Department of Civil Engineering

Date 30/07/2024 & Time 03:00 pm

Venu: Online Mode

CONTENTS

CONSITUTION OF BOARD OF STUDIES

Sr. No.	Nomenclature	Designation
1.	Dr. Jaspal Singh, Professor Dept. of Civil Engineering, PAU, Ludhiana	Member B.O.S.
2.	Dr. G.S. Bath, Professor (Retd.), Dept. of Civil Engg., GZS Campus College of Engg. & Tech., Bathinda	Member B.O.S.
3.	Er. Inderjeet Singh Bath, Director Geomedia Engg. and Consultancy Services, Bathinda	Member B.O.S.
4.	Er. Sidhant Chopara, Alumni Dept. of Civil Engg., SBSSTC, Mohali (J.E., GLADA)	Member B.O.S.
5.	Dr. Bohar Singh, Associate Prof., Dept. of Civil Engg., SBSSU, Ferozepur	Member B.O.S.
6.	Dr. Parampreet Kaur, Assistant Prof., Dept. of Civil Engg., SBSSU, Ferozepur	Member B.O.S.
7.	Dr. Gurpreet Singh, Assistant Prof., Dept. of Civil Engg., SBSSU, Ferozepur	Member B.O.S.
8.	Dr. Dapinder Deep Singh, Assistant Prof. & Head, Dept. of Civil Engg., SBSSU, Ferozepur	Chairman

Agenda Item No. 5.1 **Confirmation of the Proceedings of 4th meeting of Board of Studies of Dept. of Civil Engineering.**

The approved proceedings of the 4th Meeting of Board of Studies held on 04/01/24 were circulated through mail for information and comments, if any (**Annexure-I Page No. 6-7**). No comments received from BOS members.

The approval of proceedings of 4th meeting of Board of Studies are placed for conformation please.

Agenda Item No. 5.2 **To report action taken of the decisions of the 4th meeting of Board of Studies of Dept. of Civil Engineering.**

Agenda Item No. 4.3	**Approval regarding syllabus of B.Tech. Civil Engineering 4th semester for Batch-2022 and onwards of SBSSU, Ferozepur**
Decision:	The item has been rectified as discussed and approved.
Action:	Decision Implemented.
Agenda Item No. 4.4	**Approval regarding scheme & syllabus of M.Tech. Transportation Engineering (Part-Time) 2nd semester of Batch-2023 and onwards of SBSSU, Ferozepur**
Decision:	The item has been rectified as discussed and approved.
Action:	Decision Implemented.

Agenda Item No. 5.3 **Approval regarding scheme & syllabus of B.Tech. Civil Engineering 5th semester for Batch-2022 and onwards of SBSSU, Ferozepur**

The scheme and syllabus of 5th semester B.Tech. Civil Engineering Batch-2022 and onwards is attached as (**Annexure-II, Page No. 8-29**).

This item is placed before BOS for approval please.

Agenda Item No. 5.4 **Approval regarding open elective subjects syllabus offered by Department of Civil Engineering to other departments of the university**.

Civil Engg. Department offered two subjects to other departments of the university is attached as (**Annexure-III, Page No. 30-32**).

This item is placed before BOS for approval please.

Agenda Item No. 5.5 **Approval regarding scheme & syllabus of M.Tech. Transportation Engineering (Part-Time) 3rd semester of Batch-2023 and onwards of SBSSU, Ferozepur.**

The scheme and syllabus of 3rd semester of M.Tech. Transportation Engineering (Part-Time) Batch-2023 and onwards is attached as (**Annexure-IV, Page No.33-43**).

This item is placed before BOS for approval please.

Agenda Item No. 5.6 **Rectification in the scheme of M.Tech. Transportation Engineering (Part-Time) 2nd semester of Batch-2023 and onwards of SBSSU, Ferozepur.**

The contact hours of core subject Pavement Materials Testing Laboratory (MTTE-203) is **4** instead of **2**. The corrected scheme of 2nd semester is attached as **(Annexure-V, Page No.44-45).** Moreover, in 2nd semester (Jan-July,2024), **4** contact hours were already followed in the timetable.

This item is placed before BOS for rectification and approval please.

Annexure-I

Annexure-II

B.Tech. (Civil Engineering)

Scheme and Syllabus

Batch 2022 and Onwards

Department of Civil Engineering

Semester 3rd									Total Credits=24	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	BTCE301C	Irrigation Engineering	3	0	0	40	60	100	3
2	Core Subject	BTCE302C	Fluid Mechanics	3	1	0	40	60	100	4
3	Core Subject	BTCE303C	Solid Mechanics	3	1	0	40	60	100	4
4	Core Subject	BTCE304C	Surveying	3	0	0	40	60	100	3
5	Core Subject	BTCE305C	Fluid Mechanics Lab	0	0	2	30	20	50	1
6	Core Subject	BTCE306C	Solid Mechanics Lab	0	0	2	30	20	50	1
7	Core Subject	BTCE307C	Surveying Lab	0	0	4	30	20	50	2
8	Core Subject	BTCE308C	Computer Aided Structural Drawing Lab-I	0	0	2	30	20	50	1
9	Training/ Project	BTCE309C	Workshop Training*	0	0	2	60	40	100	2
10	Diploma Course	BTCE310C	Engineering Geology	3	0	0	40	60	100	3
Total				**15**	**2**	**12**	**380**	**420**	**800**	**24**
*Training will be imparted in the institution at the end of 2nd semester for 4 week duration.										

Semester 4th									Total Credits=24	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	BTCE401C	Structural Analysis	3	1	0	40	60	100	4
2	Core Subject	BTCE402C	Transportation Engineering-I	3	0	0	40	60	100	3
3	Core Subject	BTCE403C	Environmental Engineering-I	3	1	0	40	60	100	4
4	Core Subject	BTCE404C	Design of Concrete Structures-I	3	1	0	40	60	100	4
5	Core Subject	BTCE405C	Transportation Engineering Lab	0	0	2	30	20	50	1
6	Core Subject	BTCE406C	Structural Engineering Lab	0	0	2	30	20	50	1
7	Core Subject	BTCE407C	Environmental Engineering Lab	0	0	2	30	20	50	1
8	Open Elective Course	xxxx	Open Elective Subject is chosen from the list of Open Electives offered by other departments of university.	3	0	0	40	60	100	3
9	Diploma Course	BTCE408C	Construction Machinery and Works Management	3	0	0	40	60	100	3
Total				**18**	**3**	**6**	**330**	**420**	**750**	**24**
Survey camp will be conducted after fourth semester for which viva will be conducted along with end semester examination of fifth semester.										

