Faculty of Engineering & Technology

Syllabus

For

Master of Technology (M. Tech.)

Civil Engineering

(Program Code: ET0151CE)

(2019-20)

(Approved by the Academic Council vide Resolution No. 34.26 dated 20.06.2019)

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1. Program Educational Objectives (PEOs):

1. To provide students with a foundation in engineering areas required to formulate, solve and analyse engineering problems. **(Fundamental Knowledge)**
2. To analyse real life problems; apply the knowledge gained from modern design methodologies to address issues in a manner i.e., technically sound, economically feasible and socially acceptable. **(Professional Skill & Society).**
3. To inculcate ethical attitude, effective communication skills, teamwork in their profession and adapt to current trends by engaging in lifelong learning needed for a successful professional career. **(Ethics & Lifelong Learning)**

2. Post Graduate Attributes (PGAs)

The post graduate attributes in M. Tech. are the summation of the expected course learning outcomes mentioned in the end of each course. Some of them are stated below:

PGA1: Discipline-specific Knowledge:

Capability of demonstrating comprehensive knowledge of MCA program and understanding of core branch so that it forms a foundation for a Post Graduate program of study.

PGA2: Research-related skills:

To develop a sense of inquiry and capability for asking relevant and intelligent questions, problem identification, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PGA3: Critical Thinking & Analytical Reasoning:

Ability to employ critical thinking in understanding the concepts relevant to the various branches of technical courses. Analytical reasoning refers to the ability to look at information, be it qualitative or quantitative in nature, and discern patterns within the information.

PGA4: Problem Solving:

Capability to solve problems by using research-based knowledge and research methods including innovative thinking, design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PGA5: Usage of Modern Tools (Information/digital literacy)& Self-directed learning:

To create, select, and apply appropriate techniques, resources, and modern science and IT tools including prediction and modeling to complex science activities with an understanding of the limitations. Self – directed learning is to provide ability to work independently and do in-depth study of various problems and requirements of society.

PGA6: Communication skills:

i. Ability to communicate various concepts of technical education effectively using practical approach and their geometrical visualizations.

ii. Ability to use courses as a precise language of communication in other branches of human knowledge.

iii. Ability to resolve unsolved problems and requirements of industries and societies.

iv. Ability to show the importance of their technical knowledge as precursor to various scientific developments since the beginning of the civilization.

PGA7. Leadership Readiness/Qualities and Employability Options:

Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision and using management skills to follow the mapped path to the destination in a smooth and efficient way. This program will also help students to enhance their employability through self employment (Entrepreneur) or by opting jobs in various sectors like industries, Government offices, PSUs, corporate etc.

PGA8. Multicultural Competence:

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PGA9: Moral and ethical awareness/reasoning:

Ability to identify unethical behavior such as falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of their program.

PGA10: Lifelong learning:

Life-long learning provides the ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

3. Programme Outcomes (POs)

Students post graduating with the M. Tech degree should be able to acquire with following **POs**

PO1. Apply knowledge, skills, and current tools, recent computing technologies of Engineering innovatively to different applications

PO2. Enhance thinking skills to design and conduct experiments, as well as to analyze and interpret data and address the research gaps to produce solutions with the help of tools, technology and products.

PO3. Understand the contemporary research, security issues in the different areas of engineering.

PO4. An ability to identify, analyze, design, develop, implement and integrate based systems.

PO5. Enhance critical thinking by acquiring the skills in modern techniques, methodologies and tools to be innovative and creative.

PO6. An ability to communicate effectively, express /present ideas in an impressive and professional manner, both in written and verbal forms.

PO7. An ability to work in multidisciplinary and multicultural environment, become entrepreneur.

PO8. An ability to understand leadership and entrepreneurship qualities.

PO9. An ability to understand health, ethical, legal, financial, and professional responsibilities.

PO10. To recognizes the need for self-motivation and ability to engage in lifelong learning through continuing education, research and professional development.

Mapping of Graduate Attributes (PGAs) and Programme Outcomes (PLOs):

PO/PGA	PGA1	PGA2	PGA3	PGA4	PGA5	PGA6	PGA7	PGA8	PGA9	PGA10
PO1										
PO2										
PO3										
PO4										
PO5										
PO6										

PO7							■			
PO8								■		
PO9									■	
PO10										■

4. **Program Specific Outcomes (PSOs) :**

PSO1: Engage in sustainable development and to demonstrate engineering skills for effective interpretation and decision to solve real world problems.

PSO2: To make a strong combination of technical and leadership qualities for successful professional career in industry or in entrepreneurship.

5. Course-Wise Learning Objectives, Structures and Outcomes (CLOSOs)

MASTER OF TECHNOLOGY
(ENVIRONMENTAL ENGINEERING)

M.Tech. (CE), Semester-I, I yr. (2 yrs Degree Course)

Code	Title of Subject	L	T	P	IA	EA	Total	Credits
MTCEEV101	Energy & Environment	3	0	0	50	100	150	3
MTCEEV102	Advanced Waste Water Treatment Technology	3	0	0	50	100	150	3
Elective -1 (Any One)								
MTCEEV103A	Advanced Water Treatment Technology	3	0	0	50	100	150	3
MTCEEV103B	Statistical and Mathematical Techniques	3	0	0	50	100	150	3
MTCEEV103C	Environmental Geo Technology	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCEEV104A	Noise and Thermal Pollution	3	0	0	50	100	150	3
MTCEEV104B	Environmental Hydraulics	3	0	0	50	100	150	3
MTCEEV104C	Environmental Chemistry & Microbiology	3	0	0	50	100	150	3
MLC & Audit								
MTCEEV105	Research Methodology and IPR	2	0	0	50	100	150	2
MTCEEV106	Audit Course – 1 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	50	100	150	0
Practical/Viva Voce								
MTCEEV107	Advanced Water Treatment Lab	0	0	4	60	40	100	2
MTCEEV108	Sanitation Engineering lab	0	0	4	60	40	100	2
Total		16	0	8	370	580	950	18

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCEEV201	Environmental Policies & Legislation	3	0	0	50	100	150	3
MTCEEV202	Environment Impact Assessment & Auditing	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCEEV203A	Solid Waste Management	3	0	0	50	100	150	3
MTCEEV203B	Hydrology And Applied Hydraulics	3	0	0	50	100	150	3
MTCEEV203C	Indoor Air Quality	3	0	0	50	100	150	3
Eective -2 (Any One)								
MTCEEV204A	Industrial Waste Treatment	3	0	0	50	100	150	3
MTCEEV204B	Hazardous Waste Treatment	3	0	0	50	100	150	3
MTCEEV204C	Ground Water Pollution	3	0	0	50	100	150	3
Audit								
MTCEEV205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCEEV206	Industrial Waste Treatment Lab	0	0	4	60	40	100	2
MTCEEV207	Air Quality Testing Lab	0	0	4	60	40	100	2
MTCEEV208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCEEV301A	Air Pollution & Its Control	3	0	0	50	100	150	3
MTCEEV301B	Environmental Aspects of Industries	3	0	0	50	100	150	3
MTCEEV301C	Environment & Health	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCEEV302A	Business Analytics	3	0	0	50	100	150	3
MTCEEV302B	Industrial Safety	3	0	0	50	100	150	3
MTCEEV302C	Operations Research	3	0	0	50	100	150	3
MTCEEV302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCEEV302E	Composite Materials	3	0	0	50	100	150	3
MTCEEV302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCEEV303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCEEV401	Dissertation-II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

SEMESTER I

Energy & Environment (MTCEEV101)

COURSE OBJECTIVE

- To understand the Human Development with the Introduction to Energy Conservation.
- To develop the understanding of the Energy Use of Environmental and Pollution Control Technologies in Energy Sector.
- To study various sampling and classification problems, and the Designing Environmental Policies

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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.

Reference Books:

- Ecology of environment, Sharma, P D ,Rastogi Publishers.
- Concept of ecology, karmondy.

- Environmental Biology. Agrawal, K C , Nidhi publishers.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: have knowledge about the environment and various types of resources present in environment.

CO2: know the about the laws of energy and use the energy in various types.

CO3: Know about the use various technique to use energy and control the pollution.

CO4: Analyze and design various Programming Models for Environmental Policies.

CO5: Have knowledge about Environmental Benefits and cost of the use energy.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	L	-	M	L	-	-	M	-	L	M	M
CO2	L2 ,L4	M	-	-	-	-	L	M	L	-	-	H	M
CO3	L2	M	-	L	M	L	M	-	M	M	-	H	H
CO4	L4	L	M	H	M	-	L	-		L	L	M	M
CO5	L1,L2	H	-	M	L	-	L	-		M	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Advanced Waste Water Treatment Technology (MTCEEV102)

COURSE OBJECTIVE

- To understand about the water quality and water treatment methods.
- To develop the understanding of the water filtration method a various theory and equation.
- To study various water sampling and Disinfection types.

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 softening plant

Reference Books:

- CASEY. T.J. " Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England 1993
- Birdie G.S.& J.S."Water supply engineering"dhanpat rai New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know ability to understand different phenomena involve in water recycling and reuse.

CO2: Know about Water Supplies Standards and guidelines of Water.

CO3: Know various types of water treatment process and their use.

CO4: Analyze and design the equation and use filter operation for water treatment.

CO5: Know how to remove the hardness and make the water used.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	-	L	M	-	M	-	M	M	-	M	M
CO2	L2 , L1	M	-	M	M	M		-	-	L	L	M	M
CO3	L3,L2	H	-	M	M	-	L	M	-	-	M	H	M
CO4	L4	L	M	M	L	L	-	L	M	-	L	M	H
CO5	L2	M	-	-	L	-	M	L	L	-	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Advanced Water Treatment Technology (MTCEEV103A)

COURSE OBJECTIVE

- To have knowledge of waste water and Reuses of waste water.
- To develop the understanding of the Wastewater Treatment Fundamentals and it's Physical-chemical and biological processes.

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 ,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.

Reference Books:

- METCALF & EDDY, INC. "Wastewater Engineering - Treatment, Disposal, and Reuse ", Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 1995.
- CASEY. T.J. "Unit Treatment Processes in Water and Wastewater Engineering ",

John Wiley & Sons England 1993.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know ability to understand different phenomena involve in waste water recycling and reuse.

CO2: Knowl about Standards and guidelines of waste Water and Waste Water Characteristics and their significance.

CO3: Suggest the suitable technologies for the treatment of wastewater.

CO4: Analyze and design the treatment systems and use filter operation for waste water treatment.

CO5: Define the Principles of pollution prevention and mechanism of oxidation processes. Discuss about the wastewater characteristics.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L2 , L3	H	-	L	-	M	M	L	M	-	M
CO2	L4	H	M	-	H	-	-	-	L	L	L
CO3	L3	-	M	-	M	M	L	L	L	L	-
CO4	L4	M	H	H	M	-	-	H	-	-	M
CO5	L2,L1	-	-	M	-	-	H	M	L	L	-

H- High, M- Moderate, L- Low, '-' for No correlation

Statistical and Mathematical Techniques (MTCEEV103B)

COURSE OBJECTIVE

- To understand the the concept of solving ordinary and partial differential equations.
- To know the Fundamentals of data analysis and Various sampling techniques.
- To know the Concept of probability distributions.

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.

Recommended reference books:

- "Fundamental of Mathematical Statistics", Gupta, S. C. and Kapoor,V.K.,S.Chand and Sons.
- "Advanced Engineering Mathematics" by H. K. Dass, S.Chand and Sons.
- "Higher Engineering Mathematics" by B.S.Grewal, Khanna Publisher.

- "Higher Engineering Mathematics" by B.V. Ramana, Tata McGraw Hill.
- "Advanced Engineering Mathematics" by R. K. Jain, S. R. K. Iyengar,Tata McGraw Hill.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Apply the basic knowledge of the probabilistic distribution function to the field of Engineering.

CO2: Develop the regression equation for various phenomenon under consideration.

CO3: Design and Testing of hypothesis.

CO4: Distinguish different time series models.

CO5: Students will be able to data analysis problems of environmental engineering.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L3	H	-	-	-	-	-	M	-	-	M	M	M
CO2	L3	M	H	M	L	-	-	M	M	M	-	M	M
CO3	L4	L	M	H	-	H	M	L	L	L	M	M	H
CO4	L2,L4	L	L	M	M	-	L	L	L	L	L	M	H
CO5	L4	M	L	-	M	-	L	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Environmental Geo-Technology (MTCEEV103C)

COURSE OBJECTIVE

- To understand the Principles of Geo-technology
- To know he the Soil-contaminant interaction and transport of contaminants in sub surface.
- To study various sampling and classification problems.

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 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.

Reference Books:

- Valdiya, K.S. 1987, Environmental Geology.
- Keller, E.A. Environmental Geology & Turk and Turk.
- Environmental Geology – DR Coates, John Wiley & Sons, NY 1981

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Have comprehensive and historical overview of hazardous waste management, and prepare our students to be well-qualified and competitive in the responsibility of engineering design and permitting in the field of hazardous waste management.

CO2: Provide comprehensive and historical overviews of hazardous wastes management from both scientific and engineering principles.

CO3: Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.

CO4: Find different various AMD (Acid Mine Drainage) and its effect.

CO5: know and work on principal Remote Sensing and its application of Environmental.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2,L4	H	H	L	M	H	M	-	H	L	-	M	H
CO2	L4	M	L	-	-	L	-	H	L	-	L	H	M
CO3	L2	H	-	M	M	-	L	L	H	H	M	M	H
CO4	L1	L	M	M	L	L	-	H	-	L	-	M	H
CO5	L3,L2	M	-	-	L	-	M	-	-	H	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Noise and Thermal Pollution (MTCEEV104A)

COURSE OBJECTIVE

- To understand the effects of noise on environment and properties.
- To develop the understanding of the Noise Pollution Sources and Monitoring and collecting the sample methods.
- To study of Thermal Pollution, noise pollution and Control of Noise Pollution

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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.

Reference Books:

- Noise Pollution by Tripathy, Debipras (latest edition)
- Environmental Pollution , Agrawal K C Nidhi publishers.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Define the various types of noise and its effect on environment & human.

CO2: Find out the sources of noise pollution.

CO3: Analyze and learn to how control noise pollution and for that using equipments.

CO4: Get knowledge about the limitation of source noise and their list of BIS code books on noise pollution.

CO5: Know about the basic knowledge of thermal pollution and its effect on environment.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	L	-	M	L	M	-	-	M	L	M	H
CO2	L1	M	-	-		-	L	M	M	L	-	M	M
CO3	L4	M	-	L	M	L	H	-	L	H	M	M	M
CO4	L2	L	M	H	M	-		-	H	-	L	H	H
CO5	L1,L2	H	-	M	L	-	L	-	-	-	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Environmental Hydraulics (MTCEEV104B)

COURSE OBJECTIVE

- To have knowledge about the Surface hydrology and run off calculations.
- To get awareness on Well hydraulics.
- To understand about Ground water hydrology.
- To learn basic management concepts.

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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

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

Reference Books:

- Fluid mechanics V.L.Streeter and E.B. Wylie, Mcgraw Hill, 1985, New York
- Theory and applications of fluid mechanics K Subramanya, Tata Mcgraw Hill Publishing Co, 1993, New Delhi
- Introduction to fluid mechanics E.J. Shaughnessy, I.M. Katz, and J.P Schaffer, SI Edition 2005, Oxford University press, New Delhi.
- Fluid Mechanics, F.M. White 5th edition, McGraw Hill, New York.
- Fluid Mechanics by Dr. D.S. K umar
- Fluid Mechanics & Hydraulic Mechanics by Dr.P.N. Modi & Sheth
- Fluid Mechanics By Dr. A.K. Jain
- Hydraulic Fluid Mechanics & Fluid Mechanics By S. Ramamruthan
- Engineering Fluid Mechanics By R.J. Grade & A.C Mirajgaoker

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Get knowledge about the fluid and its types.

CO2: Get knowledge the various fluid properties and their working principal.

CO3: Know about the various equation and flow measurement of pipes flow.

CO4: Solve and find out the discharge in different orifice and notch and their coefficient.

