01.02.2023

M.Tech., Highway Technology (CHT)
(Effective from the Academic year 2022-23)

Program Outcome of this course: After successful completion of the program, the postgraduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

Semester- 1

APPLIED STATISTICS FOR HIGHWAY ENGINEERS			
Course Code	**22CHT11**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

1. Understand the use of statistical tools to express the traffic data for betterinterpretation.
2. Apply probability concept to understand the vehicular flow behavior helping the planners to predict trafficflow.
3. Use appropriate statistical testing tools to check the degree of accuracy in the trafficdata analysis.
4. Test the hypothesis and assess the error involved in the dataanalysis.
5. UsesoftwaretoolslikeMATLAB,MINITABetc.,foranalysisoftrafficdataandalso usecurvefittingtechniquesforpredictingthe performancetrends

Module-1

Introductiontostatisticalmethods:Definition,Scope,andLimitationsofStatistics.Variablesandtheirtypes.Typesofdata–PrimaryandSecondarydata,sourcesofsecondarydata.Scalesofmeasurementofdata.Methodsofcollectionofdata.Reliability and Accuracy ofdata.

Presentation of data -Tabular methods (Frequency distribution for both discrete and continuous data) and Graphical methods (Bar diagrams, Pie diagrams, Histogram – location of mode using Histogram, Frequency curves and polygons, Line graph, Ogive curve – location of median using ogives, Scattered diagram. Advantage and disadvantage of both tabular and graphical methods. Summarizing data. Measure of central tendency – and Measures of dispersion/ variation. Merits and Demerits of measures of central tendency and dispersion. Measures of Skewness and Kurtosis.

Activities: Group based assignment using excel to solve problems on frequency distribution, graphical methods, measures of central tendency and dispersion

Teaching Learning Process	Black board, LCD, Skill enhancement through problem solving.

Module-2

Probability&Probabilitydistributionfor TrafficEngineeringDesign: DefinitionofSamplespace,mutuallyexclusive,equallylikely, independent outcomes, favorable events, Definitions of different types of probability, addition and multiplication rule of probability, conditional probability, Bayes theorem. Random variables, Definition of probability mass function (pmf) based on discrete random variable and probability density function (pdf) based on continuous random variable. Expected value and Variance of discrete and continuous random variables. Cumulative distributionfunction.

Joint probability distribution. Special discrete probability distributions like Bernouli, Binomial and Poisson. Special continuous probability like Normal distribution and Standard normal distributions. Problems based on probability distributions.

Activities: Group based assignment on finding probabilities of different distribution using excel.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving.

Module-3

Sampling Techniques: – Definition of basics concepts of sampling, advantages and disadvantages of sampling, Probability and non-probability sampling techniques, Sampling variation. Definition of sampling distribution, sampling distribution of the sample mean (t-distribution), sample variance (Chi-square distribution), sample proportion (Z-distribution), ratio of sample two sample variance (F-distribution) Central limit theorem, Sampling error, Sample size distribution

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-4

Statistical Inference: Basics of testing of hypothesis.

Parametric tests: Z-test for mean and proportion, Students' t-test, F-test, Analysis of Variance

Non-parametrictests:Chi-squaretest,Fisher'sexactprobabilities,Mann-WhitneyUtest,Wilcoxonsignedranktest,Kruskal-Wallis test

Activities: Group based assignment on Students' t-test and ANOVA using excel

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-5

Correlation: Definition of correlation, Nature of correlation, Types of correlation, Measures of correlation

Regression: Curve fitting by the method of least squares, Simple Linear Regression & Multiple linear regression. Use of statistical software like SPSS, R, Python, MATLAB

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark fortheCIEis50%ofthemaximummarks.MinimumpassingmarksinSEEis40%ofthemaximummarksofSEE.Astudentshallbedeemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50%(50marksoutof100)inthesumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**