Semester 5th									Total Credits=21	
Sr. No.	Category	Subject Code	Course Title	Contact Hours			Maximum Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	Core Subject	BTCE501C	Design of Concrete Structures -II	3	0	0	40	60	100	3
2	Core Subject	BTCE502C	Transportation Engineering-II	3	0	0	40	60	100	3
3	Core Subject	BTCE503C	Geotechnical Engineering	3	0	0	40	60	100	3
4	Core Subject	BTCE504C	Concrete Technology Lab	0	0	2	30	20	50	1
5	Core Subject	BTCE505C	Geotechnical Engineering Lab	0	0	2	30	20	50	1
6	Core Subject	BTCE506C	Survey Camp	-	-	-	30	20	50	1
7	Departmental Elective (Select any one)	BTCE511C	Environmental Engineering-II	3	0	0	40	60	100	3
		BTCE512C	Repair & Rehabilitation of Structures							
		BTCE513C	Environment Impact Assessment and Life Cycle Assessment							
8	Open Elective Course	xxxx	Open Elective Subject is chosen from the list of Open Electives offered by other departments of university.	3	0	0	40	60	100	3
9	Advanced Diploma Course	BTCE507C	Earthquake Engineering	3	0	0	40	60	100	3
Total				**18**	**0**	**4**	**330**	**420**	**750**	**21**

Semester 6th									Total Credits=21	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	BTCE601C	Foundation Engineering	3	1	0	40	60	100	4
2	Core Subject	BTCE602C	Estimation & Costing	3	1	0	40	60	100	4
3	Core Subject	BTCE603C	Computer Aided Structural Drawing Lab-II	0	0	2	30	20	50	1
4	Departmental Elective (Select any one)	BTCE611C	Ground Improvement Techniques	3	0	0	40	60	100	3
		BTCE612C	Disaster Management							
		BTCE613C	Solid & Hazardous Waste Management							
5	Open Elective Course	xxxx	Open Elective Subject is chosen from the list of Open Electives offered by other departments of university.	3	0	0	40	60	100	3
6	Humanities & Management	xxxx		3	0	0	40	60	100	3
7	Advanced Diploma Course	BTCE604C	Air & Noise Pollution	3	0	0	40	60	100	3
Total				**18**	**2**	**2**	**270**	**380**	**650**	**21**

Semester 7th									Total Credits=21	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	BTCE701C	Hydrology & Dams	3	1	0	40	60	100	4
2	Core Subject	BTCE702C	Design of Steel Structures	3	1	0	40	60	100	4
3	Departmental Elective (Select any one)	BTCE711C	Rural Water Supply and Onsite Sanitation Systems	3	0	0	40	60	100	3
		BTCE712C	Traffic Engineering							
		BTCE713C	Bridge Engineering							
4	Open Elective Course	xxxx	Open Elective Subject is chosen from the list of Open Electives offered by other departments of university.	3	0	0	40	60	100	3
5	Humanities & Management	xxxx		3	0	0	40	60	100	3
6	Core Subject	BTCE703C	Project	0	0	8	40	60	100	4
Total				**15**	**2**	**8**	**240**	**360**	**600**	**21**

Semester 8th(a)									Total Credits=14	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	BTCE801C	Smart City	2	0	0	40	60	100	2
2	Departmental Elective (Select any one)	BTCE811C	Maintenance of Building Structures	3	0	0	40	60	100	3
		BTCE812C	Intelligent Transport System							
3	Departmental Elective (Select any one)	BTCE813C	Construction Engineering Materials	3	0	0	40	60	100	3
		BTCE814C	Pre-stressed Concrete							
4	Departmental Elective (Select any one)	BTCE815C	Soil Reinforcing Techniques	3	0	0	40	60	100	3
		BTCE816C	Groundwater Engineering							
5	Open Elective Course	xxxx	Open Elective Subject is chosen from the list of Open Electives offered by other departments of university.	3	0	0	40	60	100	3
Total				**14**	**0**	**0**	**200**	**300**	**500**	**14**

Semester 8th(b)								Total Credits=14
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Evaluation Internal**		**External**	**Total Marks**	**Credits**
				Institutional	**Industrial**			
1	Training (One Semester)	BTCE802C	Software Training#	50	50	100	200	14
			Industrial Training#	100	100	100	300	
Total				**150**	**150**	**200**	**500**	**14**
# Duration of software and industrial training are 2 and 4 months, respectively.								

List of open electives offered by Department of Civil Engineering to other departments

Sr.No.	Subject Code	Course Tile	Contact Hours			Maximum Marks		Total Marks	Credits
			L	T	P	Internal	External		
1	BTCE901C	Rock Mechanics and Engineering Geology	3	0	0	40	60	100	3
2	BTCE902C	Disaster Management	3	0	0	40	60	100	3
3	BTCE903C	Remote Sensing & GIS	3	0	0	40	60	100	3
4	BTCE904C	Construction Engineering & Management	3	0	0	40	60	100	3
5	BTCE905C	Concrete Technology	3	0	0	40	60	100	3
6	BTCE906C	Metro system and Engineering	3	0	0	40	60	100	3
7	BTCE907C	Traffic Management	3	0	0	40	60	100	3
8	BTCE908C	Road Safety	3	0	0	40	60	100	3
9	BTCE909C	Environmental Impact Assessment	3	0	0	40	60	100	3
10	BTCE910C	Air & Noise Pollution	3	0	0	40	60	100	3

Semester 5th

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	BTCE501C	Design of Concrete Structures-II	3	1	0	4
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Impart understanding of various aspects of design of reinforced concrete.
2. Understand the codal recommendations for methods of design.
3. Understand the design of various compression members of the building structures.
4. Understand the design of foundations, beams, retaining walls, domes and water tanks.

Note: Indian Standards-IS 456, IS 3370 and Design Aid SP-16 are permitted in examination.

UNIT-I

Design of Foundations: Concept, Application, Types, Components of Footing, Design of Isolated Footing (Square, Rectangular), Combined Footing (Rectangular, Trapezoidal & Strap footing) and Raft Foundation. **Design of Stairs:** Introduction, Elements of Stairs-Tread, Rise, Flight, Landing, Types of Stairs, Design and Reinforcement detail of Stairs.

UNIT-II

Design of Compression Members: Classifications (According to Shape, Length and loading conditions), Assumptions, Guidelines as per Indian Standards, Behavior of Compression Members, Short Compression Members under Axial Load with Uni-axial and Bi-axial Bending, Design of Slender (Long) Columns.

UNIT-III

Design of Beams (Continuous and Curved): Definition, Behavior, Design of Continuous beams and Curved beams, Reinforcement detailing.