CO5: Get the different weir and notch with their types and water flow through the different channel.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1,L2	H	-	-	-	-	H	M	-	H	M	M	M
CO2	L2,L3	-	H	M	L	-	M	-	H	M	H	M	H
CO3	L1	H	M	H	-	H	L	H	M	L	M	M	M
CO4	L2,L3	M	L	M	M	-	-	M	L	H	L	M	M
CO5	L2	M	L	-	M	-	-	L	-	-	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Environmental Chemistry & Microbiology (MTCEEV104C)

COURSE OBJECTIVE

- To know the principles and basic concepts of physical chemistry and Fundamentals of microbiology.
- To understand the techniques for the analysis of air, water and soil environment.
- To know the environmental applications of microbiology.

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.

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.

Recommended Books:

- Rose E Mckanney. Microbiology for sanitary engineers-
- Gamey and Lord. Microbiology for waste water and sewage
- Pelczhar and Reid. Test book of microbiology.
- Standard methods . APHA.

- Roger T Stainer and Michael Dandroff. General Microbiolog

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand chemistry involved in environment.

CO2: Identify the chemical reactions and changes in contaminants.

CO3: Understand the microbiology and its usefulness to environment.

CO4: Perform experimental analysis of some properties of water and wastewater.

CO5: Have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	L	-	M	L	M	-	M	-	L	M	M
CO2	L4	M	-	-	-		M	M	M	M	-	M	H
CO3	L2	M	-	L	M	L	L	M	L	M	M	M	M
CO4	L4	L	M	H	M	-	-	M	-	L	L	H	H
CO5	L2,L1	H	-	M	L	-	L	L	-	-	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Research Methodology and IPR (MTCEEV105)

COURSE OBJECTIVE

- To understand research problem formulation.
- To analyze research related information
- To follow research ethics
- To understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

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.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.

- Niebel , “Product Design”, McGraw Hill, 1974.
- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping of Course Outcomes onto Program Outcomes

Course Outcomes	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	H	M	L	L	M	L	M	L	M	M
CO2	L3	M	M	M	L	M	-	L	M	M	M	M	M
CO3	L2	H	H	L	M	M	M	L	-	M	-	L	L
CO4	L3,L4	M	M	L	L	M	-	-	-	M	L	M	M

H- High, M- Moderate, L- Low, ‘-’ for No correlation

Advanced Water Treatment Lab (MTCEEV107)

COURSE OBJECTIVE

- To understand the water quality and its various parameters
- To find out the in water present various types of solid and water present in water

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

References:

1. Refer Enviroment related lab guide.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Get knowledge about the water quality.

CO2: Analyze and evaluate the taking experiment.

CO3: Find out the various solids parts present in water sample.

CO4: Apply the various research methods followed in engineering research for formulation and Design of own research problems and to utilize them in their research project.

CO5: Get knowledge about various water supply Fittings.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2,L4	H	M	L	M	M	M	-	M	-	-	H	H
CO2	L4,L5	M	H	-	-	H	-	M	H	M	L	H	H
CO3	L4	H	-	M	M	L	L	H	L	H	M	M	H
CO4	L3	L	M	M	L	L	M	L	-	L	-	H	H
CO5	L2,L3	-	L	-	-	-	H	-	L	M	L	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Sanitation Engineering Lab (MTCEEV108)

COURSE OBJECTIVE

- To understand the sewage and present various solids and find out various methods.

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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the research methodology concepts, research problems and the quantity of various matters present in sewage.

CO2: Analyze and evaluate the vale and amount present in sewage sample.

CO3: Prepare a thesis or a technical paper, and present or publish them on the basis of the fin in lab water sample data.

CO4: Apply the various research methods followed in engineering research for formulation and Design of own research problems and to utilize them in their research project.

CO5: Get knowledge about the various types of sanitary fitting.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L5	H	M	L	M	L	M	-	M	-	L	H	M
CO2	L4	-	H	-	-	H	-	M	H	M	L	M	H
CO3	L6	H	-	M	M	L	L	H	L	-	M	H	H
CO4	L3	L	M	M	L	L	M	L	-	L	-	M	M
CO5	L2 , L3	-	L	-	-	-	H	-	-	M	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER II

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCEEV201	Environmental Policies & Legislation	3	0	0	50	100	150	3
MTCEEV202	Environment Impact Assessment & Auditing	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCEEV203A	Solid Waste Management	3	0	0	50	100	150	3
MTCEEV203B	Hydrology And Applied Hydraulics	3	0	0	50	100	150	3
MTCEEV203C	Indoor Air Quality	3	0	0	50	100	150	3
Eective -2 (Any One)								
MTCEEV204A	Industrial Waste Treatment	3	0	0	50	100	150	3
MTCEEV204B	Hazardous Waste Treatment	3	0	0	50	100	150	3
MTCEEV204C	Ground Water Pollution	3	0	0	50	100	150	3
Audit								
MTCEEV205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCEEV206	Industrial Waste Treatment Lab	0	0	4	60	40	100	2
MTCEEV207	Air Quality Testing Lab	0	0	4	60	40	100	2
MTCEEV208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

Environmental Policies & Legislation (MTCEEV201)

COURSE OBJECTIVE

- To understand about the Role of national, international agencies for environmental aspects.
- To know about the various act and legislations in developing and developed countries. And their related issue.

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.

Reference Books:

- Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8,John Wiley & Sons, 1998.
- Handbook of Accident prevention, ILO Publication, 1998.
- Encyclopedia of Industrial Safety and Health, 1999.
- G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi,1997
- J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Get knowledge Assess the value of environmental management and auditing in enterprises, and the Importance of environmental legislation.

CO2: Examine how environmental legislation, management and auditing are integrated into the Private and public sectors.

CO3: Analyze the principles and elements of environmental management and auditing systems that Achieve sustainable development

CO4: Understand the significance of environmental legislation in relation to the planning and Implementation.

CO5: Prepare a thesis or a technical paper, and present or publish them on the basis of the fin in lab water sample data.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1,L2	H	L	M	M	L	M	-	M	-	L	M	M
CO2	L4	M	H	-	-	-	M	M	M	M	-	H	H
CO3	L4	M	-	L	M	L	L	-	L	M	M	H	M
CO4	L2	L	M	H	M	-	-	L	M	L	L	M	M
CO5	L6	H	-	M	L	-	L	M	-	M	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Environmental Impact Assessment and Auditing (MTCEEV202)

COURSE OBJECTIVE

- To instruct the students on the basic concepts of EIA and The EIA methodologies.
- To understand the Environmental legislations in India and the Environmental Clearance procedure in India.
- To understand the Environmental audit and management techniques and its Fundamental Concepts of Sustainable development

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..

Recommended Books :

- Environmental Impact Assessment, Canter Mc Graw Hill Pub.
- Environmental Impact Analysis. R.K. Jain, L. V. Urban and G.S. Stacey Publishers : van Nostrand reinhold New York
- Environmental Impact Analysis. Hand book by John Ray and David W
- Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988)
- Theory and Practice of Environmental Impact assessment: By Abbasi and Ramesh
- Environmental Impact Assessment: By Shrivastava

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1:Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.

CO2: Know about the legal requirements of Environmental and Risk Assessment for projects.

CO3: have knowledge and understanding of the role of EIA in environmental Management for sustainable develops.

CO4: gain awareness regarding ecologically sustainable development and Environmental friendly technologies and also the regulatory provisions for environmental Protect.

CO5: familiar with the undertaking of EIA studies and able to quantify EIA and Make EIA report.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	L	L	M	M	M	-	M	-	-	M	M
CO2	L1	-	M	-	L	H	-	M	H	M	L	H	H
CO3	L1 , L2	H	-	M	M	L	L	H	L	-	M	H	M
CO4	L4	L	M	M	L	L	M	L	-	L	L	M	M
CO5	L3	-	L	-	-	-	H	-	L	M	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Solid Waste Management (MTCEEV203A)

COURSE OBJECTIVE

- To understand about the Different elements of land pollution
- To instruct the students on various hazardous wastes, their origin, characteristics and treatment.

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.

Recommended Books:

- Manual on municipal solid waste management – Government of India publication.
- Integrated solid waste management – George Tchobanoglous. Mcgraw Hill
- Solid waste management handbook– Pavoni.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation

CO2: Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste

CO3: Able to suggest more efficient recycling methods and to reduce the harmful climatic impacts of waste management.

CO4: Have skill to assess and develop physical/chemical/biological treatment techniques for the control of hazardous wastes.

CO5: Identify and interpret the criteria for the classification of a substance as solid/hazardous wastes.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	L	-	M	L	M	-	M	-	L	M	M
CO2	L2	M	M	-	L	-	M	M	M	M	-	M	M
CO3	L3	M	-	L	M	L	L	-	L	M	M	H	M
CO4	L4	L	M	H	M	-	-	L	M	L	L	M	H
CO5	L3	H	-	M	L	-	L	M	-	M	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Hydrology and Applied Hydraulics (MTCEEV203B)

COURSE OBJECTIVE

- To get awareness on Surface hydrology and run off calculations.
- To understand the Well hydraulics and Ground water hydrology.
- To understand about Basin management concepts.

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

Recommended Books:

- Seth-modi, applied hydraulic
- Arora k.r., fluid mechanics

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand about Hydrology and the Evaporation of water on surface

CO2: Get knowledge about the water storage equipment and measurement equipment with analysis.

CO3: Get knowledge that how to recharge the ground water and reuse the water.

CO4: Know about the method of pumping of water from ground and protect from pollution.

CO5: Design the drainage system.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	H	M	L	M	M	M	-	M	-	-	M	H
CO2	L1	L	H	-	-	H	-	M	H	M	L	M	M
CO3	L1,L2	H	-	M	M	L	L	H	L	-	M	M	M
CO4	L1,L2	L	M	M	L	L	M	L	-	L	L	M	H
CO5	L6	H	L	-	L	-	H	-	L	M	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Indoor Air Quality (MTCEEV203C)

COURSE OBJECTIVE

- To understand the level of pollutants in indoor and outdoor air and its policy and issue.
- To work on control the pollution and Measurement methods.

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- 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.

RECOMONDED REFERENCE BOOKS:

- Thaddes Godish, *Indoor air and Environmental Quality*, CRC press, 2000.
- Nazaroff W.W. and L. Alvarez-Cohen, *Environmental Engineering Science*, Wiley sons, Newyork, 2001.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Achieve fundamental aspects to design Indore air pollution control methodologies

CO2: Get knowledge Indore Air monitoring strategies.

CO3: Apply sampling techniques and Suggest suitable Indore air pollution prevention equipments and techniques for various gaseous and particulate pollutants.

CO4: Know about the various policies of public health- IAQ and their policy issues.

CO5: get the knowledge about how to prevent the environment and combust the toxics gases.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L5	M	H	M	L	-	L	M	L	L	-	H	H
CO2	L1,L4	M	M	L	L	M	-	L	L	M	M	M	H
CO3	L3	L	M	L	M	M	M	L	L	H	M	M	M
CO4	L1 , L2	M	L	-	L	M	M	-	-	M	M	M	H
CO5	L2	L	M	L	L	M	L	L	L	L	-	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Waste Treatment (MTCEEV204A)

COURSE OBJECTIVE

- To educate the students on different elements of water pollution and methods of treatment
- To get knowledge of various industrial processes and the origin, characteristics and treatment of waste water generate

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 Industry. Provision of various Indian Standards for above Industries.

Unit5.

Potential of Wastewater Recycle and Reuse in Industries, Concept of Common Effluent Treatment Plants.

Recommended Books :

- Theories and Practices of Industrial waste treatment- Nelson Nemerow.
- Waste water treatment: M.N.Rao & Datta.
- IS Standard guide for treatment and disposal of various industries

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand and apply basic concepts of industrial wastewater treatment.

CO2: Apply principle of waste minimization for reuse recycling and recovery.

CO3: Synthesize treatment system, component or processes for industrial wastewater treatment.

CO4: Formulate and design treatment units using hydraulic principles and calculation techniques for industrial wastewater treatment process.

CO5: Development of treatment flow sheet based on wastewater characteristics for various industries. Analyze and evaluates treatment alternative flow sheets through case studies.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2 , L3	M	M	H	L	-	L	M	L	L	-	M	M
CO2	L3	M	L	L	L	M	L	-	-	M	L	M	M
CO3	L4	L	M	L	M	M	M	L	L	H	M	M	H
CO4	L6	M	H	-	L	M	-	M	M	M	H	H	H
CO5	L4	-	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Hazardous Waste Treatment (MTCEEV204B)

COURSE OBJECTIVE

- To instruct the students on Different elements of land pollution
- To gave the knowledge about the Various hazardous wastes, their origin, characteristics and treatment
- To study various EPA obligations and Responsibilities, Hazardous Waste.

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.

Recommended Books :

- Hazardous Waste minimization: By Harry M Freeman, McGraw Hill publications.
- Hazardous Waste Management: By LaGrega.
-

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: provide information regarding different elements of land pollution, various hazardous wastes, their origin, characteristics and treatment.

CO2: Maintain a comprehensive integrated solid waste management approaches that addresses collection, transportation and disposal.

CO3: Enable them to protect the environment by fulfilling the laws, regulations, ordinances and other requirements as set forth by the country.

CO4: Provide safe recycling and disposal options for special wastes that may pose harm to the Environment and /or to public health and safety

CO5: Make them aware of advanced principles related to the separation, processing and transform Technologies of Solid Wastes.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L4	M	H	H	L	-	L	M	L	L	-	H	H
CO2	L3	M	-	L	L	M	-	-	L	M	L	M	M
CO3	L2	L	H	-	M	M	M	L	L	H	M	M	M
CO4	L4	M	H	L	L	M	-	-	-	M	-	M	H
CO5	L2 ,L1	L	M	L	L	M	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Ground Water Pollution (MTCEEV204C)

COURSE OBJECTIVE

- To understand the water quality its principal and Sources Of Pollution.
- To develop the understanding of the Principles of Pollutant movement with the Factors affecting Pathogen movement & Survival.
- To study various Ground Water Quality Monitoring Ground and principal.

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 of Parameters for Monitoring. Economic considerations in ground water quality management.

Recommended Books:

- Metcalf and Eddy Inc. - Waste water engineering: Treatment, disposal & reuse, Tata McGraw Hill
- Peavy- Environmental Engineering, McGraw Hill
- Rodger Walker- Water supply Treatment and distribution
- Sinero- Environmental Engineering: A Design Approach, Prentice Hall of India, Delhi

- Wilson- Design calculations in waste water treatment, McGraw Hill Kogakusha

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Get fundamental Concepts of Groundwater Flow, Transport and Contamination.

CO2: Demonstrate conceptual understanding of the contamination of the soil and groundwater Media.

CO3: Explain the governing processes and identify factors controlling transport and fate of Contaminants in soil and groundwater.

CO4: Get the knowledge about the dissolved solid present in the water and various law of water flow.

CO5: Get the knowledge the about principles and Monitoring of Ground Water Quality.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	M	M	H	L	-	L	M	L	L	L	M	H
CO2	L2	M	L	L	H	M	-	L	M	H	-	M	M
CO3	L2 ,	L	M	L	M	L	L	-	H	M	L	M	M
CO4	L1	M	H	-	L	M	-	H	-	M	-	M	H
CO5	L1 , L2	-	M	L	L	M	L	-	L	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Waste Treatment Lab (MTCEEV206)

COURSE OBJECTIVE

- To understand the get knowledge about the industrial waste and present in industry.
- To study various sampling and classification problems.

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.

10. Design problems as per syllabus of theory

COURSE OUTCOMES OF INDUSTRIAL WASTE TREATMENT LAB

At the end of the course, students will be able to:

CO1: Get Knowledge about the Water Present WASTE.

CO2: Analyze and evaluate research works and to formulate a research problem to pursue research

CO3: Prepare the different types of lab experiment related the waste treatment.

CO4: Apply the various research methods and followed in engineering research for formulation and Design of own research problems and to utilize them in their research project.

