **UNIT 1** **Plates:-** Introduction- classification of plates- thin plates and thick plates – assumptions in the theory of thin plates- Differential equation for cylindrical bending of rectangular Plates. **UNIT 2** **Pure bending of plates:-** slope and curvature of slightly bent plates – relation between bending moment and curvature in pure bending – stresses acting on a plate inclined to x and y axes-Particular cases of pure bending of rectangular plates. **UNIT 3** **Laterally loaded rectangular plates:-** Small deflections of Laterally loaded thin plates- Differential equation of plates- derivation of fourth order differential equation – Solution techniques for fourth order differential equation – boundary conditions – simply supported, built- in and free edges. **UNIT 4** **Circular plates** – polar coordinates – differential equation of symmetrical bending of laterally loaded circular plates- uniformly loaded circular plates with clamped edges and simply supported edges– circular plates loaded at the centre.		

		UNIT 5 **Classical theory of Shells –** Structural behaviour of thin shells – Classification of shells –Singly and doubly curved shells with examples – Membrane theory and bending theory of doubly curved shells.-equilibrium equations. Folded plates – Introduction, Classification, Structural action and analysis.		
40	**MTCESE304C**	**ADVANCED FOUNDATION ENGINEERING (MTCESE304C)** **UNIT –1** Bearing capacity of Footings subjected to Eccentric and Inclined Loading –Meyrhoff's and Hanse's theories –elastic settlement of Footings embedded in sands and clays of Infinite thickness –Footings on soils of Finite thickness-Schmertamaunn's method, Jaubu and Morgenstern method. **UNIT –2.** Pile Foundations –settlement of Pile groups resting in sands and clays –Negative skin friction –in single piles and groups of piles – under –reamed piles –specifications –load –carrying capacity in sands and clays. **UNIT –3.** Caissons and well foundations : Types of caissons –well foundation Different shapes of wells –Components of wells –functions and Design –Design Criteria –Sinking of wells –lateral stability by Terzaghi's analysis. **UNIT –4.** Cantilever sheet piles and anchored		

		bulkheads Earth pressure diagram – Determination of Depth of embedment in sands and clays –Timbering of trenches-Earth pressure diagrams –Forces in struts. **UNIT –5** Foundations in Expansive soils –Problems in Expansive soils –Mechanism of swelling – Swell Pressure and Swelling potential – Heave foundation practices –Sand cushion –CNS cushion –under –reamed pile Foundations –Granular pile –anchor technique, stabilization of expansive soils.		
41	**MTCESE305**	**SEMINAR (MTCESE305)**		
42	**MTCESE401**	**Dissertation (MTCESE401)**	**MTCESE401: Dissertation II** **Syllabus** **Dissertation – II:** will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.	**Course name Changed Content changed**