2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks**to attaintheCOsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50. 2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module. 4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Johnson R and G Bhattacharya, "Statistics – Principles and methods"- John Wiley & sons, New york,1985
2. L.R Kadiyali, "Traffic Engineering"- Khanna Publishers NewDelhi
3. Kumar Molugaram and G. Shanker Rao, "Statistical Techniques for Transportation Engineering"-BSPublications

Reference Books:

1. Medhi, "Introduction to statistics"- New Age Pub, NewDelhi
2. Benjamin Jack R and Cornell C Allin, "Probability Statistics & Decisions for Civil Engineers"- McGraw HillCo.
3. Agarwal, B.L, "Basic Statistics"- 3rd edition, New Age Pub. NewDelhi.
4. Martin Wohl, Brian V Martin, "Traffic System Analysis"- Mc Graw HillSeries

Web links and Video Lectures (e-Resources):

1.https://nptel.ac.in/courses/110107080

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the use of statistical tools to express the traffic data for better interpretation.	L2, L3
CO2	Apply probability concept to understand the vehicular flow behavior helping the planners to predict traffic flow.	L3, L4, L5
CO3	Use appropriate statistical testing tools to check the degree of accuracy in the traffic data analysis.	L3, L4
CO4	Test the hypothesis and assess the error involved in the data analysis.	L2, L3, L4
CO5	Use software tools like MATLAB, MINITAB etc., for analysis of traffic data and also use curve fitting techniques for predicting the performance trends.	L4, L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1				x	x				
CO2		x		x	x				
CO3				x		x			
CO4					x				
CO5				x		x			

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Semester – 1

Pavement Analysis and Design			
Course Code	22 CHT12	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

This course will enable students to

Understand the factors affecting pavement design and performance

Evaluate the strength of soil subgrade and factors that affect the behaviour of soil.

Compute the stresses and deflections in flexible and rigid pavement layers under the action of wheel loads.

Design the thickness of flexible pavements by different methods under different exposure conditions and materials.

Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.

MODULE-1	
Pavements and pavement layers - types, functions, Highway and Airfield pavements, axle load distribution, ESWL, EWL, VDF due to varying loads and CSA. Flexible pavement design factors	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Field studies
MODULE-2	
Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation Pavement Material Characterization,climatic,drainageandenvironmentalfactors,theireffectsandevaluation.Factorsaffectingdesignandperformance of airportpavements.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Lab tests and Field studies
MODULE-3	
Stresses in Flexible pavements: Layered System concepts, Stress solution for one, two- and three-layered systems. Applications in pavement design. Problems **Stresses in Rigid Pavements:** Westergaard's theory and assumptions, Stresses due to Curling, stresses and deflection due to loading, frictional stresses. Stresses in dowel bars and tie bars.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving
MODULE-4	
Flexible pavement design: Empirical, semi- empirical and theoretical design approaches, principle, advantages and application. Design steps by CBR method as per IRC, outline of other common design methods such as AASHTO and Asphalt Institute methods, Problems. **Application of IIT PAVE software, ANSYS, KENPAVE, KENLAYER, AASHTOWARE**	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Demo and learning of design software
MODULE 5	
Rigid pavement design: Rigid pavement design factors, Determination of ESWL, EWL for dual and dual tandem wheel loads in Rigid pavements, General design principle, , design of cement concrete pavements (joints and slab thickness) as per IRC/PCA guidelines. Design features of CRCP, SFRC and ICBP, Problems. Application of Design Software	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Demo and learning of design software.

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PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Classified traffic volume studies, Axle load survey
2	Subgrade strength evaluation tests such as California Bearing Ratio (CBR), Dynamic Cone Penetrometer (DCP) test, Triaxial compression or direct shear test
3	Determination of field density of pavement layers by sand replacement method, core cutter method
4	Plate bearing test for determination of modulus of subgrade reaction
5	The field CBR test or in –situ CBR value by Dynamic Cone Penetration Test
6	Tests on Bituminous Pavement Layers: 1. Destructivetest: a. To determine density, void analysis, bitumen content and aggregate gradation after bitumen extractionby b. Coredrilling c. Digging and taking bituminous mix samples from a testpit
7	Learning IITPAVE Software for flexible pavement Design as per IRC 37 2018
8	Design of CC pavement as per IRC 58 2015 using MS Excel