Design of Retaining Walls: Classification, Elements-Stem, Base, Heel, Toe, Behavior and design of Cantilever and Counter fort type retaining wall.

UNIT-IV

Design of Domes: Types, Components, Design of Spherical and Conical Dome.

Water Tanks: Introduction, Types & uses of Underground water tanks and ground water tanks. Design of Circular and Rectangular water tanks resting on ground.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Design the components of footings i.e. isolated, combined and raft foundations.
2. Know about column's types, applications, behaviour of columns along with their design.
3. Design the details of the concrete components i.e. beams (continuous and curved) and retaining walls.
4. Design the special structures like domes and water tanks.

Books Recommended :

1. Jain, A.K., "Reinforced Concrete-Limit State Design" Nem Chand & Bro.
2. Bhavikatti, S.S., "Advanced RCC Design" New Age International Private Limited.
3. Punmia, B.C.,"Design of Concrete Structures" Laxmi Publications.
4. Krishna, R.,"Pre-stressed Concrete"; TMH.
5. Subramanian, N., "Design of Reinforced Concrete Structures", Oxford University Press.
6. Pillai and Menon, "Reinforced Concrete Design", Tata McGraw Hill Education.
7. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India Pvt. Ltd.
8. Mallick and Rangasamy, "Reinforced Concrete", Oxford-IBH.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	BTCE502C	Transportation Engineering-II	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Impart basic knowledge of railway track components and their functions.
2. Introduce geometric design, points and crossings, track resistances, signalling and control system.
3. Learn advancement in railway stations, yards, modernization of railways and high speed trains.
4. Design the airport runway, taxiways and aprons.
5. Summarise the concepts of the terminal service facilities.

UNIT-I

Railway Engineering: Introduction to Railway Engineering: History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge.

Railway Track: Requirements of a Good Track, Track Specifications on Indian Railways, Detailed Cross-Section of Single/Double Track on Indian Railways.

Components of Railway Track: Rails, Sleepers, Ballast, Subgrade and formation, Track fixtures and fastenings, Coning of wheels, Tilting of rails, Adzing of sleepers, Rail joints, Creep of rails.

UNIT-II

Geometric Design of Railway Track: Alignment, Gradients, Horizontal curve, Super elevation, Equilibrium Cant, Cant deficiency, Transition curves.

Points and Crossings: Functions, Working of Turnout, Various types of Track Junctions and their layouts, Level-crossing.

Railway Stations & Yards: Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards

Signalling and Interlocking: Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking.

Modernization of Railway Tracks: High Speed Tracks, Improvement in existing track for high speed, Ballastless Track, MAGLEV, TACV Track.

UNIT-III

Airport Engineering: Introduction to Airport Engineering: Air Transport Scenario in India and Stages of Development, National and International Organizations.

Airport Planning: Aircraft Characteristics, Factors for Site Selection, Airport Classification, General Layout of an Airport. Obstructions and Zoning Laws, Imaginary Surfaces, Approach Zones and Turning Zones.

UNIT-IV

Runway Orientation and Design: Head Wind, Cross Wind, Wind Rose Diagram, Basic Runway Length, Corrections, Geometric Design Elements, Runway Configuration.

Taxiway and Aircraft Parking: Aircraft Parking System. Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.

Visual Aids: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Apply the knowledge of railway track components, materials and fixtures and fastenings.
2. Solve problems of railway track geometrics, train resistance, points and crossings, signalling and control system.
3. Carry out feasibility study of rail tracks.
4. Describe the different components of airport and aircrafts.
5. Analyse the requirements of an airport layout with respect to international regulations.

Books Recommended :

1. Chandra S., and Aggarwal, "Railway Engineering", M.M. Oxford University Press, New Delhi, 2007.
2. Saxena, S.C., and Arora, S.P., "A Text Book of Railway Engineering", DhanpatRai and Sons, Delhi, 1997.
3. J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009
4. Khanna, S.K., Arora, M.G., and Jain, S.S., "Airport Planning and Design", Nem Chand & Bros. Roorkee, 1999.
5. Horenjeff, R. and McKelvey, F., "Planning and Design of Airports", McGraw Hill Company, New York, 1994.
6. Norman J. Ashford, SalehMumayiz, Paul H. Wright, "Airport Engineering: Planning, Design and Development of 21st Century", Wiley Publishers, 2011.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Core Subject	BTCE503C	Geotechnical Engineering	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. Also to become familiar broadly with geotechnical engineering problems such as flow of water through soil medium and terminologies associated with geotechnical engineering.
2. Know the basic engineering properties and the mechanical behaviour of different types of soil. This includes strength-deformation characteristics under shearing stresses. Also consolidation properties of clayey soils.
3. Determine the improvement in mechanical behaviour by densification of soil deposits using compaction.
4. Know how the properties of soils that can be measured in the laboratory.

UNIT-I

Types of Soils, Their Formation and Deposition, Definitions: Soil mechanics, Soil engineering, Geotechnical engineering. Scope of soil engineering. Basic definitions and relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: Moisture content, Unit weights, Degree of saturation, Void ratio, Porosity, Specific gravity and their relationships, Determination of various parameters such as: Moisture content by oven dry method, Specific gravity by density bottle method, Unit weight by core-cutter method, sand-replacement method.

Plasticity Characteristics of Soil: Introduction to definitions of: Plasticity of soil, Consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, Definitions of activity and sensitivity, Determination of: liquid limit, plastic limit and shrinkage limit, Use of consistency limits, Particle size classification, Textural classification, Indian standard soil classification system

UNIT-II

Compaction: Compaction, Concept of O.M.C. and Zero air void line, Standard and Modified proctor test, Factors affecting compaction, Effect of compaction on engineering soil properties, Field compaction methods their comparison of performance and relative suitability, Field control of compaction by proctor needle.

Permeability of Soil: Concept of effective stress principle, Critical hydraulic gradient and quick sand condition, Capillary phenomenon in soil, Darcy's law and its validity, Co-efficient of permeability and its determination by Constant head permeability test and Variable head permeability test, Average permeability of stratified soils, Factors affecting coefficient of permeability.

UNIT-III

Consolidation: Consolidation, Difference between compaction and consolidation, Concept of various consolidation characteristics, Primary and secondary consolidation, Terzaghi's theory for one-dimensional consolidation, Consolidation test, Determination of coefficient of consolidation from curve fitting methods, Normally consolidated and over consolidated clays, Importance of consolidation settlement in the design of structures, e-logσ curve.