CO5: Know the various practical and Design problems.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1,L2	H	M	H	L	-	L	M	L	L	M	M	H
CO2	L4 , L5	M	H	L	L	L	L	-	-	M	L	H	H
CO3	L5	L	M	L	M	M	M	L	L	H	M	H	H
CO4	L3 , L5	M	H	-	L	M	-	M	-	M	-	M	H
CO5	L1,L2	M	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Air Quality Testing Lab (MTCEEV207)

COURSE OBJECTIVE

- To understand the monitoring the various source like (gases, air and materials).
- To understand Bioaerosol sampling
- To study various meteorological parameters.

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

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: monitor respirable particulate materials.

CO2: understand the gases and particulates in ambient air.

CO3: get the knowledge about the indoor air quality and related their practical.

CO4: get knowledge of meteorological measurement parameter.

CO5: know the various practical and the specification of the materials.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L4	M	M	M	L	-	L	M	L	L	M	H	H
CO2	L2	M	H	L	L	M	H	-	H	M	M	M	M
CO3	L1 ,L2	L	H	L	M	H	M	H	M	H	M	M	M
CO4	L1 ,L2	M	H	-	L	M	-	M	-	M	M	M	H
CO5	L4	L	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mini Project with Seminar (MTCEEV208)

COURSE OBJECTIVE

- To identification of the problem
- To use modern research tools/methods.
- To design and conduct experiments and identify the solution of the problem/s.

COURSE OUTCOMES

CO1: Enable the Students to undertake short research project under the direction of guide

CO2: To impart skills in preparing detailed report describing the project and results.

CO3: To enable the students to undertake fabrication work of new experimental set up/devices

CO4: To effectively communicate by making an oral presentation before an evaluation committee

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3,L5	M	H	M	L	M	-	-	-	-	L	H	H
CO2	L6	L	L	-	H	-	H	-	-	M	L	M	H
CO3	L3 ,L6	H	H	L	L	H	-	-	-	-	M	H	H
CO4	L1	-	-	L	M	L	H	-	L	-	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER III

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCEEV301A	Air Pollution & Its Control	3	0	0	50	100	150	3
MTCEEV301B	Environmental Aspects of Industries	3	0	0	50	100	150	3
MTCEEV301C	Environment & Health	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCEEV302A	Business Analytics	3	0	0	50	100	150	3
MTCEEV302B	Industrial Safety	3	0	0	50	100	150	3
MTCEEV302C	Operations Research	3	0	0	50	100	150	3
MTCEEV302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCEEV302E	Composite Materials	3	0	0	50	100	150	3
MTCEEV302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCEEV303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

Air Pollution and Its Control (MTCEEV301A)

COURSE OBJECTIVE

- To have understanding on fundamentals of air pollution control.
- To develop the understanding of the Design and operation of various air pollution control devices.
- To study various sampling and classification problems.

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.

Recommended Books:

- Air Pollution Control Engineering by N.D. Nevers (1995) MC Graw Hill
- Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
- Air pollution: By K Wark and C Warner
- Air Pollution control: By De Nevers
- Environmental Pollution control engineering: By C S Rao
- Air pollution control: By Howard and Hesketh
- Air Pollution Volume I to VII: By Stern
- Air Pollution: By Seinfeld

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Gain ability to interpret meteorological data and develop capability to assessment of project proposal, air quality pollution index for any region.

CO2: Apply modeling techniques. Ability to justify the use of pollution control equipment and their design.

CO3: Suggest suitable air pollution prevention equipments and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards.

CO4: Ability to identify air pollution problems and interpret criteria air quality data.

CO5: Ability to interpret meteorological data and develop capability to assessment of project proposal, air quality pollution index for any region.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3 ,L4	M	L	M	L	-	-	M	L	M	-	M	H
CO2	L3	M	M	L	L	M	M	-	M	-	M	M	M
CO3	L4	L	H	L	M	H	-	L	L	H	-	H	H
CO4	L3	M	L	-	L	M	L	-	L	M	L	M	H
CO5	L4	L	M	L	L	M	L	L	L	L	L	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Environmental Aspects of Industries (MTCEEV301B)

COURSE OBJECTIVE

- To understand about the Environmental laws related to Various Industries and the Environmental management for captive power plants. Environmental problems in cement industries.
- To develop the understanding of the Environmental Aspects and Metallurgical Industries.
- To study various R&R, industrial disasters, industrial safety Environmental laws.

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

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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role of occupational health and safety in the workplace in the prevention of incidents, Injury and illness. Understand the modus operandi of onsite and offsite emergency control plans in industry.

CO2: Have a basic understanding of fire hazards in industry, its causes, types, detection and extinguishing Procedures.

CO3: Get the knowledge about the different types of effective personal protective gears used in industry for Specific operations, their maintenance and disposal methods.

CO4: Get the knowledge about Hazard assessment studies and ways to handle hazard situations in industry acting as Environment and Safety officers.

CO5: Develop an understanding about the role of plant layout, housekeeping and machine guards to assure health and safety in workplaces.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	M	H	M	L	L	M	L	M	L	M	H
CO2	L2 ,L4	M	M	M	L	M	-	L	M	M	M	H	H
CO3	L1 ,L4	H	-	L	M	M	M	L	-	M	-	M	M
CO4	L2 , L3	M	M	L	L	M	-	-	M	M	L	M	H
CO5	L2	L	M	M	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Environment & Health (MTCEEV301C)

COURSE OBJECTIVE

- To get the knowledge of students about the importance of work place safety and various measures to prevent occupational health hazards.
- To develop the understanding of the Industrial and agricultural pollutants.
- To study Disease control, disease prevention, Nuclear energy and environmental health.

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.

Recommended Books:

- Willgoose-Environmental Health
- Morgan-Environmental Health
- Cairncross and Feachem-Environmental Health engineering in tropics
- The world bank-Appropriate technology for water supply and sanitation

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Increase the awareness of environmental issues and how they affect society.

CO2: Develop skills and insight into critical thinking and situational awareness of surrounding environment.

CO3: Develop the quantitative skills needed to function as a professional in occupational and Environmental hygienist.

CO4: Understand basic biological concepts needed to evaluate exposure-response relationships.

CO5: Get knowledge about the human health and their relative laws, education and human welfare.

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2 ,L4	M	M	M	H	-	H	M	L	L	M	H	H
CO2	L3	M	H	L	L	M	M	L	-	M	L	H	M
CO3	L3	L	M	M	M	H	L	L	M	H	-	H	M
CO4	L2	-	H	M	L	M	-	M	M	M	-	M	M
CO5	L1	M	M	L	L	M	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Business Analytics (MTCEEV302A)

COURSE OBJECTIVE

- To understand the role of business analytics within an organization.
- To analyze data using statistical and data mining techniques and understand relationships
- To understand the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- To use decision-making tools/Operations research techniques.
- To manage business process using analytical and management tools. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

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.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role of business analytics within an organization.

CO2: Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

CO3: To become familiar with processes needed to develop, report, and analyze business data.

CO4: Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

CO5: Use decision-making tools/Operations research techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Safety (MTCEEV302B)

COURSE OBJECTIVE

- To know about Industrial safety
- To know about fundamental concepts of maintenance engineering.
- To know about preventive measures to be taken.

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

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role industrial safety.

CO2: Understand fundamentals of maintenance engineering.

CO3: Learn different methods of Wearing and Corrosion and their prevention.

CO4: Trace out the faults occurring in various electrical systems.

CO5: Know about Periodic and preventive maintenance of various systems.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Operations Research (MTCEEV302C)

COURSE OBJECTIVE

- To know about the optimization Techniques.
- To know about Competitive Models.
- To learn about Formulation of a LPP.

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

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008

- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to carry out sensitivity analysis.

CO2: Should able to model the real world problem and simulate it.

CO3: Should able to apply the dynamic programming to solve problems of discreet and continuous variables.

CO4: Should able to apply the concept of non-linear programming

CO5: Should be able to formulate optimization techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L6**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Cost Management of Engineering Projects (MTCEEV302D)

COURSE OBJECTIVE

- To know about Cost concepts in decision-making
- To know about Project making.
- To know about Cost Behavior and Profit Planning Marginal Costing

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.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to do cost management for various projects.

CO2: Should able to understand the meaning of cost management.

CO3: Should able to analyze Cost Behavior and Profit Planning.

CO4: Understand Quantitative techniques for cost management

CO5: Analyze the pricing and apply for various projects.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Composite Materials (MTCEEV302E)

COURSE OBJECTIVE

- To know about introduction to composite materials.
- To know about reinforcements.
- To know about manufacturing process of 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, hygrothermal failure. Laminate first play failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand Definition – Classification and characteristics of Composite materials.

CO2: Know about Reinforcements.

CO3: Know about manufacturing of Metal Matrix Composites.

CO4: Know about manufacturing of Polymer Matrix Composites:

CO5: Know about strength and laminates.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Waste to Energy (MTCEEV302F)

COURSE OBJECTIVE

- To know about Energy waste introduction.
- To know about Biomass process.
- To know about various types of biomass plants and gasifiers.

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.

References:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifiers.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

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.

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L3	M	H	H	L	M	-	-	-	-	-
CO2	L4	M	M	H	L	M	M	-	-	-	L
CO3	L6	H	L	M	M	H	L	-	-	-	M
CO4	L3	H	-	M	H	H	H	-	-	-	L
CO5	L3	H	-	M	H	M	H	-	-	-	L

H- High, M- Moderate, L- Low, '-' for No correlation

Semester-IV

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCEEV401	Dissertation-II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

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 OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	M	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MASTER OF TECHNOLOGY

(Transportation Engineering)

M.Tech. (CE), Semester-I, I yr. (2 yrs Degree Course)

Code	Title of Subject	L	T	P	IA	EA	Total	Credits
MTCETE101	Traffic Engineering-I	3	0	0	50	100	150	3
MTCETE102	Highway Materials	3	0	0	50	100	150	3
Elective -1 (Any One)								
MTCETE103A	Pavement analysis and Design	3	0	0	50	100	150	3
MTCETE103B	Statistical and Mathematical Techniques	3	0	0	50	100	150	3
MTCETE103C	Transportation Planning	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCETE104A	Ground Improvement Techniques	3	0	0	50	100	150	3
MTCETE104B	Intelligent Transportation system	3	0	0	50	100	150	3
MTCETE104C	Pavement Maintenance System	3	0	0	50	100	150	3
MLC & Audit								
MTCETE105	Research Methodology and IPR	2	0	0	50	100	150	2
MTCETE106	Audit Course – 1 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	50	100	150	0
Practical/Viva Voce								
MTCETE107	Ground Improvement Techniques Lab	0	0	4	60	40	100	2
MTCETE108	Pavement analysis and Design Lab	0	0	4	60	40	100	2
Total		16	0	8	370	580	950	18

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCETE201	Traffic Engineering II	3	0	0	50	100	150	3
MTCETE202	Urban Transportation Planning	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCETE203A	Highway Geometric Design	3	0	0	50	100	150	3
MTCETE203B	Highway Construction	3	0	0	50	100	150	3
MTCETE203C	GIS Application in Transportation Engineering	3	0	0	50	100	150	3
Eective -2 (Any One)								
MTCETE204A	Bridge Engineering	3	0	0	50	100	150	3
MTCETE204B	Transportation Facility Design	3	0	0	50	100	150	3
MTCETE204C	Quantitative techniques for transportation engineering	3	0	0	50	100	150	3
Audit								
MTCETE205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCETE206	Highway Material Testing Lab	0	0	4	60	40	100	2
MTCETE207	CAD in Transportation Engineering	0	0	4	60	40	100	2
MTCETE208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCETE301A	Pavement Management System	3	0	0	50	100	150	3
MTCETE301B	Mass transit system planning	3	0	0	50	100	150	3
MTCETE301C	Traffic Flow Theory	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCETE302A	Business Analytics	3	0	0	50	100	150	3
MTCETE302B	Industrial Safety	3	0	0	50	100	150	3
MTCETE302C	Operations Research	3	0	0	50	100	150	3
MTCETE302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCETE302E	Composite Materials	3	0	0	50	100	150	3
MTCETE302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCETE303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCETE401	Dissertation II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

I Semester

Traffic Engineering-I (MTCETE101)

COURSE OBJECTIVE

- To Study Traffic Engineering and its elements.
- To understand the Sampling in Traffic Studies.
- To Traffic Regulations and Control.

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 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.

References:

- Pignataro, L., Traffic Engineering – Theory & Practice, John Wiley, 1973.
- Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2007.
- The Institute of Transportation Engineers, Transportation and Traffic Engg. Hand Book, Prentice Hall (1982) Chapters 8, 17, 21, 23 and 24.
- O'Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK, 2002
- McShane W R & Roess R P, Traffic Engineering, Prentice-Hall, NJ, 2010

- IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas.
- Salter, R J., Highway Traffic Analysis and Design, ELBS, 1996.
- Matson, Smith and Hurd, Traffic Engineering, Mc-Graw Hill Book Co, 1955.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the scope of Traffic Engineering.

CO2: Study and Analysis of Traffic Engineering.

CO3: Understand the Traffic Signs, Markings and Signals.

CO4: Analyze and study the Traffic Engineering Facilities like Channelising Islands, Mini-roundabout, etc,.

CO5: Evaluation of Regulations on Speed and Traffic management.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	H	L	-	L	M	L	L	L	H	M
CO2	L2, L4	M	L	L	L	L	M	-	M	M	L	H	M
CO3	L2	L	L	L	M	L	M	L	M	H	L	H	M
CO4	L2, L4	M	H	-	L	M	M	L	-	M	L	H	M
CO5	L4	-	M	L	L	M	L	L	L	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Highway Materials (MTCETE102)

COURSE OBJECTIVE

- To study about aggregates, soil and bitumen.
- To understand the bitumen mixes.
- To get to know about the Cement Concrete Constituents and their requirements

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 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.

References:

- Krebs, Robert D. And Walker, R. D., "*Highway Materials*", McGraw Hill Book Co., New York 1971.
- Her Majesty's Stationery Office, "*Soil Mechanics for Road Engineers*", Ministry of Transport, Road Research Laboratory, UK 1966.
- Her Majesty's Stationery Office, "*Bituminous Materials in Road Construction*", Ministry of Transport, Road Research Laboratory, UK 1966 .
- Her Majesty's Stationery Office, "*Concrete Roads Design and Construction*", Ministry of Transport, Road Research Laboratory, UK 1966.
- Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003.
- Relevant IRC and IS codes.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand aggregates and its Classification.

CO2: The students will be able to understand the Classification, Structural and Constructional problems in soil.

CO3: Understanding Bitumen, its sources, manufacturing and its Classification.

CO4: Student will be able to get knowledge about bituminous mixes.

CO5: Student will know Cement Concrete, Constituents and their requirements.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	L	H	L	-	L	M	L	L	-	M	H
CO2	L2	M	M	L	L	M	-	M	H	M	M	H	M
CO3	L2	L	H	L	M	M	H	M	H	H	M	H	M
CO4	L1	M	H	-	L	M	M	L	-	M	L	H	M
CO5	L1	-	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Pavement Analysis and Design (MTCETE103A)

COURSE OBJECTIVE

- To learn the concept of pavement and their types.
- To design the pavement layers and study further the sub-grade.
- To analyse the detailing of the Pavement evaluation, rehabilitation and Road Construction.

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

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.

References:

- Yoder and Witezak, “Principles of Pavement Design”, John Wiley and sons.
- Yang, Design of functional pavements, McGraw-Hill.
- Kadiyali L.R., “Principles & Practice of Highway Engineering”, Khanna

Publishers,2003

- Khanna S.K., Justo C.E.G., "Highway Engineering", Nem Chand & Bros., Roorkee, 2001
- IRC: 37-2001, "Guidelines for the Design of Flexible Pavements (Second Revision)".
- IRC: 58-2001, "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Second Revision)".
- AASHTO – Design of pavement Structures

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: know the Types and Component parts of Pavements and Subgrade.

CO2: Analyze of Stresses in Flexible Pavements and its design.

CO3: Analyze of Stresses in Rigid pavements and its design.

CO4: Understand Pavement evaluation and rehabilitation.