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of thesemester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report.Eachexperimentreportcanbeevaluatedfor10marks.Marksofallexperiments'write-upsareaddedandscaleddown to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50marks.
2. The question paper will have ten questions. Each question is set for 20marks.
3. Therewillbe2questionsfromeachmodule.Eachofthetwoquestionsunderamodule(withamaximumof3sub-questions), **should have a mix of topics** under that module.

4. The students have to answer 5 full questions, selecting one full question from eachmodule.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.

Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEEwillbeconductedfor100marksandstudentsshallsecure40%ofthemaximummarkstoqualifyintheSEE.Markssecured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE+SEE)

Suggested Learning Resources:

Books

Text Books:

1. Yang H. Huang, "Pavement Analysis and Design", Second Edition, Pearson Education,2008.
2. Rajib B. Mallick and Tahar EL-Korchi., "Pavement Engineering Principles and Practice", Third Edition, CRC Press Taylor and Francis Group.
3. Yoder,E.J.andWitczak,M.W.,"PrinciplesofPavementDesign",SecondEdition,JohnWileyandsons

ReferenceBooks:

1. Huang, "Pavement Analysis"- Elsevier Publications
2. DavidCroney,PaulCroney,"Design&PerformanceofRoadPavements"-McGrawhillBookCo.3.W.RonaldHudson,RalphHaasand Zeniswki "Modern Pavement Management"- McGraw Hill andCo.
4. S.K. Khanna, C.E.G Justo and A. Veeraragavan "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10thEdition.
5. Relevant IRCCode

Web links and Video Lectures (e-Resources):

1) https://www.youtube.com/watch?v=uJntLOgEHD4
2) https://youtu.be/HLVjhGDdsSM
3) https://youtu.be/GxXONAINMBE

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Determining various design factors such as VDF, ESWL, CSA through Problemsolving
- LabTestingofsubgradesoilto determineitsbasicpropertiessuchasGrain sizeanalysis,Atterberglimits,MDDandOMC, CBRetc
- Lab testing of other pavement materials such as aggregates, Bitumen, cement, Bituminous mixes and concrete

Learning Design Software for flexible and Rigid pavementdesign

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the factors affecting pavement designandperformance	L1, L2, L3, L4
CO2	Evaluate the strength of soil subgrade and other factors that influencepavementdesign	L2, L5
CO3	Compute the stresses and deflections in flexible and rigidpavementlayers	L1, L2, L3, L4,L5
CO4	Design the flexible pavements by IRC methods and also know the outline ofotherdesign methods	L1, L2, L3, L4, L5, L6
CO5	Design the thickness of concrete pavements and joints associated with CC pavementsanddesign outline of special concretepavements.	L1, L2, L3, L4, L5, L6

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Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	x			x	x			x
CO2	x			x	x		x		
CO3	x			x	x		x		
CO4	x	x		x	x	x			
CO5	x	x		x	x	x			

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Semester- 1

PAVEMENT MATERIALS			
Course Code	**22CHT13**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	4	Exam Hours	03

Course Learning objectives: This course will enable students to

- Identify and select the basic construction materials for road construction, based on theircharacteristics.
- Design aggregate gradation for construction of pavement layers in view of its density and strengthparameters.
- Characterize the binder material for bituminous roads and provide an optimum bituminous mixdesign.
- Provide mix design procedure for PQC and the specification for base layer for a CCpavement.
- Propose soil stabilization techniques for highway construction using locally availablematerials.