UNIT-IV

Shear Strength: Mohr circle and its characteristics, Principal planes, Relation between major and minor principal stresses, Mohr-Coulomb theory, Types of shear tests: Direct shear test, Merits of direct shear test, Tri-axial compression tests, Test behavior of UU, CU and CD tests, Pore-pressure parameters, Computation of effective shear strength parameters. Unconfined compression test, Vane shear test.

Stability of Slopes: Introduction, Types of slopes and their failure mechanisms, Factor of safety, Analysis of finite and infinite slopes, Wedge failure, Swedish circle method, Friction circle method, Stability numbers and charts.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Comprehend the various geotechnical field challenges and understand their fundamental, index and engineering properties and then use (apply) the soil as an engineering material.
2. Apply the various concepts of compaction of soils in the construction of highways and earthen dams as well as investigate and write the laboratory reports for soil design properties and parameters by applying the

concept of permeability.
3. Able to apply the knowledge of consolidation, soil deformation parameters, and calculate settlement magnitude and rate of settlement.
4. Learn the Shear Strength parameter of soil and design the embankment slopes and check the stability of finite slopes.

Books Recommended :

1. Arora, K.R., "Soil Mech. & Foundation Engg", Standard Publishers Distributors.
2. Raj, P. P., "Geotechnical Engineering", Tata McGraw Hill.
3. Murthy,V.N.S., "Soil Mech. & Foundation Engg", CBS Publishers & Distributors.
4. Das, B.M., "Principle of Geotechnical Engineering", Cengage Publisher.
5. Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers.
6. Bowle, J. E., "Physical & Geotechnical Properties of Soil".

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	BTCE504C	Concrete Technology Lab	0	0	2	1
Internal Marks: 30, External Marks: 20, Total Marks: 50							

Course Objectives: The course should enable the students to:

1. Give practical exposure of laboratory testing of different kinds of building construction materials such as brick, cement, lime, aggregate, etc.
2. Check the suitability for different materials used in civil construction works.
3. Determine the engineering properties in terms of strength, strain, fatigue, stiffness, durability and workability.
4. The knowledge of these tests is very essential to choose appropriate construction material to exercise better quality control in a civil construction project.

List of Experiments:

1. To determine the specific gravity, soundness, consistency and setting time (initial & final setting time) of cement.
2. To determine the compressive strength of cement.
3. To determine the specific gravity, water absorption and moisture content of coarse aggregate & fine aggregate.
4. To determine the shape & size, efflorescence, water absorption and compressive strength of bricks.
5. To determine the workability of concrete by Slump Cone and Vee-Bee test method.
6. To determine the workability of concrete by Compaction Factor Method.
7. Design mixes of concrete by IS methods.
8. To determine the compressive Strength, flexural strength and split tensile strength of Concrete by IS methods.
9. To determine the strength of hardened concrete by Rebound hammer.
10. To determine strength and quality of hardened concrete by Ultra Sonic Pulse Velocity test .

Course Outcomes:

1. Determine the consistency, setting time and fineness of cement.
2. Determine the grading, density & specific gravity of aggregates.
3. Determine the shape & size, compressive strength and water absorption of bricks.
4. Design concrete mixes as per BIS provisions.
5. Analyze the properties of concrete in fresh and hardened state.
6. Understand and apply nondestructive testing for evaluating concrete quality.

Books/Manual Recommended:

1. Gambhir, M.L., "Building and Construction Materials: Testing and Quality Control" TMH.
2. "Concrete Lab Manual" NITTTR, Chandigarh.
3. Shetty, M.S., "Concrete Technology, Theory and Practice" S. Chand & Company.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	BTCE505C	Geotechnical Engineering Lab	0	0	2	1
Internal Marks: 30, External Marks: 20, Total Marks: 50							

Course Objectives: The course should enable the students to:

1. Distinguish various soil properties and its behavior.
2. Carry out firm foundation in testing various types of soils and their properties.
3. Experience with the measurement of geotechnical laboratory parameters.
4. Excel in experiment research and to succeed with real time projects.
5. Ability to design and conduct experiments as well as analyze and interpret data.

List of Experiments:

1. Determination of natural moisture content by oven drying method.
2. Determination of field dry unit weight using core cutter method.
3. Determination of field dry unit weight using sand replacement method.
4. Determination of specific gravity of Soils.
5. Grain size distribution analysis by sieve analysis.
6. Grain size distribution by hydrometer analysis.
7. Determination of liquid limit by Casagrande's apparatus.
8. Determination of plastic limit.
9. Determination of shrinkage limit.
10. Determination of coefficient of permeability using Constant-head test method.
11. Determination of coefficient of permeability using Falling-head method.
12. Compaction of soil by standard proctor test.
13. Compaction of soil by modified proctor test.
14. Determination of relative density of soil.
15. Consolidation Test.
16. Unconfined Compression Strength Test.
17. Direct Shear Test.
18. Triaxial Test (UU)

Course Outcomes: Upon completion of this course the student shall be able to:

1. Analyze soil behavior and its mechanism.
2. Find role of basic properties of soil in simple and complex applications.
3. Develop a proficiency in handling experimental data. 4.
4. Report the results of a laboratory experiment at a professional standard.
5. Recommend extensive research in geotechnical properties.

Recommended Books / Manuals:

1. Prakash, S. and Jain, P.K, "Soil Testing Engineering, Manual", Nem Chand & Brother.
2. Craig, R.F., "Soil Mechanics", Chapman & Hall.
3. Taylor, "Fundamentals of Soil Engineering", John Wiley & Sons.
4. Holtz,R.D. and Kovacs, W.D., "An Introduction to Geotechnical Engineering", Prentice Hall.
5. Das, B.M., "Principles of Geotechnical Engineering", CengageLearning.
6. Das, B.M., "Learning Principles of Foundation Engineering", Cengage Learning.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Departmental Elective	BTCE511C	Environmental Engineering-II	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Understand characteristics of wastewater and its determination.
2. Study wastewater generation and design periods for wastewater treatment units.
3. Expose the students to understand components of sewer lines.
4. Develop analytical skills and design of wastewater treatment units.

UNIT-I

Introduction: Terms & definitions, types of sewage, system of sewerage, choice of sewerage system and suitability to Indian conditions.

Sewerage Systems: Generation and estimation of community sewage, flow variations, storm water flow, types of sewers. Design of sewers and storm water sewers, construction & maintenance of sewers, sewer appurtenances, sewage pumping and pumping stations.

UNIT-II

House Drainage: Principles of house drainage, traps, sanitary fittings, systems of plumbing, drainage lay out for residences.

Characteristics of Sewage: Composition of domestic and industrial sewage, sampling, physical, chemical and microbiological analysis of sewage, biological decomposition of sewage, BOD and BOD kinetics, effluent disposal limits.