CO5: know various road construction procedures and specifications.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	L	M	L	-	L	M	L	L	H	M	H
CO2	L4, L6	M	H	M	L	H	H	-	M	M	-	H	H
CO3	L4, L6	L	M	L	M	M	M	L	M	H	M	H	H
CO4	L2	M	H	-	L	L	-	M	L	M	M	M	M
CO5	L1	-	M	L	L	M	L	L	H	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Statistical and Mathematical Techniques (MTCETE103B)

COURSE OBJECTIVE

- To solve the Linear Programming problem and their solutions.
- To understand the Dual Simplex method, Formulation of a transportation problem.
- To solve problems related to Probability Distribution,Regression and Correlation.
- To come up with analysis of sampling, standard error, sampling distribution etc.

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.

References:

- "Fundamental of Mathematical Statistics", Gupta, S. C. and Kapoor,V.K.,S.Chand and Sons.
- "Advanced Engineering Mathematics" by H. K. Dass, S.Chand and Sons.

- "Higher Engineering Mathematics" by B.S.Grewal, Khanna Publisher.
- "Higher Engineering Mathematics" by B.V. Ramana, Tata McGraw Hill.
- "Advanced Engineering Mathematics" by R. K. Jain, S. R. K. Iyengar,Tata McGraw Hill.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyze the Formulation of the Linear Programming problem.

CO2: Understand the Formulation of a transportation problem.

CO3: Understand the Probability Distribution.

CO4: Apply the numerical techniques and tools for the Regression and Correlation.

CO5: know various types of sampling, hypothesis and parameters of the population.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	L	M	H	L	-	L	M	L	L	H	H	H
CO2	L2	M	M	M	L	M	-	H	M	M	M	M	M
CO3	L2	L	-	L	M	H	H	M	H	H	M	M	H
CO4	L3	M	H	-	L	M	M	-	-	M	M	H	M
CO5	L1	L	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Transportation Planning (MTCETE103C)

COURSE OBJECTIVE

- To introduce to the field of transportation planning, Transportation data and survey methods, Transportation Modes and Technologies.
- To explains the Four-stage Sequential Planning and Land use–Transportation Planning.

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 – 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.

References:

- B. G. Hutchinson, "Principles of Urban Transport Systems Planning" Scripta Book Co., Washington 1974.
- Anthony J. Richardson, Elizabeth S. Ampt and Arnim H. Meyburg, "Survey Methods for Transport Planning" Eucalyptus Press, Australia. 1995.
- Roy Thomas, "Traffic Assignment Techniques", Avebury Technical, Aldershot, England 1991.
- C A O'Flaherty, ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA 2006.
- C Jotin Khisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi 2003.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the Transportation planning, problems and problem solving process.

CO2: Know the Type of Transportation data and its sources and survey methods.

CO3: Know the Transportation Modes and Technologies.

CO4: Analyze of the Four-stage Sequential Planning.

CO5: Understand the Urban Forms of Transportation Planning and Modern era models.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	L	H	L	-	L	M	L	L	M	H	H
CO2	L1	H	M	L	L	M	-	H	-	M	M	M	M
CO3	L1	L	L	M	M	H	M	L	M	H	M	M	M
CO4	L4	M	L	-	L	M	M	M	L	M	L	M	M
CO5	L2	L	M	L	M	H	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Ground Improvement Techniques (MTCETE104A)

COURSE OBJECTIVE

- To do densification methods in granular soils and cohesive soils.
- To understand the mechanical, lime, cement and bitumen stabilization.
- To understand reinforced earth and geo-textiles.

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.

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.

References:

- Hausmann M.R(1990) Engineering Principles of ground modification, McGraw-Hill International edition.
- Ground improvement Techniques, P.Purushothama Raju, Laxmi Publications Pvt. Ltd., New Delhi.
- Robert M. Koerner, Designing with Geosynthatics, Prentice Hall New Jercy, USA.
- Construction and Geotechnical methods in Foundation Engineering, R.M.Koerner, McGraw-Hill Book Company.

- Current Practices in Geotechnical Engineering Vol.-I, Alam Singh and Joshi, International Book Traders, New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Providing knowledge about ground improvement and ground modification techniques.

CO2: Determining the In-situ densification methods in granular soils & Cohesive soils.

CO3: Analyzing the Mechanical Stabilization of Cement, Lime and Bitumen.

CO4: Determining the components and principles of reinforced earth.

CO5: Providing knowledge about geotextiles, geogrids and its functions.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	H	M	H	L	-	L	M	L	L	H	H	H
CO2	L5	M	M	L	L	M	H	-	-	M	M	M	H
CO3	L4	L	H	L	M	M	M	L	M	H	L	M	M
CO4	L5	M	H	-	L	M	-	M	M	M	H	M	H
CO5	L2	-	M	L	L	M	L	L	L	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Intelligent Transportation System (MTCETE104B)

COURSE OBJECTIVE

- To know travel management and ITS designs.
- To understand the Evolution of AHS and Current Vehicle Trends.
- To familiarize students with Spacing and Capacity for Different AHS Concepts.
- To understand ITS Travel Management.

Syllabus

UNIT 1: Introduction of Travel 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.

References:

- ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
- Roger R. Stough, “Intelligent Transport Systems – Cases and Policies”, Publisher: Edward Elgar, 2001.
- Chris Drane and Chris Rizos, “Positioning Systems in Intelligent Transportation Systems”, Artech House Publishers, London.
- Joseph M. Sussman, “Perspectives on Intelligent Transport Systems”, Springer Publishers.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand Travel Management.

CO2: Apply Modelling and Simulation Techniques.

CO3: Know Automated Highway Systems.

CO4: Understand Provision of Spacing and Capacity for Different AHS Concepts.

CO5: Asses ITS Travel Management, Vehicle Positioning System, Electronic Toll Collection and Electronic Car Parking.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	M	H	M	-	L	M	L	L	-	H	H
CO2	L3	M	-	L	L	M	M	M	-	M	M	M	H
CO3	L1	L	H	L	M	M	L	L	M	H	L	M	M
CO4	L2	M	H	-	L	M	-	M	L	M	M	M	M
CO5	L5	L	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Pavement Maintenance System (MTCETE104C)

COURSE OBJECTIVE

- To perform Pavement Evaluation and Performance.
- To understand the pavement deformation and behaviour in flexible and rigid pavement.
- To Analyze the Pavement Evaluation & Measuring Equipments.

Syllabus

UNIT 1:

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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyz the Pavement Evaluation and Performance.

CO2: Assess the pavement deformation and behaviour in flexible and rigid pavement.

CO3: Analyz the Pavement Evaluation & Measuring Equipments.

CO4: Understand Pavement Overlays and their designs.

CO5: Understand Analyze, Evaluation and Selection of Pavement Maintenance System.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	H	M	H	L	-	L	M	L	L	M	H	H
CO2	L5	M	H	L	L	M	M	M	-	M	H	H	H
CO3	L4	-	L	L	M	L	H	H	M	H	M	M	M
CO4	L2	H	H	-	L	L	-	-	H	M	-	M	M
CO5	L2	M	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCETE105: Research Methodology and IPR

COURSE OBJECTIVE

- To understand research problem formulation.
- To analyze research related information
- To follow research ethics
- To understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

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.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.

- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcomes	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	M	L	L	M	L	M	L	M	M
CO2	L3	M	M	M	L	M	-	L	M	M	M	M	M
CO3	L2	H	H	L	M	M	M	L	-	M	-	L	L
CO4	L3,L4	M	M	L	L	M	-	-	-	M	L	M	M

H- High, M- Moderate, L- Low, ‘-’ for No correlation

Ground Improvement Techniques Lab (MTCETE107)

COURSE OBJECTIVE

- To analyse shear strength parameters and shear.
- To understand the settlement of soil and different tests.
- To determine the Lime Content and Short-Term Compression Behavior of soil.

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-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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Study the shear strength parameters and shear.

CO2: Determine the settlement of soil and different tests performed on it.

CO3: Determine the Lime Content and Short-Term Compression Behavior of soil.

CO4: Determine the liquid limit, plastic limit and plasticity index of a given soil sample.

CO5: Know visual classification of soil.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	H	M	-	M	M	L	M	M	L	L	M	M
CO2	L5	M	L	M	L	H	L	-	L	H	-	H	M
CO3	L5	L	L	L	M	M	L	L	M	H	H	M	M
CO4	L5	M	M	M	L	H	-	-	L	M	M	M	M
CO5	L1	-	M	L	L	M	L	L	L	M	H	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Pavement Analysis and Design Lab (MTCETE108)

COURSE OBJECTIVE

- To understand the pavement deformation and behavior in flexible and rigid pavement.
- To perform the Pavement Evaluation & Measuring Equipments.
- To know the Analysis, Evaluation and Selection of Framework for pavement.

Syllabus

Problems as per the subject/course

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyze the Pavement Evaluation and Performance.

CO2: Assess the pavement deformation and behavior in flexible and rigid pavement.

CO3: Analyze the Pavement Evaluation & Measuring Equipments.

CO4: Understand Pavement Overlays and their designs.

CO5: Analyze, Evaluation and Selection of Framework for pavement.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	M	H	M	L	-	L	M	L	L	M	H	H
CO2	L5	M	H	H	L	M	M	M	-	M	-	H	H
CO3	L4	L	M	L	M	L	L	M	M	H	M	M	M
CO4	L2	M	H	M	L	M	-	L	L	M	L	M	M
CO5	L1,L2, L4,L6	-	M	L	L	L	L	L	M	L	M	H	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER II

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCETE201	Traffic Engineering II	3	0	0	50	100	150	3
MTCETE202	Urban Transportation Planning	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCETE203A	Highway Geometric Design	3	0	0	50	100	150	3
MTCETE203B	Highway Construction	3	0	0	50	100	150	3
MTCETE203C	GIS Application in Transportation Engineering	3	0	0	50	100	150	3
Eective -2 (Any One)								
MTCETE204A	Bridge Engineering	3	0	0	50	100	150	3
MTCETE204B	Transportation Facility Design	3	0	0	50	100	150	3
MTCETE204C	Quantitative techniques for transportation engineering	3	0	0	50	100	150	3
Audit								
MTCETE205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCETE206	Highway Material Testing Lab	0	0	4	60	40	100	2
MTCETE207	CAD in Transportation Engineering	0	0	4	60	40	100	2
MTCETE208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

Traffic Engineering-II (MTCETE201)

COURSE OBJECTIVE

- To analyse the Highway Capacity and Accident Analysis
- To understand the Flow Theory and Probabilistic Aspects of Traffic Flow
- To know about the Fundamental principle, application of simulation techniques in traffic engineering.

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, 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.

References:

- Babkov, V.F. “Road conditions and Traffic Safety”, MIR publications, - 1975.
- Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna

Publications.

- Drew, D.R., “Traffic Flow Theory and Control”, McGraw Hill Book Co.
- Wohl and Martin, “Traffic Systems Analysis for Engineers and Planners”, McGraw Hill Book Co.
- Pignataro, Louis, “Traffic Engineering - Theory and Practice”, John Wiley.
- Barenbag, `Traffic Flow Theory' – Monograph.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand Traffic Forecast.

CO2: Determine Highway Capacity and Accident Analysis.

CO3: Identify Traffic Flow Theory and Probabilistic Aspects of Traffic Flow.

CO4: Know about the Fundamental principle, application of simulation techniques in traffic engineering.

CO5: Identify and determine the Design Hourly Volume for Varying Demand Conditions.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom’s Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	M	-	-	L	M	L	L	M	H	M
CO2	L5	M	M	L	L	M	-	M	-	M	H	H	H
CO3	L2	L	H	L	M	L	M	L	M	H	M	M	M
CO4	L1	M	M	M	L	M	H	M	H	M	L	M	M
CO5	L4,L5	L	-	L	L	M	L	L	L	L	-	H	H

H- High, M- Moderate, L- Low, ‘-’ for No correlation

Urban Transportation Planning-I (MTCETE202)

COURSE OBJECTIVE

- To understand the Urban Transportation Problems and Planning.
- To get the Knowledge of Data Collections and inventories.
- To understand the UTPS Approach and Trip Generation.

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, 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.

Reference:

- Hutchinson B G (1974), “Principles of urban transportation system planning”, McGraw Hill.
- Bruton M J (1981), “Introduction to transportation planning”, Hutchinson of London.
- Dickey J W(1980), “Metropolitan Transportation Planning”, Tata McGraw Hill.

- Michael D Mayer and Eric J Miller(1974), “Urban transportation planning A Decision Oriented Approach”, McGraw Hill.
- C. S. Papacostas and P.D. Prevedouros (2002), “Transportation Engineering and Planning”, Prentice Hall.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the Urban Transportation Problems and Planning.

CO2: Know Data Collections and inventories.

CO3: Understand the UTPS Approach and Trip Generation.

CO4: Understand the Land use and its interaction.

CO5: Know various Transit Networks and System Analysis.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom’s Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1,L2	M	H	M	L	M	L	H	L	L	L	M	H
CO2	L1	M	M	L	L	M	-	M	M	M	M	M	M
CO3	L2	L	M	M	M	L	M	M	H	H	H	M	M
CO4	L2	M	H	H	H	L	H	H	-	M	M	H	H
CO5	L1	-	M	L	M	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, ‘-’ for No correlation

Highway Geometric Design (MTCETE203A)

COURSE OBJECTIVE

- To understand the Design Elements like traffic composition, traffic forecasting, design vehicle, etc,
- To understand the Design Elements like super elevation, widening, transition curves and Cross Section Elements like shoulders, kerbs, camber, etc,.
- To Design the Intersections and Parking lots.

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.

References:

- AASHTO, A Policy on Geometric Design of Highways and Streets', American Association of State Highway and Transportation Officials, Washington D.C.
- Khanna S.K. and Justo, C.E.G., Highway Engineering', Nem Chand and Bros.

- DSIR, Roads in Urban Areas', HMSO, London.
- Jack E Leish and Associates, Planning and Design Guide: At-Grade Intersections. Illinios.
- IRC: 86-1983, IRC: 52- 1973, IRC: 64-1990, IRC: 3-1984, IRC: 38-1988, IRC:66-1976, IRC: 65-1976, IRC: 92-1985, IRC: 103-1988, IRC SP: 41.
- Kadiyali, L.R., Principles & Practice of Highway Engineering, Khanna Publishers,2003
- Kadiyali, L.R. Traffic Engineering and Transport Planning, Khanna Publishers

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the Design Elements like traffic composition, traffic forecasting, design vehicle, etc,.

CO2: Know the Design Elements like super elevation, widening, transition curves, etc,.

CO3: Know the Cross Section Elements like shoulders, kerbs, camber, etc,.

CO4: Design of Intersections.

CO5: Design of Parking lots.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	L	H	L	-	L	L	M	M	L	M	H
CO2	L1	H	H	L	L	M	H	L	L	-	M	H	H
CO3	L1	M	M	L	M	M	M	H	H	H	H	M	M
CO4	L6	M	H	-	L	M	-	M	M	M	M	H	H
CO5	L6	L	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Highway Construction (MTCETE203B)

COURSE OBJECTIVE

- To understand the Equipment in Highway Construction and Sub grade.
- To understand the Flexible Pavements Layers and Cement Concrete Pavement Layers.
- To understand the Maintenance and Hill Roads.

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 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.

References:

- Peurifoy, R.L., “Construction, Planning, Equipment and Method” - McGraw Hill Book Co.
- DSIR - Soil Mechanics for Road Engineers', HMSO – London.
- DSIR - Bituminous Materials in Road Construction', HMSO London.
- DSIR - Concrete Roads, Design and Construction', HMSO London.
- Leonards, G.A., Foundation Engineering', McGraw Hill Book Co.
- Cedergren, H.R., “Drainage of Highway and Airfield Pavements”, John Wiley and Sons.
- Woods, K.B., Berry D.S. and Goetz, W.H., “Highway Engineering Hand Book”, McGraw Hill Book Co.
- Relevant IRC standards.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know the Equipments used in Highway Construction and Sub grades.

CO2: Explain Flexible Pavements Layers.

CO3: Understand the Cement Concrete Pavement Layers.

CO4: Know the Soil Stabilized Pavement Layers and drainage.