UNIT-III

Treatment of Sewage: Introduction to unit operations and processes – Primary treatment: screening (theory), grit chamber (theory and design), floatation units, sedimentation tanks (theory and design), Secondary treatment units: ASP (theory and design), Sequencing batch reactors (theory and design), Trickling filters (theory and design) Anaerobic systems; Anaerobic filters (theory), UASB (theory), Anaerobic lagoons (theory), Sludge handling and disposal; thickening, stabilization, dewatering, drying and disposal.

UNIT-IV

Low Cost Sanitation Systems: Imhoff tanks (theory and design), septic tank (theory and design), soakage pit/soil absorption systems; stabilization ponds (theory and design); oxidation ponds (theory and design); and constructed wetland systems.

Wastewater Treatment Plants and Advanced Wastewater Treatment: Treatment Plants; site selection, operation and maintenance aspects, advanced wastewater treatment for nutrient removal, disinfection for sewage.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Understand assessment procedure and significance of physical, chemical and biological characteristics of wastewater.
2. Explain the process of self-purification of the sources of disposal and determine the degree of treatment of sewage based on the source of disposal of wastewater.
3. Evaluate the quantity estimation for sewage generation.
4. Describe and design various parameters of collection and conveyance of wastewater.
5. Design of wastewater treatment units.

Books Recommended :

1. Punmia, B.C. and Jain, A., "Waste Water Engg. (Environmental Engg.-II)'' Laxmi Publications.
2. Garg, S.K., "Environmental Engineering (Vol. II)" Khanna Publishers, Delhi.
3. Sincero, A. P. and Sincero, G. P., "Environmental Engg. – A design Approach" Prentice Hall of India, New Delhi.
4. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., "Environmental Engg."McGraw Hill, International Edition.
5. Metcalf and Eddy,"Wastewater Engineering Treatment, Disposal, Refuse",T.M.H. Edition, New Delhi, 1995.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Departmental Elective	BTCE512C	Repair & Rehabilitation of Structures	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Understand the cause of deterioration of concrete structures.
2. Able to assess the damage for different types of structure.
3. Summarize the principles of repair and rehabilitation of structures.
4. Recognize the ideal material for different repair and retrofitting techniques.

UNIT-I

Maintenance and Repair Strategies: Definitions: Maintenance, Repair and rehabilitation. Facets of maintenance, Importance of maintenance and Daily, weekly, monthly, yearly Routine Maintenance, Various aspects of inspection, Stages of inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.

UNIT-II

Materials for Repair: Special concretes and mortar, Concrete chemicals, special elements for accelerated strength gain, Expansive cement, Polymer concrete, Sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete.

Strength and durability of concrete: Quality assurance for concrete: Strength, Durability and Thermal properties, Cracks: Different types, Causes, Effects due to climate, Temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness.

UNIT-III

Techniques for Repair and Protection Methods: Non-destructive testing techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques: Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, Cathodic protection.

Demolition techniques: Engineered demolition methods and Case studies.

UNIT-IV

Repair, Rehabilitation and Retrofitting of Structures: Evaluation of root causes, Under pinning & shoring some simple systems of rehabilitation of structures; Guniting, Shortcreting, Non-destructive testing system; Use of external plates, Carbon fibre wrapping and carbon composites in repairs. Strengthening of structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Understand design and construction errors.
2. Understand special concretes and mortar, concrete chemicals etc..
3. Understand maintenance, repair and rehabilitation.
4. Understand various techniques of repair.

Books Recommended :

1. Panchdari, A.C., “Maintenance of Buildings”, New Age International (P) Limited Publishers.
2. Gambhir, M.L., “Concrete Technology”, McGraw Hill, 2013.
3. Ravishankar, K. and Krishnamoorthy, T.S., “ Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures”, Allied Publishers, 2004.
4. Chudley, R., “Building Finishes, Fittings and Domestic Services”, Longman Technical Services.
5. Szechy, G., SCD., “Foundation Failures”, Concrete Publications Limited, 14 Dartmouth Street, London.
6. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
7. Ransom, W.H., “Building Failures: Diagnosis and Avoidance”, New Age Publications (P) Ltd.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Departmental Elective	BTCE513C	Environment Impact Assessment and Life Cycle Assessment	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Learn the purpose and role of EIA in the decision-making process.
2. Provide knowledge on the strengths of EIA in regard to environmental management.

UNIT-I

Evolution of EIA Concepts: Methodologies – Screening- Scoping- Base line studies- Mitigation – Matrices - Check List.

UNIT-II

Elements of Life Cycle Assessment: Life Cycle Costing, Eco Labelling, Design for the Environment, Environmental Audit- Life cycle Assessment, International Environmental Standards

UNIT-III

Assessment of Impacts: Air, Water, Soil, Noise, Biological, Green energy and green process management in Pharmaceutical, Construction, Textiles, Petroleum Refineries, Iron and Steel.

UNIT-IV

Documentation of EIA: Environmental management Plan- Post Project monitoring Environmental Management System EMS – case studies in EIA.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Identify the negative impacts and propose the provision of infrastructure or mitigation measures.
2. Develop current EIA methods, assessment methods, environmental monitoring systems and legislation.
3. Assess process of environmental impact modelling and prediction as a design tool.
4. Interact with experts of other fields to assess the impact.

Books Recommended :

1. Ramaswami, A., Milford J.B. and Small M. J., "Integrated Environmental Modeling - Pollutant Transport, Fate and Risk in the Environment", John Wiley & Sons.
2. Burrough, P.A. and McDonnell, R.A, "Principles of Geographical Information Systems", Oxford University Press 1998.
3. Snape, J.B., Dunn I.J., Ingham, J. and Prenosil, J.E., "Dynamics of Environmental Bioprocesses Modeling and Simulation", VCH, Weinheim 1995.
4. Chapra, S.C., "Surface Water Quality Modeling", McGraw-Hill Inc. 1997

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Advanced Diploma Course	BTCE507C	Earthquake Engineering	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Provide a coherent development to the students for the courses in sector of earthquake engineering.
2. Present the foundations of many basic engineering concepts related earthquake engineering.
3. Give an experience in the implementation of engineering concepts which are applied in field of earthquake engineering.
4. Involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

UNIT-I

Introduction to Earthquakes: Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters, Seismic Zoning Map of India, Seismograms and Accelerogram. Past earthquakes and Lessons learnt.