CO5: ExplainMaintenance and Hill Roads.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom’s Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	H	M	L	-	L	M	M	L	-	M	H
CO2	L2	M	H	L	L	M	L	M	L	M	-	H	H
CO3	L2	-	L	M	M	M	-	L	L	H	M	M	M
CO4	L1	M	L	-	L	H	M	M	-	M	H	M	M
CO5	L2	L	M	L	L	M	L	L	L	L	M	M	M

H- High, M- Moderate, L- Low, ‘-’ for No correlation

GIS Application in Transportation Engineering (MTCETE203C)

COURSE OBJECTIVE

- To obtain the Applications of GIS in Environment monitoring.
- To understand the Geographic Data Representation, Storage, Quality and Standards.
- To get the knowledge of Components of GIS and coordinate systems.

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 errors, Geographic data standards

References:

- Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2006.
- Anji Reddy, M., Remote Sensing and Geographical Information Systems, B.S.Publications, Hyderabad, 2001.
- Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
- Clarke, K., Getting Started with Geographic Information Systems, Prentice Hall, New Jersy, 2010.
- DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2002.

- Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know Components of GIS and coordinate systems .

CO2: Understand the Geographic Data Representation, Storage, Quality and Standards.

CO3: Understand the GIS Data Processing, Analysis and Modeling.

CO4: Know the Applications of GIS in Environment monitoring

CO5: Know the Structure of GIS.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	L	M	H	L	-	L	H	L	L	M	M	H
CO2	L2	M	-	L	M	M	-	M	M	M	H	M	H
CO3	L2	L	L	M	M	H	M	M	H	H	L	M	M
CO4	L1	M	H	-	L	M	H	H	-	M	-	H	M
CO5	L1	H	M	L	L	M	L	L	L	L	M	H	M

H- High, M- Moderate, L- Low, '-' for No correlation

Bridge Engineering (MTCETE204A)

COURSE OBJECTIVE

- To know the Standard specifications for brigdes and IRC loadings.
- To get the knowledge of the History of Bridge Development.
- To obtain the knowledge of the Bridge Construction.

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.

References:

- Ponnuswamy, S., “Bridge Engineering”, Tata McGraw - Hill, New Delhi, 1997.
- Victor, D.J., “Essentials of Bridge Engineering”, Oxford & IBH Publishers Co., New Delhi, 1980.
- Bindra S.P., “Bridge Engineering”, Dhanpat Rai & Sons.
- Relevant IRC codes.
- MORT&H Specifications & Standards for Roads & Bridges.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Get the knowledge of the History of Bridge Development.

CO2: Understand the Bridge Super structure.

CO3: Draw the key points in the Bridge Foundation.

CO4: Obtain the knowledge of the Bridge Construction.

CO5: Know the Standard specifications for brigdes and IRC loadings.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	M	-	L	M	L	L	M	M	M
CO2	L2	M	M	L	L	M	M	M	-	M	H	M	M
CO3	L3	L	H	L	M	H	H	H	M	H	M	M	H
CO4	L1	-	H	-	L	M	L	-	H	M	H	M	H
CO5	L1	L	M	L	L	M	L	L	M	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Transportation Facility Design (MTCETE204B)

COURSE OBJECTIVE

- To Design the Intersections & geometric standards.
- To identify the Energy Issues in Transportation and Transportation alternatives.
- To understand the Terminal Planning & Design Terminal Planning & Design.

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.

References:

- Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers.
- IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas
- Salter, R J., Highway Traffic Analysis and Design, ELBS.
- Edward K. Morlock, "Introduction to Transportation Engineering & Planning, International Student Edition", Mc-Graw Hill Book Company, New York.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know and understanding of the Design of highways.

CO2: Understand the Terminal Planning & Design of Terminal Planning & Design.

CO3: Evaluate and design of existing geometrics of Highway.

CO4: Design of Intersections & geometric standards.

CO5: Identify the Energy Issues in Transportation and Transportation alternatives.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1,L2	M	L	H	M	-	L	M	L	M	L	H	M
CO2	L2,L4	M	-	L	L	M	L	L	-	M	M	M	H
CO3	L4,L6	L	H	M	M	M	M	M	L	H	L	M	H
CO4	L6	M	H	-	L	M	H	-	M	M	M	M	H
CO5	L2	-	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Quantitative Techniques for Transportation Engineering (MTCETE204C)

COURSE OBJECTIVE

- To understand the Sampling And Survey Methods.
- To Getting knowledge of Probability Distributions and Application in Traffic Engineering.
- To come up with different Advanced Techniques like Network Flow Problems.

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

References:

- John W Dickey and Thomas M.Watts, "Analytic Techniques in Urban and Regional Planning", McGraw Hill,1978.
- Ravindran, Phillips and Solberg, "Operations Research, Principles and Practice", John Wiley and Sons, New York,2000.
- William G. Cochran, Sampling Techniques, John Wiley Series in Probability and Mathematical Statistics – Applied, New York,1999 .

- Richard I.Levin and David S.Rubin, "Statistics for Management", Prentice Hall Publication, New Delhi, 1997.
- Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2006 .
- George Argyrous, "Statistics for Research",2011, Sage Publications, London.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the Sampling And Survey Methods.

CO2: Get knowledge of Probability Distributions and Application in Traffic Engineering.

CO3: Know the Hypotheses testing and different Types of error.

CO4: Solve Simple and Multiple Linear Regression.

CO5: Asses different Advanced Techniques like Network Flow Problems.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	M	H	M	-	L	M	L	L	H	H	M
CO2	L1,L3	L	L	M	L	M	H	H	-	M	M	M	M
CO3	L1	L	-	M	M		-	M	H	H	H	M	M
CO4	L3	M	H	-	H	M	-	-	M	M	M	M	H
CO5	L5	H	M	L	M	L	H	L	H	L	L	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Highway Material Testing Lab (MTCETE206)

COURSE OBJECTIVE

- To test different highway materials like aggregates, bitumen, etc,.
- To understand the necessary tests required for the sampling of the materials used in road construction.

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 OUTCOMES

At the end of the course, students will be able to:

CO1: Study different aggregate tests.

CO2: Determine elongation index, flakiness index and fineness modulus of aggregates.

CO3: Students will be able to perform Marshall Stability test and Ductility test.

CO4: Study different bitumen tests.

CO5: Know Softening test and Standard tar viscometer test.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	H	M	H	M	M	L	M	M	L	L	H	H
CO2	L5	M	L	M	L	H	L	-	L	M	-	M	H
CO3	L3	L	L	H	M	L	M	L	M	H	M	M	H
CO4	L2	-	M	M	L	M	-	-	L	M	L	M	M
CO5	L1	L	H	L	M	L	M	L	L	M	L	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

CAD for Transportation Engineering (MTECTE207)

COURSE OBJECTIVE

- To design different elements of transportation projects.
- To understand the Formulation and evaluation of the designs made.

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

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Study Rotary design.

CO2: Study different Traffic signals.

CO3: Design parking structure.

CO4: Study Public transportation route.

CO5: Students will be able to plan the transport for a small area. viscometer test.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	M	H	-	M	L	M	-	L	M	M	H
CO2	L2	M	L	M	L	H	L	-	L	M	L	M	H
CO3	L6	-	M	H	-	L	M	L	M	H	M	H	H
CO4	L2	M	-	M	L	M	-	-	L	M	L	M	M
CO5	L6	L	H	L	M	-	M	L	-	M	-	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCETE208: Mini Project with Seminar

COURSE OBJECTIVE

- To identification of the problem
- To use modern research tools/methods.
- To design and conduct experiments and identify the solution of the problem/s.

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	H	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER III

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCETE301A	Pavement Management System	3	0	0	50	100	150	3
MTCETE301B	Mass transit system planning	3	0	0	50	100	150	3
MTCETE301C	Traffic Flow Theory	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCETE302A	Business Analytics	3	0	0	50	100	150	3
MTCETE302B	Industrial Safety	3	0	0	50	100	150	3
MTCETE302C	Operations Research	3	0	0	50	100	150	3
MTCETE302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCETE302E	Composite Materials	3	0	0	50	100	150	3
MTCETE302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCETE303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

Pavement Management System (MTCETE301A)

COURSE OBJECTIVE

- To get the Knowledge of Types of Distress: Structural and functional.
- To Analyse the Expert Systems and Pavement Management.
- To know the Design Alternatives and Selection.

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.

References:

1. Ralph Haas and Ronald W. Hudson, “Pavement Management System”, McGraw Hill Book Co. 1978.
2. Ralph Haas, Ronald Hudson and Zanieswki , “Modern Pavement Management”, Kreiger Publications. OECD, Pavement Management Systems, O E C D 1987.

3. Shahin M. Y., "Pavement Management for Airport, Roads and Parking Lots", Chapman and Hall, 1994.
4. Susan Brown, Pavement Management Systems, Transportation Research Board, 1993.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Use of Ranking and Optimisation Methodologies.

CO2: Know the Pavement Performance Prediction.

CO3: Know and understand the Design Alternatives and Selection.

CO4: Analyze Expert Systems and Pavement Management.

CO5: Know of Types of Distress: Structural and functional.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	M	H	L	-	L	M	L	L	-	M	H
CO2	L1	M	L	L	L	M	L	L	-	M	L	M	M
CO3	L1,L2	L	M	L	M	M	M	M	L	H	M	M	H
CO4	L4	M	L	-	L	M	-	-	M	M	L	M	M
CO5	L1	-	M	L	L	M	M	L	M	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mass Transit System Planning (MTCETE301B)

COURSE OBJECTIVE

- To analyze and study of the dynamics response of single degree freedom system using fundamental theory and equation of motion.
- To know the Impact of Transit and Recent Trends in Mass Transportation Planning and Management.
- To come up with Knowledge of Bus Transit Planning And Scheduling.

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 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.

References:

- Michael J.Bruton , "An Introduction to Transportation Planning", Hutchinson,1985.
- Michael D.Meyer and Eric J.Miller , "Urban Transportation Planning – A Decision Oriented Approach", McGraw Hill Book Company, New York,1984
- F.D.Hobbs, "Traffic Planning and Design", Poargamon Oress
- John W.Dickey, "Metropolitan Transportation Planning" – Tata McGraw Hill Publishing Company Limited, New Delhi, 1980.

- Paul H.Wright, "Transportation Engineering – Planning and Design", John Wiley and Sons, New York, 1989.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyze and study of the dynamics response of single degree freedom system using fundamental theory and equation of motion.

CO2: Analyze and study of Public Transport and Urban Development Strategies.

CO3: Know of Bus Transit Planning and Scheduling.

CO4: Analyze of Rail Transit Terminals And Performance Evaluation.

CO5: Know the Impact of Transit and Recent Trends in Mass Transportation Planning and Management.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2,L4	M	M	H	L	-	L	M	L	L	-	M	H
CO2	L2,L4	H	M	L	H	M	M	-	-	M	L	M	H
CO3	L1	L	L	M	M	M	-	L	L	H	M	M	M
CO4	L4	M	H	-	L	M	H	M	M	M	L	H	H
CO5	L1	L	M	L	L	M	M	L	H	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Traffic Flow Theory (MTCETE301C)

COURSE OBJECTIVE

- To know the Traffic stream characteristics and Description using distributions.
- To understand the Traffic Stream Models and Queuing Analysis.
- To get knowledge about the Highway Capacity and Level of Service Studies.

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.

References:

- TRB-SR No.165-Traffic Flow Theory, Transportation Research Board, Washington-D.C.
- May, A.D, Traffic Flow Fundamentals, Prentice-Hall, NJ.
- Drew D.R, Traffic Flow Theory and Control, McGraw-Hill, New York.
- TRB Special Report 209: Highway Capacity Manual, Transportation Research Board, Washington DC, 1985.
- Wohl M. and Martin, B.V., “Traffic System Analysis for Engineers and Planners”, McGraw-Hill, New York.
- McShane W R & Roess R P, “Traffic Engineering”, Prentice-Hall, NJ.

- Mannering F.L & Kilareski, W.P., "Principles of Highway Engineering andTraffic Analysis", John Wiley & Sons.
- Neylor, T. H et al., "Computer Simulation Techniques", John Wiley

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know and understand the Traffic stream characteristics and Description using distributions.

CO2: Analyze the design concepts of Traffic Stream Models.

CO3: Understand the Queuing Analysis.

CO4: Get knowledge about the Highway Capacity and Level of Service Studies.

CO5: Understand the Simulation Models and Generation of Inputs.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1,L2	M	H	M	L	L	L	M	L	L	L	M	H
CO2	L4	H	L	L	M	L	-	L	H	M	M	M	M
CO3	L2	L	M	H	M	M	H	M	-	H	L	M	M
CO4	L1	M	L	-	L	L	-	L	M	M	H	M	M
CO5	L2	-	M	L	H	M	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Business Analytics (MTCETE302A)

COURSE OBJECTIVE

- To understand the role of business analytics within an organization.
- To analyze data using statistical and data mining techniques and understand relationships
- To understand the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- To use decision-making tools/Operations research techniques.
- To manage business process using analytical and management tools. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

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.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role of business analytics within an organization.

CO2: Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

CO3: To become familiar with processes needed to develop, report, and analyze business data.

CO4: Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

CO5: Use decision-making tools/Operations research techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Safety (MTCETE302B)

COURSE OBJECTIVE

- To know about Industrial safety
- To know about fundamental concepts of maintenance engineering.
- To know about preventive measures to be taken.

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

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role industrial safety.

CO2: Understand fundamentals of maintenance engineering.

CO3: Learn different methods of Wearing and Corrosion and their prevention.

CO4: Trace out the faults occurring in various electrical systems.

CO5: Know about Periodic and preventive maintenance of various systems.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Operations Research (MTCETE302C)

COURSE OBJECTIVE

- To know about the optimization Techniques.
- To know about Competitive Models.
- To learn about Formulation of a LPP.

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

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008

- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to carry out sensitivity analysis.

CO2: Should able to model the real world problem and simulate it.

CO3: Should able to apply the dynamic programming to solve problems of discreet and continuous variables.

CO4: Should able to apply the concept of non-linear programming

CO5: Should be able to formulate optimization techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L6**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Cost Management of Engineering Projects (MTCETE302D)

COURSE OBJECTIVE

- To know about Cost concepts in decision-making
- To know about Project making.
- To know about Cost Behavior and Profit Planning Marginal Costing

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.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to do cost management for various projects.

CO2: Should able to understand the meaning of cost management.

CO3: Should able to analyze Cost Behavior and Profit Planning.

CO4: Understand Quantitative techniques for cost management

CO5: Analyze the pricing and apply for various projects.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Composite Materials (MTCETE302E)

COURSE OBJECTIVE

- To know about introduction to composite materials.
- To know about reinforcements.
- To know about manufacturing process of 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, hygrothermal failure. Laminate first play failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand Definition – Classification and characteristics of Composite materials.

CO2: Know about Reinforcements.

CO3: Know about manufacturing of Metal Matrix Composites.

CO4: Know about manufacturing of Polymer Matrix Composites:

CO5: Know about strength and laminates.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Waste to Energy (MTCETE302F)

COURSE OBJECTIVE

- To know about Energy waste introduction.
- To know about Biomass process.
- To know about various types of biomass plants and gasifiers.

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.

References:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifiers.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

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.