UNIT-II

Introduction to Dynamics: Theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, spring action and damping, Single Degree of Freedom (SDOF) Systems – Formulation of equations of motion –Undamped and damped free vibration –Damping –Response to harmonic excitation –Concept of response spectrum. Multi-Degree of Freedom (MDOF) Systems: -Formulation of equations of motion –Free vibration –Determination of natural frequencies of vibration and mode shapes –Orthogonal properties of normal modes –Mode superposition method of obtaining response.

UNIT-III

Lateral Force Analysis: Lateral Strength, stiffness, ductility and structural configuration, Floor Diaphragm action, Moment resisting frames, shear walls.

Codal Design Provisions: Review of the latest Indian seismic code IS:1893 (Part-I) provisions for buildings – Earthquake design philosophy.

UNIT-IV

Codal Detailing Provisions: Review of the latest Indian Seismic codes IS: 4326 and IS: 13920 provisions for ductile detailing of R.C buildings –Beam, column and joints, Design of Shear walls as per IS: 13920 –Detailing of reinforcements.

Course Outcomes: The course will enable the student to:

1. Gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.
2. Get a diverse knowledge of earthquake engineering practices applied to real life problems.
3. Understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.
4. Apply various codal provisions related to seismic design of buildings.

Books Recommended:

1. Aggarwal, P. and Shrikhande, M., "Earthquake Resistant Design of Structure" Learning, PHI.
2. Chopra, A.K., "Dynamics of Structures: Theory and application of earthquake engineering" Prentice Hall.
3. Clough, R.W. and Penzien, J., "Dynamics of structures" McGraw-Hill Education.
4. David, J. and Dowrick, "Earthquake Resistant Design" Willey India Pvt. Ltd.
5. Krishna, J., Chandrasekaran, A.R. and Chandra, B., "Elements of Earthquake Engg" South Asian Publishers.

6. IS 12893-2016 Indian Standard Criteria for Earthquake Resistant Design of structures.
7. IS: 4326-1993 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
8. IS:13920: 2016 Ductile Design and Detailing of Reinforced Concrete Structures subjected to Seismic Forces- Code of Practice.

Annexure-III

Syllabus of Open Electives offered by Department of Civil Engineering to

Other Departments

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Open Elective	BTCE907C	Traffic Management	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Learn the basics of traffic management, regulation & control devices.

UNIT-I

Fundamentals of Traffic Management:

Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow.

UNIT-II

Traffic Regulation and Control devices:

Road Signs and markings; Channelization; At-grade and Grade separated intersections; Traffic Rotary; Designprinciples of traffic signals.

UNIT-III

Traffic Management Techniques:

Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in traffic management.

UNIT-IV

Logistics for Traffic Management:

Definition, domain, role and responsibility of traffic management agencies, Principles and systems of coordination in Traffic management; Intelligent transport system- concept, Traffic Management logistics - equipment's, vehicles and traffic control centre; Centralized Data Processing and Monitoring, Traffic personnel-skills & deployment systems.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Have an overall knowledge of the traffic components and assess the traffic characteristics and related problems.
2. Develop a strong knowledge base of traffic planning and its management in any transportation area.
3. Provide knowledge of traffic control devices and its techniques in transportation interaction.
4. Traffic data, traffic volume count, intersection studies and spot and journey speed studies and further to analyse them.

Books Recommended :

1. Fred, L. Mannering, Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis.7th Edition, Wiley, 2019.
2. Kadiyali, L.R. "Traffic Engineering & Transport Planning". KhannaPublications,2013.
3. Khisty, C.J. and Lall B.K. "Transportation Engineering–An Introduction".3rd Edition, Pearson, 2017.
4. Khanna, S.K., Justo C.E.G and Veeraragavan A. "Highway Engineering". Revised 10 th Edition, Nem Chand Bros, 2017.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Open Elective	BTCE908C	Road Safety	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. learn the basics of road safety measures & audits.

UNIT-I

Road Accidents:

Causes of road accidents: Vehicle design factors &Driver characteristic s influencing road safety, Road condition, Parking and its influence on traffic safety

UNIT-II

Road safety measures:

Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to identify and prioritize black spots.

UNIT-III

Road safety audits:

Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety

UNIT-IV

Ensuring Traffic Safety in Road Operation:

Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Investigate & determine the collective factors and remedies of accident involved.
2. Able to collect and represent accident data to identify black spots.
3. Understand the role of intelligent transport system in Road safety.

Books Recommended :

1. K.W. Ogden, “Safer Roads – A Guide to Road Safety Engg”Averbury Technical, Ashgate Publishing Ltd., Alder shot, England, 1996.
2. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna Publications, New Delhi, 2009.
3. C. JotinKishty& B. Kent Lall, “Transportation Engineering-An Introduction”, Third Edition, Prentice Hallof India Private Limited, New Delhi, 2006.

Annexure-IV

M.Tech. Transportation Engineering (Part-Time)

Scheme and Syllabus

Batch 2023 and Onwards

Department of Civil Engineering

Semester 1st									Total Credits=9	
Sr. No.	Category	Subject Code	Course Title	Contact Hours			Maximum Marks		Total Marks	Credits
				L	T	P	Internal	External		
1.	Core Subject	MTTE-101	Advanced Traffic Engineering	3	0	0	40	60	100	3
2.	Core Subject	MTTE-102	Advanced Soil Engineering	3	0	0	40	60	100	3
3.	Department Elective	MTTE-111	Reinforced Soil Design & Construction	3	0	0	40	60	100	3
		MTTE-112	Transportation Economics & Finance)							
		MTTE-113	Transportation & Environment							
4.	Mandatory (Non-Credit)	SBS101C	Introduction to Shaheed Bhagat Singh and his co-patriots	1	0	0	S/US			
Total				**10**	**0**	**0**	**120**	**180**	**300**	**9**

Semester 2nd									Total Credits=8	
Sr. No.	Category	Subject Code	Course Title	Contact Hours			Maximum Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	Core Subject	MTTE-201	Highway Construction Material and Methods	3	0	0	40	60	100	3
2	Core Subject	MTTE-202	Application of GIS in Transportation Engineering	3	0	0	40	60	100	3
3	Core Subject	MTTE-203	Pavement Materials Testing Laboratory	0	0	4	30	20	100	2
Total				**6**	**0**	**4**	**110**	**140**	**300**	**8**

Semester 3rd									**Total Credits=9**	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1.	Core Subject	MTTE-301	Transportation System Planning & Management	3	0	0	40	60	100	3
2.	Core Subject	MTTE-302	Advanced Foundation Engineering	3	0	0	40	60	100	3
3.	Department Elective	MTTE-311	Railway Infrastructure Planning and Design	3	0	0	40	60	100	3
		MTTE-312	Sustainable Transportation Systems							
		MTTE-313	Road Safety and Management							
Total				**9**	**0**	**0**	**120**	**180**	**300**	**9**

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	MTTE-301	Transportation System Planning & Management	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Familiarize with the techniques of analysis, performance evaluation and management of transportation systems.
2. Acknowledge the various techniques related to estimation of transportation.
3. Examine various transportation planning techniques and their applications.

UNIT-I

General: Importance of transportation, transportation planning methodology, hierarchical levels of planning and its relation to rural, urban areas, Long range planning, Passenger and goods transportation, General concept and process of transport planning, Land-use transport interactions, Socio-economic characteristics of Land use.

Transportation and society: Role of Transport in Society and Economy – Functions and Problems in Transportation Planning - Economic, Geographical, Political, Technological, Social and Cultural Factors in Planning of Transportation System.

UNIT-II

Transport Technology: System Classification and their Variation; Conventional Systems and Unconventional Systems - Air, Water and Ground Modes.

Transportation Systems: Multi modal transportation system; Characteristics of Mass Transit systems including technical, demand operational and economic problems, Mass Rapid Transit System Elevated, Surface and Underground construction, Express Bus System, Operating Characteristics of Terminal and Transfer facilities.

UNIT-III

Urban Transportation Planning Studies: Urban Travel Characteristics, Transportation demand Surveys, Delineation of the urban area, zoning, Origin-Destination Studies, Home interviews trip, Classification and Socio-Economic variables in trip making projections.

Planning Methodology and Systems Analysis: Study of existing network-trip generation techniques, Category analysis, multiple regression techniques, Trip distribution techniques, Growth Factor model, Gravity models, Opportunity models and multiple regression models, Traffic assignment methods, Minimum Path Tree-All or nothing assignment

UNIT-IV

Maintaining and Operating System: Operational Controls of Air, Water, Railway and Highway Transportation Systems, Functions of Control & Communications - Signals and Traffic Control Devices - Navigational Aids of the different Transportation Systems, Air Traffic Control, Navigational Control, Automatic Signalling Systems of Railway and Highway Movements.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Gain Knowledge of various systems of transportation.
2. Have an in-depth knowledge of demand projection techniques of various transportation systems.
3. Identify and analyse the impact of various factors that affect various aspects of urban transportation system.

Books Recommended :

1. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, KhannaPublishers.
2. Khanna,S.K. and Justo, C. E.G. “Highway Engg.” New Chand Publication.
3. Papacostas, C.S. and Prevedouros, P.D., “Transportation Engineering and Planning”, Prentice Hall of India Private Limited.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Core Subject	MTTE-302	Advanced Foundation Engineering	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Study the different types of foundation and their suitability for particular site and structure., soil-structure interaction, calculation of allowable load and settlement of the foundation.
2. Be able to analyze and design shallow foundations and deep foundations.
3. Get acquainted with the concept of soil liquefaction and its remedial measures.

UNIT-I

Shallow Foundations: Design considerations- factors of safety (including limit state), Allowable settlements, Location and depth of foundations, Codal provisions, Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N- values, Elastic solutions. Static cone tests, Plate load test.

UNIT-II

Deep Foundations: Type of Piles. Construction methods. Axial capacity of single piles-static formulae, Skin friction and end bearing in sands and clays, Axial capacity of groups, Laterally Loaded Piles, Short and long piles, Free head and fixed head piles, Lateral load capacity of single piles, Lateral deflection, Elastic analysis, Group effect, Lateral load test, Codal provisions, Caissons and Wells.

UNIT-III

Soil Structure Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT-IV

Soil Liquefaction: Concept of soil liquefaction, Effects of soil liquefaction , quick sand condition and remedial measures, stone column, vibro floatation, deep compaction.

UNIT-V

Foundations in difficult soils: Expansive soils, chemically aggressive environment, soft soils, fills, regions of subsidence.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Decide the type of foundation required for a particular site and structure.
2. Make geotechnical design of the foundations for civil engineering structures under varied field conditions.
3. Carry out analysis to identify problems of liquefaction and ascertain remedial measure for soil improvement.

Books Recommended :

1. Bowles, J.E., “Foundation Analysis and Design”, Mc-Graw Hill Publications.
2. Kaniraj, S.K., “Design aids in soil mechanics and foundation engineering”, Mc-GrawHill .
3. Poulos, H.G. and Davis, E.H., “Pile Foundation Analysis and Design”, John Wiley.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Department Elective	MTTE-311	Railway Infrastructure Planning and Design	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Over view of importance of railway, its infrastructure and analyze the travel behavior and plan for the railway line network.
2. Design the geometry of the track system.
3. Get acquainted with the signaling, interlocking, maintenance and management of the railway track system.
4. Explore and evaluate the recent advancements in the field of railway and their applications.

UNIT-I

Planning of Railway Lines: Railways operational system, historical background of Indian railways, plans and developments, policy and standards, traffic forecast and surveys, railway alignment, project appraisal, and organization setup.

Components of Railway Track and Rolling Stock: Permanent way, forces acting, rails, rail fixtures and fastenings, sleepers and ballast, rail joints, elements of junctions and layouts, types of traction, locomotives and other rolling stock, brake systems, resistance due to friction, wave action, wind, gradient, curvature, starting, tractive effort of a locomotive, hauling power of a locomotive.

UNIT-II

Railway Track Geometric Design: Right of way and formation, field investigations, geometric design elements, safe speed on curves, speeds computation, string lining of curves, gradients, grade compensation, railway cant and cant deficiency, traction.

Track Construction and Maintenance: Track laying, inspection and maintenance, maintenance tools, maintenance of rail surface, track drainage, track tolerances, mechanized method, ballast confinement and directed track maintenance, bridge maintenance, renewal, classification of renewal works, mechanized relaying, track renewal trains.

UNIT-III

Signaling and Interlocking: Objectives, classification, fixed signals, stop signals, signaling systems, mechanical signaling system, electrical signaling system, systems for controlling train movement, interlocking, **modern signaling installations**

Railway Accidents and Safety: Train accidents, collision, derailments, causes, restoration of traffic, safety measures, disaster management, classification of level crossings, accidents at level crossings, remedial measures, maintenance of level crossings.

UNIT-IV

Railway Station and Yards: Site selection, facilities, classification, platforms, building areas, types of yards, catch sidings, slip sidings, foot over bridges, subways, cranes, weighbridge, loading gauge, end loading amps, locomotive sheds, triangles, traverser, carriage washing platforms, buffer stop, scotch block, derailing switch, sand hump, fouling mark.