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	M
CO2	L4	M	M	H	L	M	M	-	-	-	L	M	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER IV

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCETE401	Dissertation II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

SEMESTER IV

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 OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	H	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	H	M

MASTER OF TECHNOLOGY

(Structural Engineering)

M.Tech. (CE), Semester-I, I yr. (2 yrs Degree Course)

Code	Title of Subject	L	T	P	IA	EA	Total	Credits
MTCESE101	Advanced Structural Analysis	3	0	0	50	100	150	3
MTCESE102	Advanced Solid Mechanics	3	0	0	50	100	150	3
Elective -1 (Any One)								
MTCESE103A	Theory of Thin Plates and Shells	3	0	0	50	100	150	3
MTCESE103B	Theory and Applications of Cement Composites	3	0	0	50	100	150	3
MTCESE103C	Theory of Structural Stability	3	0	0	50	100	150	3
Elective -2 (Any One)								
MTCESE104A	Analytical and Numerical Methods for Structural Engineering	3	0	0	50	100	150	3
MTCESE104B	Structural Health Monitoring	3	0	0	50	100	150	3
MTCESE104C	Seismic Design of Structures	3	0	0	50	100	150	3
MLC & Audit								
MTCESE105	Research Methodology and IPR	2	0	0	50	100	150	2
MTCESE106	Audit Course – 1 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	50	100	150	0
Practical/Viva Voce								
MTCESE107	Structural Design Lab	0	0	4	60	40	100	2
MTCESE108	Advanced Concrete Lab	0	0	4	60	40	100	2
Total		16	0	8	370	580		18

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCESE201	FEM in Structural Engineering	3	0	0	50	100	150	3
MTCESE202	Structural Dynamics	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCESE203A	Advanced Steel Design	3	0	0	50	100	150	3
MTCESE203B	Design of Formwork	3	0	0	50	100	150	3
MTCESE203C	Design of High Rise Structures	3	0	0	50	100	150	3
MTCESE203D	Design of Masonry Structures							
Eective -2 (Any One)								
MTCESE204A	Design of Advanced Concrete Structures	3	0	0	50	100	150	3
MTCESE204B	Advanced Design of Foundations	3	0	0	50	100	150	3
MTCESE204C	Soil Structure Interaction	3	0	0	50	100	150	3
MTCESE204D	Design of Industrial Structure	3	0	0	50	100	150	3
Audit								
MTCESE205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCESE206	Model Testing Lab	0	0	4	60	40	100	2
MTCESE207	Numerical Analysis Lab	0	0	4	60	40	100	2
MTCESE208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCESE301A	Design of Prestressed Concrete Structures	3	0	0	50	100	150	3
MTCESE301B	Analysis of Laminated Composite Plates	3	0	0	50	100	150	3
MTCESE301C	Fracture Mechanics of Concrete Structures	3	0	0	50	100	150	3
MTCESE301 D	Design of Plates and Shells							
Elective -2 (Any One)								
MTCESE302A	Business Analytics	3	0	0	50	100	150	3
MTCESE302B	Industrial Safety	3	0	0	50	100	150	3
MTCESE302C	Operations Research	3	0	0	50	100	150	3
MTCESE302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCESE302E	Composite Materials	3	0	0	50	100	150	3
MTCESE302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCESE303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCESE401	Dissertation II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

MTCESE101: Advanced Structural Analysis

COURSE OBJECTIVE

- To understand the Local Coordinates and Global Coordinates with physical significance of the members.
- To solve problems by direct stiffness method, Structure Approach and Member Approach knowing their limitations.
- To evaluate solutions for different type of problems.

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.

References:

- Matrix Analysis of Framed Structures, Weaver and Gere.
- The Finite Element Method, Lewis P. E. and Ward J. P., Addison-Wesley Publication Co.
- Computer Methods in Structural Analysis, Meek J. L., E and FN, Span Publication
- The Finite Element Method, Desai and Able, CBS Publication.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: know and understand the Local Coordinates and Global Coordinates. Also the physical significance of members.

CO2: Use direct stiffness method understanding its limitations.

CO3: Solve problems by Structure Approach and Member Approach.

CO4: Solve problems in Approximate Solution and Boundary Value Problems.

CO5: Evaluate solutions for Linear Elements and Generalized One Dimensional Equilibrium Problems.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1,L2	M	M	L	L	-	L	M	L	L	L	M	M
CO2	L3	H	M	M	L	L	L	-	H	M	-	M	H
CO3	L3	L	-	L	M	M	-	L	-	H	L	M	M
CO4	L3	H	M	L	L	L	-	-	L	M	H	M	M
CO5	L4	H	M	M	L	M	L	L	M	L	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE102: Advanced Solid Mechanics

COURSE OBJECTIVE

- To solve simple problems of elasticity and plasticity understanding the basic concepts.
- To understand the Elementary Concepts of Strain, Principal Strains and Principal Axes, Compatibility Conditions and Differential Equations of other components.
- To know about Torsion of Prismatic Bars, Plastic Deformation and other criterias related to it.

Syllabus

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.

References:

- Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961
- Elasticity,SaddM.H.,Elsevier,2005.
- Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.
- Computational Elasticity, AmeenM., Narosa,2005.
- Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
- Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Solve simple problems of elasticity and plasticity understanding the basic concepts.

CO2: Understand the Elementary Concepts of Strain, Principal Strains and Principal Axes, Compatibility Conditions and Differential Equations of other components.

CO3: Apply numerical methods to solve continuum problems.

CO4: Obtain the Two-Dimensional Problems in Polar Coordinates and also the problems related to Plane Stress and Plane Strain.

CO5: Know and analyze the Torsion of Prismatic Bars, Plastic Deformation and other criterias related to it.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	M	L	-	L	M	L	L	-	M	H
CO2	L2	M	-	L	L	M	-	L	L	-	M	M	M
CO3	L3	L	M	L	M	M	M	L	L	H	M	M	H
CO4	L3	M	L	-	L	M	M	-	-	M	M	M	M
CO5	L1,L4	L	M	L	L	M	L	L	L	L	-	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE103A: Theory of Thin Plates and Shells

COURSE OBJECTIVE

- To understand Circular Plates and Rectangular Plates and also can solve equations in Polar Co-ordinates.
- To realize the Space Curves, Surfaces, Shell Co-ordinates. Also they will get the ideas about the Shell theory and Virtual Work.
- To know various Shells of Revolution with Bending Resistance and Thermal Stresses. Also a brief knowledge of Pipes and Pressure Vessels.

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.**

References:

- Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
- Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
- Thin Elastic Shells, KrausH., John Wiley and Sons.
- Theory of Plates, ChandrashekharaK., Universities Press.
- Design and Construction of Concrete Shells, RamaswamyG.S.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyze the Space Curves, Surfaces, Shell Co-ordinates. Also they will get the ideas about the Shell theory and Virtual Work.

CO2: Use analytical methods for the solution of thin plates and shells.

CO3: Understand Circular Plates and Rectangular Plates and also can solve equations in Polar Co-ordinates.

CO4: Apply the numerical techniques and tools for the complex problems in thin plates and shells.

CO5: Know various Shells of Revolution with Bending Resistance and Thermal Stresses. Also a brief knowledge of Pipes and Pressure Vessels.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1, L4	M	M	H	L	-	L	M	L	L	-	H	H
CO2	L3	M	L	L	L	M	L	-	-	M	L	M	H
CO3	L2,L3	L	M	L	M	L	M	L	L	H	M	M	H
CO4	L3	M	H	-	L	M	-	M	M	M	H	M	H
CO5	L1	-	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE103B: Theory and Applications of Cement Composites

COURSE OBJECTIVE

- To Know the effect and behavior of Mechanical Properties of Cement Composites.
- To know the Construction Techniques for Fibre Reinforced Concrete and other Cement Composites.
- To analyse and design structural elements made 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.

References:

- Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1st Ed. Blackie, Academic and Professional, Chapman & Hall, 1983.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the Composite Materials and their characteristics. Formulate constitutive behaviour of composite materials – Ferro cement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.

CO2: Estimate strain constants using theories applicable to composite materials.

CO3: Know the Construction Techniques for Fibre Reinforced Concrete and other Cement Composites.

CO4: Know the effect and behavior of Mechanical Properties of Cement Composites.

CO5: Analyse and design structural elements made of cement composites. Classify the materials as per orthotropic and anisotropic behaviour.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L3	M	H	H	L	-	L	M	L	L	-	M	H
CO2	L2	M	H	L	L	M	-	-	L	-	L	M	H
CO3	L1	L	-	L	M	M	M	L	L	H	-	M	M
CO4	L1	M	H	L	L	M	-	-	H	M	-	M	M
CO5	L1,L4,L6	L	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE103C: Theory of Structural Stability

COURSE OBJECTIVE

- To study the design criterias and stability of the structures.
- To use the stability criteria and concepts for analysing discrete and continuous systems

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.

References:

- Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
- Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
- Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
- Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Use stability criteria and concepts for analysing discrete and continuous systems

CO2: Determine stability of columns and frames.

CO3: Identify and solve problems by related to columns and frames.

CO4: Determine stability of beams and plates.

CO5: Identify and solve problems related to beams and plates.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	M	H	L	-	L	M	L	L	L	M	H
CO2	L3	M	L	L	L	M	-	L	M	H	-	M	M
CO3	L2,L3	L	M	L	M	L	L	-	H	M	L	H	M
CO4	L3	M	H	-	L	M	-	H	-	M	-	M	H
CO5	L2,L3	-	M	L	L	M	L	L	L	-	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE104A: Analytical and Numerical Methods for Structural Engineering

COURSE OBJECTIVE

- To apply statistical techniques to analyze Solution of Nonlinear Algebraic and Transcendental Equations.
- To solve Differentiation & Integration and other matrix problems and apply these to 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.

References:

- An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
- Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
- Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Identify and solve engineering problems by applying the Fundamentals of Numerical Methods like Approximations, Interpolation and extrapolation.

CO2: Apply statistical techniques to analyze Solution of Nonlinear Algebraic and Transcendental Equations.

CO3: Identify and solve Elements of Matrix Algebra and Linear Equations.

CO4: Solve Differentiation & Integration.

CO5: Analyze and solve the Computer Algorithms and logical networks with ease.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L3	H	M	H	L	-	L	M	L	L	M	M	H
CO2	L3	M	H	L	L	L	L	-	-	M	L	M	M
CO3	L2, L3	L	M	L	M	M	M	L	L	H	M	M	M
CO4	L3	-	H	-	L	M	-	-	-	M	-	M	H
CO5	L3,L4	M	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE104B: Structural Health Monitoring

COURSE OBJECTIVE

- To learn the new concepts related to structural health monitoring.
- To assess the health of structure using static and dynamic field methods.
- To assess different techniques for repair and rehabilitation of structures.

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.

References:

- Structural Health Monitoring, Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
- Health Monitoring of Structural Materials and Components_Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
- Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan,Taylor and Francis Group, London, UK, 2006.
- Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.
-

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Diagnosis of the distress in the structure understanding the causes and factors.

CO2: Assess the health of structure using static field methods.

CO3: Assess the health of structure using dynamic field tests.

CO4: Suggest repairs and rehabilitation measures of the structure.

CO5: Assessing and understanding different techniques for repair and rehabilitation of structures.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L4	M	L	M	L	-	L	M	L	L	-	M	H
CO2	L5	M	-	L	L	M	-	L	M	-	L	M	H
CO3	L5	-	L	L	M	H	L	M	L	H	M	H	H
CO4	L3	M	M	-	L	M	M	L	-	M	L	M	M
CO5	L2,L5	L	L	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE104C: Seismic Design of Structures

COURSE OBJECTIVE

- To understand the study of different elements of Engineering seismology.
- To apply the Seismic design philosophy using the provisional codes.
- To solve problems in bridges and dams using Codal provisions.

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 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.

References:

- Course Notes Design of Reinforced Concrete Buildings IIT Kanpur, June 1999.
- Minoru Wakabayashi Design of Earthquake Resistant Buildings, Mc Graw

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the study of different elements of Engineering seismology.

CO2: Learn basic Seismic behavior of the structural elements.

CO3: Apply the Seismic design philosophy using the provisional codes.

CO4: Students will be able to solve problems in bridges and dams using Codal provisions.

CO5: Evaluate the modern concepts and base isolation techniques.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	M	L	-	L	M	L	L	-	M	H
CO2	L1	L	-	L	L	M	M	-	L	M	M	M	M
CO3	L3	L	M	L	M	M	L	L	L	H	-	H	M
CO4	L3	M	H	-	L	M	-	-	-	M	L	M	H
CO5	L4	L	M	L	L	M	L	L	L	L	-	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCOMRS105: Research Methodology and IPR

COURSE OBJECTIVE

- To understand research problem formulation.
- To analyze research related information
- To follow research ethics
- To understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

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.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.

- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcomes	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	M	L	L	M	L	M	L	M	M
CO2	L3	M	M	M	L	M	-	L	M	M	M	M	M
CO3	L2	H	H	L	M	M	M	L	-	M	-	L	L
CO4	L3,L4	M	M	L	L	M	-	-	-	M	L	M	M

H- High, M- Moderate, L- Low, ‘-’ for No correlation

MTCESE107: Structural Design Lab

COURSE OBJECTIVE

- To understand the structural design in detail.
- To design and detail structural components of Frame Buildings or Multi-Storey Frame Buildings.

Syllabus

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

References:

- Refer the detailings and plans from different sources like projects, sites, etc,.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Design and detail all the structural components of Frame Buildings.

CO2: Design and detail complete Multi-Storey Frame Buildings.

CO3: Analysis of different building frames.

CO4: Study of reinforcement laid in structures.

CO5: Study of beams, columns and slabs in detail.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L6	M	L	M	L	-	L	M	L	M	L	M	H
CO2	L2, L6	M	M	L	L	M	L	-	-	M	-	M	H
CO3	L4	L	-	L	M	H	-	L	L	H	L	H	H
CO4	L2	M	L	-	L	M	-	-	L	M	-	M	M
CO5	L2	L	M	L	L	M	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE108: Advanced Concrete Lab

COURSE OBJECTIVE

- To learn the concept of strength in tension or compression and cyclic loading on steel.
- To conduct Non-Destructive Tests on existing concrete structures.
- To apply the engineering principles to understand behaviour of structural elements.

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.

References:

- Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
- Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Design high grade concrete and study the parameters affecting its performance.

CO2: Conduct Non Destructive Tests on existing concrete structures.

CO3: Apply engineering principles to understand behaviour of structural elements.

CO4: Study effect of cyclic loading.

CO5: Knowledge of split tensile strength.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L6	H	M	M	L	M	L	M	H	L	L	H	H
CO2	L3	M	-	L	L	M	L	-	L	H	-	M	M
CO3	L2,L3	L	L	L	M	M	L	L	M	H	L	H	H
CO4	L2	M	M	M	L	M	-	-	L	M	L	M	M
CO5	L1	L	-	L	L	M	L	L	L	M	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

II-Semester

M.Tech. (CE), Semester-II, I yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCESE201	FEM in Structural Engineering	3	0	0	50	100	150	3
MTCESE202	Structural Dynamics	3	0	0	50	100	150	3
Eective -1 (Any One)								
MTCESE203A	Advanced Steel Design	3	0	0	50	100	150	3
MTCESE203B	Design of Formwork	3	0	0	50	100	150	3
MTCESE203C	Design of High Rise Structures	3	0	0	50	100	150	3
MTCESE203D	Design of Masonry Structures							
Eective -2 (Any One)								
MTCESE204A	Design of Advanced Concrete Structures	3	0	0	50	100	150	3
MTCESE204B	Advanced Design of Foundations	3	0	0	50	100	150	3
MTCESE204C	Soil Structure Interaction	3	0	0	50	100	150	3
MTCESE204D	Design of Industrial Structure	3	0	0	50	100	150	3
Audit								
MTCESE205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTCESE206	Model Testing Lab	0	0	4	60	40	100	2
MTCESE207	Numerical Analysis Lab	0	0	4	60	40	100	2
MTCESE208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

SEM II

MTCESE201: Finite Element Method in Structural Engineering

COURSE OBJECTIVE

- To use Finite Element Method for structural analysis and understand the concepts related to it.
- To solve continuum problems using finite element analysis..
- To understand the analysis of Strain and Stress Computations.

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-Processing, Use of Commercial FEA Software.

References:

- Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
- Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
- Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
- Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
- Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
- Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Use and analysis of Finite Element Method for structural analysis.

CO2: Execute the Finite Element Program/ Software.

CO3: Solve continuum problems using finite element analysis.

CO4: Analyze of Strain and Stress Computations.

CO5: Implementation of FEM procedure.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3, L4	M	M	M	H	-	H	M	L	L	M	M	H
CO2	L3	M	H	L	L	M	M	L	-	M	L	M	H
CO3	L2	L	-	M	M	H	L	L	M	H	-	M	M
CO4	L4	M	H	M	L	M	-	M	M	M	-	M	H
CO5	L3,L6	M	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE202: Structural Dynamics

COURSE OBJECTIVE

- To analyze and study dynamics response of single degree freedom system using fundamental theory and equation of motion.
- To analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion.
- To study the Dynamics of Wind Loading and Moving Loads.

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.

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.

References:

- Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
- Structural Dynamics andIntroduction to Earthquake Engineering, Chopra A. K.
- Vibration ofStructures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
- Dynamics of Structures, Humar J. L., Prentice Hall

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyze and study dynamics response of single degree freedom system using fundamental theory and equation of motion.

CO2: Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion.

CO3: Use the available software for dynamic analysis.

CO4: Analyze of Multiple Degree of Freedom, Strain and Stress Computations.

CO5: Analyze the dynamics of Wind Loading and Moving Loads.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L4	H	H	H	L	-	L	M	L	L	-	H	H
CO2	L2, L4	M	-	L	L	M	L	-	M	M	L	M	H
CO3	L3	L	H	L	M	M	M	L	L	H	L	H	H
CO4	L4	M	H	-	M	M	-	L	-	M	-	M	H
CO5	L4	L	M	L	L	M	L	L	L	L	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE203A: Advanced Steel Design

COURSE OBJECTIVE

- To understand P-Effect and drift criterias.
- To design steel structures/ components by different design processes.
- To analyze and design beams and columns for stability and strength, and drift.

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.

References:

- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
- The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
- Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
- IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
- SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Design steel structures/ components by different design processes.

CO2: Analyze and design beams and columns for stability and strength, and drift.

CO3: Design welded and bolted connections.

CO4: Understand and evaluating the different methods of design.

CO5: Understand P Effect and drift criterias.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L6	H	M	M	L	-	L	M	L	L	M	H	H
CO2	L4,L6	H	H	M	L	M	L	-	L	M	M	H	H
CO3	L6	L	-	L	M	M	-	L	M	H	-	M	H
CO4	L2,L4	M	H	-	L	M	L	-	-	M	-	H	M
CO5	L2	L	M	L	L	M	L	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE203B: Design of Formwork

COURSE OBJECTIVE

- To know the concept and design criterias of formwork.
- To design the form work for Beams, Slabs, columns, Walls and Foundations.
- To understand the working of flying formwork and its failure.

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.

References:

- Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
- Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
- IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Select the proper formwork, accessories and material.

CO2: Design the form work for Beams, Slabs, columns, Walls and Foundations.

CO3: Design the form work for Special Structures.

CO4: Understand the working of flying formwork.

CO5: Judge the formwork failures through case studies.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1,L2, L6	M	H	H	M	L	L	M	L	L	H	H	H
CO2	L6	M	H	L	L	M	M	-	M	M	-	H	M
CO3	L6	H	H	L	M	L	-	L	H	-	L	H	M
CO4	L2	M	H	-	L	M	-	-	-	M	L	M	M
CO5	L1,L5	-	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE203C Design of High Rise Structures

COURSE OBJECTIVE

- To know the design criterias of High rise structures.
- To analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.
- To analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

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.

References:

- Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers,New Delhi, 2002.
- Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
- Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. & Karve S. R.,Structures Publications, Pune, 2013.
- Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
- Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
- High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
- Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

CO2: Analyse, design and detail the RC and Steel Chimney.

CO3: Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

CO4: Design provisions for fire-fighting.

CO5: Application of software in analysis and design.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L4,L6	H	M	H	L	L	L	M	L	L	L	M	H
CO2	L2, L4,L6	M	M	M	L	M	-	L	M	M	-	M	H
CO3	L2, L4,L6	L	M	L	M	M	L	L	-	H	L	M	H
CO4	L6	M	-	-	L	M	-	-	L	M	M	M	H
CO5	L3	L	M	L	L	M	L	L	L	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE203D: Design of Masonry Structures

COURSE OBJECTIVE

- To know the design criterias of Masonry structures.
- To design and analyse Reinforced Masonry Members. Determine interactions between members.
- To Perform elastic and Inelastic analysis of masonry walls and check the stability.

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.

References:

- Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
- Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
- Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
- Earthquake-resistant Design of Masonry Buildings, Toma evi Miha, Imperial College Press, 1999.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the masonry design approaches.

CO2: Analyse Reinforced Masonry Members. Determine interactions between members.

CO3: Determine shear strength and ductility of Reinforced Masonry members.

CO4: Check the stability of walls.

CO5: Perform elastic and Inelastic analysis of masonry walls.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L3	M	M	M	L	L	L	M	M	L	L	M	H
CO2	L4,L5	M	-	L	L	M	L	L	L	M	-	H	H
CO3	L5	L	H	L	M	M	-	L	L	H	L	H	H
CO4	L5	M	H	-	L	M	M	-	L	M	-	H	H
CO5	L3	L	M	L	L	M	L	L	L	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE204A: Design of Advanced Concrete Structures

COURSE OBJECTIVE

- To know the design criterias of Advanced concrete structures.
- To design and prepare detail structural drawings for execution citing relevant IS codes.
- To understand the types of tensional bending and shear wall.

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.

References:.

- Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999.
- Design of Steel Structures, SubramaniamN., Oxford University Press, 2008.
- Reinforced Concrete Structures, Park R.and PaulayT. , John Wiley & Sons, 1995.
- Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.
- Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
- Steel Structures Design and Behavior Emphasizing Load and Resistance Factor Design, Salmon C. G., Johnson J. E. and Malhas F. A., Pearson Education, 5th Ed, 2009.
- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Plastic Methods of Structural Analysis, Neal B.G., Chapman and Hall London

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyse the special structures by understanding their behaviour.

CO2: Design and prepare detail structural drawings for execution citing relevant IS codes.

CO3: Design of shear wall.

CO4: Understand types of tensional bending.

CO5: Analyze and designing through different IS codes.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	L	H	M	L	L	L	M	L	L	M	M	M
CO2	L6	M	-	L	L	M	L	L	-	M	-	H	H
CO3	L6	L	M	L	M	M	-	-	-	H	L	H	H
CO4	L2	M	H	-	L	M	L	-	L	M	L	M	M
CO5	L4,L6	-	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE204B: Advanced Design of Foundations

COURSE OBJECTIVE

- To know the design criterias of Advanced design of foundations.
- To design and understand the analysis methods for well and shallow foundations.
- Students will be able to analyze the tunnels and dams.

Syllabus

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

References:

- Design of foundation system, N.P. Kurian, Narosa Publishing House
- Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
- Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Decide the suitability of soil strata for different projects.

CO2: Design shallow foundations deciding the bearing capacity of soil.

CO3: Analyze and design the pile foundation.

CO4: Understand the analysis methods for well foundation.

CO5: Analyze and design the coffer dams.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L5	M	H	M	L	L	L	M	L	L	M	M	H
CO2	L6	M	-	L	L	M	-	L	M	M	L	M	H
CO3	L4,L6	L	M	L	M	L	L	L	-	M	M	H	H
CO4	L2,L4	M	H	M	L	M	L	-	M	M	-	M	M
CO5	L4,L6	H	M	L	L	M	L	L	L	L	-	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE204C: Soil Structure Interaction

COURSE OBJECTIVE

- To understand the soil structures and their interactions.
- To evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
- To prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

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.

References:

- Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., NewYork, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.

- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand soil structure interaction concept and complexities involved.

CO2: Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.

CO3: Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

CO4: Analyze different types of frame structure founded on stratified natural deposits with linear and non-.linear stress-strain characteristics.

CO5: Evaluate action of group of piles considering stress-strain characteristics of real soils.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	M	H	-	M	M	L	L	M	M	M
CO2	L4	M	M	L	L	M	L	L	M	M	M	M	H
CO3	L6	L	M	M	M	L	M	-	L	H	-	H	H
CO4	L4	M	-	L	L	M	-	M	H	M	M	M	M
CO5	L6	M	M	L	L	M	L	L	L	L	L	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE204D: Design of Industrial Structures

COURSE OBJECTIVE:

- To understand about the materials used and design of industrial structural elements.
- To know the basic concepts and design of power plant structures
- To understand the design concepts of Chimneys, bunkers and silos

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

REFERENCES:

1. Transmission Line Structures by S. S. Murthy and A. R. Santakumar McGraw Hill
2. SP 32: 1986, Handbook on functional requirements of Industrial buildings

3. Design of steel structures by N. Subramanian

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Plan the functional requirements of structural systems for various industries.

CO2: Get an idea about the materials used and design of industrial structural elements.

CO3: Realize the basic concepts and design of power plant structures

CO4: Design Power transmission structures.

CO5: Possess the ability to understand the design concepts of Chimneys, bunkers and silos.

MappingofCourseOutcomeswithProgramOutcomes

Course Outcomes	Bloom'sLevel	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	H	H	M	H	-	M	M	L	L	M	M	H
CO2	L2	M	M	L	L	M	L	L	M	M	M	M	H
CO3	L3	L	M	M	M	L	M	-	L	H	-	H	H
CO4	L6	M	M	L	M	M	-	M	M	H	M	M	H
CO5	L3	H	H	M	H	M	L	L	L	L	L	H	H

H-High,M-Moderate,L-Low,'-'forNocorrelation

MTCESE206: Model TESTING LAB

COURSE OBJECTIVE

- To understand the model testing of dynamics, statics and vibrations.
- To study response of structures and its elements against extreme loading events.
- To conduct Model Testing on concrete structures.

- **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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Study response of structures and implement its elements against extreme loading events.

CO2: Conduct Model Testing on concrete structures.

CO3: Apply and evaluation of dynamic modulus.

CO4: Study and analyze the effects of vibration.

CO5: Know and interpretation of vibration Characteristics.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L6	M	M	H	M	M	L	M	M	L	L	H	H
CO2	L3	M	L	M	L	M	L	-	L	H	-	M	H
CO3	L2,L3	L	L	L	M	M	L	L	M	H	L	M	M
CO4	L2,L4	M	M	M	L	M	-	-	L	M	L	H	M
CO5	L1,L2,L3	-	M	L	L	M	L	L	L	M	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE207: Numerical Analysis Lab

COURSE OBJECTIVE

- To understand the different numerical and their solutions.
- To apply the approximations and integrations to the solutions.

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.
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.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: study roots of Non-Linear Equations.

CO2: solve System of Linear Equations.

CO3: Apply and calculating Least Square Approximations.

CO4: Study and analysis of integration of numerical.

CO5: Know different numerical and their solutions.

Table : Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	H	H	M	M	M	M	M	M	L	M	M	H
CO2	L3	M	L	M	-	H	L	-	L	H	-	M	H
CO3	L2,L3	-	L	M	M	M	L	L	M	H	M	M	M
CO4	L2,L4	M	M	-	L	H	-	-	L	M	L	H	M
CO5	L2	M	M	L	L	M	L	L	L	M	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE208: Mini Project with Seminar

Syllabus

COURSE OBJECTIVE

- To identification of the problem
- To use modern research tools/methods.
- To design and conduct experiments and identify the solution of the problem/s.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Enable the Students to undertake short research project under the direction of guide

CO2: impart skills in preparing detailed report describing the project and results.

CO3: enable the students to undertake fabrication work of new experimental set up/devices

CO4:effectively communicate by making an oral presentation before an evaluation committee

Table: Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3,L5	M	H	M	L	M	-	-	-	-	L	H	H
CO2	L6	L	L	-	H	-	H	-	-	M	L	H	H
CO3	L3 ,L6	H	H	L	L	H	-	-	-	-	M	H	H
CO4	L1	-	-	L	M	L	H	-	L	-	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

III Semester

M.Tech. (CE), Semester-III, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
Elective -1 (Any One)								
MTCESE301A	Design of Prestressed Concrete Structures	3	0	0	50	100	150	3
MTCESE301B	Analysis of Laminated Composite Plates	3	0	0	50	100	150	3
MTCESE301C	Fracture Mechanics of Concrete Structures	3	0	0	50	100	150	3
MTCESE301 D	Design of Plates and Shells							
Elective -2 (Any One)								
MTCESE302A	Business Analytics	3	0	0	50	100	150	3
MTCESE302B	Industrial Safety	3	0	0	50	100	150	3
MTCESE302C	Operations Research	3	0	0	50	100	150	3
MTCESE302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTCESE302E	Composite Materials	3	0	0	50	100	150	3
MTCESE302F	Waste to Energy	3	0	0	50	100	150	3
Practical/Viva Voce								
MTCESE303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

MTCESE301A: Design of Pre-stressed Concrete Structures

COURSE OBJECTIVE

- To design pre-stressed concrete deck slab and beam/ girders.
- To find out losses in the pre-stressed concrete and understand the basic aspects of pre- stressed concrete fundamentals, including pre and post-tensioning processes.
- To analyse and design the pre-cast composite construction.

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.

References:

- Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
- Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
- Limited State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1971.
- IS: 1343- Code of Practice for Prestressed Concrete
- IRC: 112

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Find out losses in the pre-stressed concrete. Understand the basic aspects of pre-stressed concrete fundamentals, including pre and post-tensioning processes.

CO2: Analyse pre-stressed concrete deck slab and beam/ girders.

CO3: Design pre-stressed concrete deck slab and beam/ girders.

CO4: Design of end blocks for pre-stressed members.

CO5: Analysis and design of pre-cast composite construction.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2, L3,L4	M	M	H	M	L	L	M	M	L	H	M	H
CO2	L4	M	-	M	L	L	M	L	-	M	-	M	M
CO3	L6	L	M	L	-	M	-	L	M	H	M	H	H
CO4	L6	M	H	L	L	M	L	-	H	M	L	H	H
CO5	L4,L6	-	M	L	L	M	L	L	L	L	L	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE301B: Analysis of Laminated Composite Plates

COURSE OBJECTIVE

- To analyse the rectangular composite plates using the analytical methods
- To develop the computer programs for the analysis of composite plates.
- To understand the concepts of FEM.

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 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.

References:

- Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyse the rectangular composite plates using the analytical methods.

CO2: Analyse the composite plates using advanced finite element method.

CO3: Develop the computer programs for the analysis of composite plates.

CO4: Understanding and finding the concepts of FEM.

CO5: Analysis of Rectangular Composite Plates and Computation of Stresses.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4	M	H	H	H	-	L	L	L	L	M	H	H
CO2	L4	M	M	L	L	L	M	L	M	M	M	M	M
CO3	L3,L6	L	H	L	M	M	M	M	M	H	-	H	H
CO4	L2, L3,L4	M	M	-	L	M	-	-	H	M	L	M	M
CO5	L4	-	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE301C: Fracture Mechanics of Concrete Structures

COURSE OBJECTIVE

- To identify cracking of concrete structures based on fracture mechanics
- To get the knowledge of Damage mechanics and Numerical modeling.

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.

References:

- Fracture Mechanics, Suri C. T. and Jin Z.H., Lst Edition, Elsevier Academic Press, 2012.
- Elementary Engineering Fracture Mechanics, Broek David, Hrd Rev. Ed. Springer, 1982.
- Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
- Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Identify and classify cracking of concrete structures based on fracture mechanics.

CO2: Implement stress intensity factor for notched members

CO3: Apply fracture mechanics models to high strength concrete and FRC structures.

CO4: Compute J-integral for various sections understanding the concepts of LEFM.

CO5: Knowledge and understanding of of Damage mechanics and Numerical modeling.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1, L2	M	M	-	H	L	L	M	M	L	L	M	H
CO2	L6	M	H	L	L	M	M	L	M	M	L	H	H
CO3	L3	L	M	L	M	M	L	L	-	M	-	M	M
CO4	L3	M	H	-	M	L	L	-	L	M	L	M	M
CO5	L1, L2	-	M	L	L	M	M	L	L	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE301D: Design of Plates and Shells

COURSE OBJECTIVE

- To get the knowledge of design criterias of plates and shells.
- To get the approximate Solutions for the problems in designing 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.

References:

- Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
- Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., Lst Edition, 2005.
- Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., Lst Edition, PHI.
- Design of Plate and Shell Structures, Jawad Maan H., Springer Science

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Analyse and design prismatic folded plate systems.

CO2: Analyse and design shells using approximate solutions.

CO3: Analyse and Design Cylindrical Shells.

CO4: Design Doubly Curved Shells using Approximate Solutions.