High-Speed Railways: Modernization of railways, the effect of high-speed track, vehicle performance on the track, railway track design for high speeds, dedicated freight corridors, high-speed ground transportation system, ballast less track, elevated railways, underground and tube railways.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Plan the railway network.
2. Determine factors governing the design of railway infrastructure.
3. Design the railway track system and identify a suitable signal system and develop maintenance strategies.
4. Assess requirements of high-speed railway track and recommend suitable measures for the safety of the railway network.

Books Recommended :

1. Chandra, S., and Agarwal, M.M., "Railway Engineering, Oxford University Press", Noida, India, Second Edition, 2013.
2. Mundrey, J.S., "Railway Track Engineering", McGraw-Hill Education Private Limited, New Delhi, India, 2017, Fifth Edition.
3. Gupta, B.L., and Gupta, A., "Railway Engineering" Standard Publishers Distributors, New Delhi, India, Third Edition, 2012.
4. Rangwala, S.C., Charotar "Railway Engineering" Publishing House Pvt. Ltd., Anand, India, Twenty Seventh Edition, 2017.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Department Elective	MTTE-312	Sustainable Transportation Systems	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. examine the sustainability of transportation systems by determining environmental issues, their characteristic, scale of the problem related to transportation systems.
2. evaluate the challenges of potential solutions in order to reduce unsustainable impacts of the transport
3. study the concept of Environmental Impact Assessment and different planning processes related to sustainability in transportation.
4. familiarize with different modes of sustainable transportation

UNIT-I

Introduction to Transportation Systems: Evolution of Transportation modes, Transportation Systems, Factors influencing Development & Efficiency of a Transport System, Components of Transportation System, Multimodal Transport, Concept of Sustainability, Current Scenario of Transportation in India, Climate change: Indicators and impacts.

UNIT-II

Impacts of Transportation Systems-I: Transport-Environmental Link, Energy consumption and Emissions by Transport Sector, Environmental Impacts of Transport, Traffic generated Air Pollution (The Case of Los Angeles, California), Policy implication, Health Improvement Strategies, Case Study, Mitigation Measures, Conclusion

Impacts of Transportation Systems-II: Noise, Harmful Effects of Noise, Noise Level Standards, Factors affecting Traffic Noise, Sources of Vehicular Noise, Noise measurements, Mitigation measures for Noise pollution, Numerical Problems.

UNIT-III

Introduction to Environmental Impact Assessment (EIA): EIA processes, Methodologies of EIA, Global practices in EIA process EIA Process in India, Case Study.

Introduction of Land Use: Land use planning & zoning, Transit Oriented Development(TOD), TOD implementation, TOD case study – Section of Delhi Metro.

Introduction to Sustainable Transport Planning: Material Flow Analysis (MFA), Concept of Circular economy in Transport Sector, Initiatives & Policies for Environmental Sustainability, National Clean Air programme & Transport Sector.

UNIT-IV

Alternative Fuels and Sustainable Transportation: Non-Motorized Transport (NMT), Electric vehicles, Emerging Transport Technology – Hyperloop, Case Study- Bus Rapid Transit System (BRTS), Mass Rapid Transit Systems (MRT).

Sustainability Indicators: Sustainable Transport Appraisal Rating (STAR), Measuring Sustainability, Material Flow Analysis Tool- STAN.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Explain the unsustainable impacts of today's transport sector.
2. Analyze and compare the potentials and challenges of technological, organizational and policy solutions.
3. Find optimum solutions and propose a plan towards sustainable transportation.

Books Recommended :

1. Sucharov, L.J. and Baldasano, J.M., "Urban Transport and the Environment, Vol. II", Computational Mechanics Publications,1996.
2. Wood, C. and Wood, C., "Environmental Impact Assessment: A Comparative Review", Prentice Hall, 2002
3. Petts, J., "Handbook of Environmental Impact Assessment", Blackwell Publishing, 1999.
4. Zannetti P. (Ed.), "Environmental Modeling, Vol. I", Computational Mechanics Publication, Elsevier Applied Science,1993.
5. Assessment & Decision Making for Sustainable Transport, European Conference of Ministers of Transport, OECD Publishing, 2004.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Department Elective	MTTE-313	Road Safety and Management	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. Understand the causes of accidents, statistical measures of accident data analysis and computer application in data analysis.
2. Examine and evaluate different parameters responsible for providing road safety in the construction of new roads.
3. Learn about road safety audit principle and procedure, various traffic management techniques and their effectiveness.

UNIT-I

Road accidents, Causes, Scientific Investigations and Data Collection: Analysis of Individual Accidents to Arrive at Real Causes; Statistical Methods of Analysis of Accident Data, Application of Computer Analysis of Accident Data**.**

Ensuring Traffic Safety in Designing New Roads: Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section & Objects.

UNIT-II

Ensuring Traffic Safety in Road Reconstruction: Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads, Examples of Reconstruction of Selected Road Sections for Improving Traffic Safety, Improving Traffic Conditions on Grades, Sharp Curves, Redesign of Intersections, Channelized At-grade Intersections, Bus Stops, Parking & Rest Areas and Effectiveness of Minor Road Improvements.

UNIT-III

Ensuring Traffic Safety in Road Operation: Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.

UNIT-IV

Road Safety Practices: Principles- Procedures and Practice, Code of Good Practice and Checklists. Road Safety Issues and Various Measures through Engineering, education and enforcement measures for improving road safety.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Acquire knowledge statistical methods and computer application of accident analysis.
2. Analyzing the factors affecting the construction of new roads, reconstruction of existing road and operational conditions of road.
3. Remember the process of road safety audit and the measures of improving road safety.
4. Evaluate the effectiveness of various management techniques adopted in reducing road accident.

Books Recommended :

1. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna Publishers, 2009.
2. Kishty, J.C. and Lall, K.B., “Transportation Engineering- An Introduction”, Thrid Edition, Prentice Hall of India Private Limited, New Delhi, 2006.
3. Khanna, S.K. and Justo, C. E.G., “Highway Engg.” New Chand Publication, 2001.
4. Babkov, V.F., “Road conditions and Traffic Safety”, MIR, publications, Mascow, 1975.

Annexure-V

Semester 2nd									Total Credits=8	
Sr. No.	**Category**	**Subject Code**	**Course Title**	**Contact Hours**			**Maximum Marks**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
1	Core Subject	MTTE-201	Highway Construction Material and Methods	3	0	0	40	60	100	3
2	Core Subject	MTTE-202	Application of GIS in Transportation Engineering	3	0	0	40	60	100	3
3	Core Subject	MTTE-203	Pavement Materials Testing Laboratory	0	0	4	30	20	100	2
Total				**6**	**0**	**4**	**110**	**140**	**300**	**8**