CO5: Analyze and solve the Approximate Solutions.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L4, L6	H	M	M	M	L	L	M	L	M	L	H	H
CO2	L4, L6	M	M	L	M	M	L	L	L	M	-	M	H
CO3	L4, L6	H	-	M	M	M	-	L	M	-	L	M	H
CO4	L6	M	M	L	L	L	M	-	M	M	L	H	H
CO5	L3,L4	L	M	L	L	M	L	L	L	L	-	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302A: Business Analytics

COURSE OBJECTIVE

- To understand the role of business analytics within an organization.
- To analyze data using statistical and data mining techniques and understand relationships
- To understand the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- To use decision-making tools/Operations research techniques.
- To manage business process using analytical and management tools. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

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.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role of business analytics within an organization.

CO2: Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

CO3: To become familiar with processes needed to develop, report, and analyze business data.

CO4: Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

CO5: Use decision-making tools/Operations research techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302B: Industrial Safety

COURSE OBJECTIVE

- To know about Industrial safety
- To know about fundamental concepts of maintenance engineering.
- To know about preventive measures to be taken.

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

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand the role industrial safety.

CO2: Understand fundamentals of maintenance engineering.

CO3: Learn different methods of Wearing and Corrosion and their prevention.

CO4: Trace out the faults occurring in various electrical systems.

CO5: Know about Periodic and preventive maintenance of various systems.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302C: Operations Research

COURSE OBJECTIVE

- To know about the optimization Techniques.
- To know about Competitive Models.
- To learn about Formulation of a LPP.

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

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008

- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to carry out sensitivity analysis.

CO2: Should able to model the real world problem and simulate it.

CO3: Should able to apply the dynamic programming to solve problems of discreet and continuous variables.

CO4: Should able to apply the concept of non-linear programming

CO5: Should be able to formulate optimization techniques.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L6**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302D: Cost Management of Engineering Projects

COURSE OBJECTIVE

- To know about Cost concepts in decision-making
- To know about Project making.
- To know about Cost Behavior and Profit Planning Marginal Costing

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.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Should able to do cost management for various projects.

CO2: Should able to understand the meaning of cost management.

CO3: Should able to analyze Cost Behavior and Profit Planning.

CO4: Understand Quantitative techniques for cost management

CO5: Analyze the pricing and apply for various projects.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302E: Composite Materials

COURSE OBJECTIVE

- To know about introduction to composite materials.
- To know about reinforcements.
- To know about manufacturing process of 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, hygrothermal failure. Laminate first play failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Understand Definition – Classification and characteristics of Composite materials.

CO2: Know about Reinforcements.

CO3: Know about manufacturing of Metal Matrix Composites.

CO4: Know about manufacturing of Polymer Matrix Composites:

CO5: Know about strength and laminates.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

MTCESE302F: Waste to Energy

COURSE OBJECTIVE

- To know about Energy waste introduction.
- To know about Biomass process.
- To know about various types of biomass plants and gasifiers.

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.

References:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifiers.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

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.

COURSE OUTCOMES

By the end of this course every student is expected to be able to:

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	M
CO2	L4	M	M	H	L	M	M	-	-	-	L	M	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

SEMESTER IV

M.Tech. (CE), Semester-IV, II yr. (2 yrs Degree Course)

Course Number	Subject	L	T	P	IA	EA	Total	Credits
MTCESE401	Dissertation II	0	0	32	300	400	700	16
Total		0	0	32	300	400	700	16

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 OUTCOMES

By the end of this course, every student is expected to be able to:

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	M	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	H	M

H- High, M- Moderate, L- Low, '-' for No correlation

Audit Courses (Common for all)

AUDIT 1 and 2 : ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVE

- To understand that how to improve your writing skills and level of readability
- To learn about what to write in each section
- To understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

UNIT-1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT-3: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when Writing a Review of the Literature.

UNIT-4: skills are needed when writing the Methods, skills needed when writing the Results, Skills are needed when writing the Discussion; skills are needed when writing the Conclusions.

UNIT-5: useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

Suggested Studies:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Students should know how to Plan and Prepare research paper.

CO2: Knowledge of Paraphrasing, Plagiarism and Literature review.

CO3: Knowledge and understanding of write every aspect and part of thesis like Abstract, Literature review, Title, etc,.

CO4: Discussion and skills developed in students when writing the Conclusions.

CO5: Ensuring students to write the paper first- time and also giving them knowledge about the quality of paper and procedure of Submission.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	H	M	H	M	-	L	M	L	L	M	L	L
CO2	L1	M	-	L	L	M	-	H	H	M	M	L	L
CO3	L1,L2	L	H	L	M	H	L	H	M	H	L	L	L
CO4	L2	M	M	-	L	H	M	-	M	M	-	L	L
CO5	L1	M	L	L	L	M	L	M	L	-	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2: DISASTER MANAGEMENT

COURSE OBJECTIVE

- To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Syllabus

UNIT-1: Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-2: Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War and Conflicts.

UNIT-3: Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT-4: Disaster Preparedness and Management

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-5: Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies For Survival.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Suggested Studies:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

- Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of disaster and its types.

CO2: Knowledge of Repercussions of Disasters And Hazards.

CO3: Study of Seismic Zones and Disaster Prone Areas In India.

CO4: Study of Disaster Preparedness and Management.

CO5: Understanding Disaster Risk Situation, Risk Assessment and Disaster Mitigation in India.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO1	PSO2
CO1	L1	H	M	H	L	-	L	M	L	L	M	L	L
CO2	L1	M	H	L	L	M	M	-	-	M	L	L	L
CO3	L2	-	M	L	M	L	M	-	M	H	M	L	L
CO4	L2	M	H	-	L	M	L	-	M	M	M	L	L
CO5	L2	M	M	L	H	M	L	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : SANSKRIT FOR TECHNICAL KNOWLEDGE

COURSE OBJECTIVE

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To do Learning of Sanskrit to improve brain functioning
- To have thorough Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- To enhance the memory power
- To explore the huge knowledge from ancient literature

Syllabus

UNIT-1: Alphabets in Sanskrit.

UNIT-2: Past/Present/Future Tense.

UNIT-3: Simple Sentences Order.

UNIT-4: Introduction of roots.

UNIT-5: Technical information about Sanskrit Literature, Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Studies:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

COURSE OUTCOMES OF SANSKRIT FOR TECHNICAL KNOWLEDGE

At the end of the course, the student will be able to:

CO1: Knowledge of Alphabets in Sanskrit.

CO2: Knowledge of Past/Present/Future Tense.

CO3: Study of Simple Sentences Order.

CO4: Introduction of roots and its knowledge.

CO5: Understanding Technical information and concepts about Sanskrit Literature and related Engineering concepts.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	-	L	L	M	-	H	M	M	L	L	L
CO3	L2	L	H	L	M	H	M	L	M	H	M	L	L
CO4	L1	M	H	-	L	M	L	-	-	M	L	L	L
CO5	L2	-	M	L	L	M	M	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : VALUE EDUCATION

COURSE OBJECTIVE

- To understand value of education and self-development
- To imbibe good values in students
- To let the should know about the importance of character

Syllabus

UNIT-1: Values and self-development –Social values and individual attitudes.

Work ethics, Indian vision of humanism.

 Moral and non- moral valuation. Standards and principles.

 Value judgments

UNIT-2: Importance of cultivation of values.

 Sense of duty. Devotion, Self-reliance. Confidence, Concentration.

Truthfulness, Cleanliness.

 Honesty, Humanity. Power of faith, National Unity.

 Patriotism. Love for nature ,Discipline

UNIT-3: Personality and Behavior Development - Soul and Scientific attitude.

 Punctuality, Love and Kindness.

 Avoid fault Thinking.

 Free from anger, Dignity of labor.

 Universal brotherhood and religious tolerance.

UNIT-4: Positive Thinking. Integrity and discipline. Positive Thinking. Integrity and discipline.

 True friendship.

 Happiness Vs suffering, love for truth.

 Aware of self-destructive habits.

 Association and Cooperation.

 Doing best for saving nature

UNIT-5: Character and Competence –Holy books vs. Blind faith.

 Self-management and Good health.

 Science of reincarnation.

 Equality, Nonviolence ,Humility, Role of Women.

 All religions and same message.

 Mind your Mind, Self-control.

 Honesty, Studying effectively.

Suggested Studies:

- Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of Values and self-development.

CO2: Understanding the Importance of cultivation of values.

CO3: Study of Personality and Behavior Development.

CO4: Understanding and inculcating Positive Thinking.

CO5: Study of Character and Competence.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PSO 1	PSO 2
CO1	L2	M	H	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	M	L	L	M	L	M	-	M	L	L	L
CO3	L2	L	H	L	M	M	M	M	L	H	-	L	L
CO4	L2	M	H	-	L	M	-	-	L	M	L	L	L
CO5	L2	-	M	L	L	M	L	L	L	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : CONSTITUTION OF INDIA

COURSE OBJECTIVE

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals'constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

Syllabus

UNIT-1: History of Making of the Indian Constitution:

History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble Salient Features.

UNIT-2: Contours of Constitutional Rights & Duties:

 Fundamental Rights

 Right to Equality

 Right to Freedom

 Right against Exploitation

 Right to Freedom of Religion

 Cultural and Educational Rights

 Right to Constitutional Remedies

 Directive Principles of State Policy

 Fundamental Duties.

UNIT-3: Organs of Governance:

 Parliament

 Composition

 Qualifications and Disqualifications

 Powers and Functions

 Executive

 President

 Governor

 Council of Ministers

 Judiciary, Appointment and Transfer of Judges, Qualifications

 Powers and Functions

UNIT-3: Local Administration:

 District's Administration head: Role and Importance,

 Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

 Pachayati raj: Introduction, PRI: Zila Pachayat.

 Elected officials and their roles, CEO Zila Pachayat: Position and role.

 Block level: Organizational Hierarchy (Different departments),

 Village level: Role of Elected and Appointed officials,

 Importance of grass root democracy

UNIT-5: Election Commission:

 Election Commission: Role and Functioning.

 Chief Election Commissioner and Election Commissioners.

 State Election Commission: Role and Functioning.

 Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Studies:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of History and Philosophy of the Indian Constitution.

CO2: Understanding the Contours of Constitutional Rights & Duties.

CO3: Study of Organs of Governance.

CO4: Understanding the Local Administration.

CO5: Study of Election Commission.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	H	H	L	-	L	M	L	L	M	L	L
CO2	L2	M	M	L	M	M	-	M	M	M	H	-	-
CO3	L2	L	M	L	M	L	M	H	M	H	M	-	-
CO4	L2	-	H	-	L	M	H	-	M	M	-	L	-
CO5	L2	L	M	L	L	M	L	L	-	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : PEDAGOGY STUDIES

COURSE OBJECTIVE

- To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- To identify critical evidence gaps to guide the development.

Syllabus

UNIT-1: Introduction and Methodology:

 Aims and rationale, Policy background, Conceptual framework and terminology

 Theories of learning, Curriculum, Teacher education.

 Conceptual framework, Research questions**.**

 Overview of methodology and Searching.

UNIT-2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

 Curriculum, Teacher education

UNIT-3: Evidence on the effectiveness of pedagogical practices

 Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

 Theory of change.

 Strength and nature of the body of evidence for effective pedagogical practices.

 Pedagogic theory and pedagogical approaches.

 Teachers' attitudes and beliefs and Pedagogic strategies

UNIT-4: Professional development: alignment with classroom practices and follow up support

 Peer support

 Support from the head teacher and the community.

 Curriculum and assessment

 Barriers to learning: limited resources and large class sizes

UNIT-5: Research gaps and future directions

 Research design

 Contexts

 Pedagogy

 Teacher education

 Curriculum and assessment

 Dissemination and research impact

Suggested Studies:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of Theories of learning and Conceptual framework.

CO2: Understanding the Pedagogical practices.

CO3: Interpretating the Theory of change when pedagogical practices are done.

CO4: Understanding the Professional development and Barriers to learning.

CO5: Study of Research gaps and future directions.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PSO1	PSO 2
CO1	L1	H	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	-	M	M	L	L	L
CO3	L2	H	H	L	M	M	M	M	M	H	M	L	L
CO4	L2	L	H	-	L	M	-	M	-	M	M	L	L
CO5	L2	L	M	L	L	M	L	L	L	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

COURSE OBJECTIVE

- To achieve overall health of body and mind
- To overcome stress

Syllabus

UNIT-1: Definitions of Eight parts of yog (Ashtanga).

UNIT-2: Yam and Niyam: Do`s and Don't's in life.

UNIT-3: Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwar pranidhan.

UNIT-4: Asan and Pranayam

I) Various yog poses and their benefits for mind & body

UNIT-5: Regularization of breathing techniques and its effects-Types of pranayam.

Suggested Studies:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of Eight parts of yog (Ashtanga).

CO2: Understanding the Do`s and Don't's in life.

CO3: Knowledge and application of Ahinsa, satya, astheya, bramhacharya, aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

CO4: Pracicing Asan and Pranayam..

CO5: Regularization of breathing techniques and its effects.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	H	-	M	-	L	L
CO3	L1,L3	L	H	L	M	L	M	M	M	H	M	L	L
CO4	L3	M	H	-	L	M	M	-	M	M	M	-	-
CO5	L1,L2	L	M	L	L	M	L	H	L	L	L	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

COURSE OBJECTIVE

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Syllabus

UNIT-1: Neetisatakam - Holistic development of personality

 Verses- 19,20,21,22 (wisdom)

 Verses- 29, 31, 32 (pride & heroism)

 Verses- 26,28,63,65 (virtue)

 Verses- 52, 53, 59 (dont's)

 Verses- 71,73,75,78 (do's)

UNIT-2: Approach to day to day work and duties.

 Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47, 48,

 Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17,

23, 35,

 Chapter 18-Verses 45, 46, 48.

UNIT-3: Statements of basic knowledge.

 Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

 Chapter 12 -Verses 13, 14, 15, 16, 17, 18

UNIT-4: Personality of Role model. Shrimad BhagwadGeeta:

 Chapter2-Verses 17,

 Chapter 3-Verses 36, 37, 42,

 Chapter 4-Verses 18, 38, 39

 Chapter18 – Verses 37, 38, 63

Suggested Studies:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Knowledge of Neetisatakam - Holistic development of personality.

CO2: Approach to day to day work and duties.

CO3: Understanding the Theory of Statements of basic knowledge.

CO4: Understanding the Personality of Role model. Shrimad Bhagwad Geeta.

CO5: Study of Personality Development through Life Enlightenment Skills.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	M	L	-	L	M	L	L	M	-	-
CO2	L1,L2	M	H	L	L	M	M	-	H	M	L	-	-
CO3	L2	L	H	L	M	M	L	M	L	H	L	-	-
CO4	L2	M	L	-	L	L	M	M	M	M	-	-	-
CO5	L2	M	M	L	L	M	L	L	L	L	M	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

6. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of technical program in a canonical manner. In this context, applications of technical program and linkage with the theory constitute a vital aspect of the teaching-learning process. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teaching learning process are summarized in the following heads.

1. **Class room Lectures:** The most common method of imparting knowledge is through lectures.There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.

2. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern ofstudy, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.

3. **Practical:** To provide scientific visualization and obtaining results of Technical program inpractical sessions. These sessions provide vital insights into scientific concepts and drawlearner's attention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.

4. **Choice based learning/Open elective:** LOCF in this undergraduate program providesgreat flexibility both in terms of variety of courses and range of references in each course.

5. **Field based learning:** Students may enhance their knowledge through field based learningwhile understanding the practical importance.

6. **Textbooks learning:** A large number of books are included in the list of references of eachcourse for enrichment and enhancement of knowledge.

7. **E-learning:** Learner may also access electronic resources and educational websites for betterunderstanding and updating the concepts.

8. **Self-study materials:** Self-study material provided by the teachers is an integral part oflearning. It helps in bridging the gaps in the classroom teaching. It also provides scope for teachers to give additional information beyond classroom learning.

9. **Assignment/Problem solving:** Assignments at regular intervals involving applications oftheory are necessary to assimilate basic concepts of courses. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.

10. **Internships:** The teaching-learning process needs to be further supported by other activitiesdevoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.

11. **Institute visits:** Institute visit by a learner is also a part of learning process. During suchvisits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.

12. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power of mathematical ideas and their translation in problem solving.

13. **Training programs:** Training programs organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.