Module-1	
Soil Mechanics: Basic soil properties, methods to determine strength of soil, Soil compaction for use in fill and subgrade of roads, compaction studies in laboratory and field, properties of compacted soils; strength characteristics of soil; field testing and applications. **Alternate and New materials:** Reclaimed Asphalt Pavement, Fly Ash Slags, GGBS and other marginal materials Characteristics and Application in Highway	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Laboratory Studies

Module-2	
Aggregates: Origin, classification, Equipment, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Laboratory Studies

Module-3	
Bituminous binders: different types, properties and uses, physical tests on bitumen, Rheological and pavement performance related properties,Modifiedbinders,idealpavementbinders,characteristicsandapplicationsinroadconstruction,criteriaforselectionofdifferent binders, characterization of bituminous binders. Bituminous mixes, types, requirements, properties, tests, Marshall Method of mix design, Criteria and super pave mix design, Additives & Modifiers in Bituminous mixes, problems on mix design. Performance based mixdesign	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Laboratory Studies

Module-4	
Portland cement and cement concrete for use in road works – requirements, design of mix for CC pavement as per BIS/PCA, use of additives, IRC specifications & Tests, joint filler and sealer materials and their testing	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Laboratory Studies

Module-5	
Soil stabilization: principle, methods and tests, proportioning of materials and mix design, application of Rothfutch's method. Marginal and waste materials in road construction, their properties and scope in road construction. Use of Fly-ash in road embankment and cement concrete mixes, use of chemical stabilizers in road Construction. Use of Natural stabilizers; characterization of stabilized mixes.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Laboratory Studies

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivity of40marks**to attaintheCOsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse.

Semester EndExamination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised10th Edition.
2. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland,USA
3. Prithvi Singh Kandhal, "Bituminous Road Construction in India", PHI Publications,2016, ISBN:978-81-203-5258-2
4. "Bituminous materials in Road Construction"- HMSOPublication.

Reference Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian RoadsCongress.
2. Relevant IRC/ASTM codes andspecifications
3. Delatte N. J., Concrete Pavement Design, Construction and Performance, CRC Press, Taylor &Franscis Group,2014.
4. PeterC.Taylor,StevenH.Kosmatka,GeraldF.Voigt,etal.,IntegratedMaterialsandConstructionPracticesforConcrete Pavement: A State of the practice Manual Report No. FHWA HIF-07 – 004, 2007. Available online athttps://intrans.iastate.edu/app/uploads/2019/05/IMCPmanual pdf, Accessed on March 17,2020.
5. Neville, A.M., Properties of Concrete, Fifth edition, Pearson,2012.
6. Mehta,P.K.,andMonterio,P.J.M.,Concrete:Microstructure,PropertiesandMaterials,Mc GrawHill,FourthEdition,2013.
7. Shin-CheHuangandHerveDiBenedetto.,AdvancesinAsphaltMaterials:RoadandPavementConstruction,Firstedition,April 2015.
8. S. K. Khanna and C.E.G Justo., "Highway Materials Testing"- NemChand and Bros.,Roorkee.
9. "Soil Mechanics for Road Engineers" - HMSOPublication.
10. Highway Hand Book ny FAW, Publication from NUS,Singapore.
11. Road and Pavement Construction, Shin-Che Huang Hervé Di Benedetto,Hardcover

ISBN: 9780081002698, **eBook ISBN:** 9780081002711, **Imprint:** Woodhead Publishing, **Published Date:** 1st April, 2015, **Page Count:** 492

Web links and Video Lectures (e-Resources):

1) https://onlinecourses.nptel.ac.in/noc22_ce93/preview
2) https://archive.nptel.ac.in/courses/105/106/105106203/

Skill Development Activities Suggested

- Characterization of different pavement materials throughlaboratory.
- Determine the basic properties of materials such as soil, aggregates, Bitumen, Bituminous mixes, cement, and concrete through problemsolving
- Marshal mix designproblems

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Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Identify and select the basic construction materials for road construction depending on their properties.	L1, L2, L3, L4, L5
CO2	Design the aggregate gradation for the pavement layers taking the density and strength factors into consideration.	L1, L2, L3, L4, L5
CO3	Characterize the binder material for bituminous roads and develop the best bituminous mix.	L1, L2, L3, L4, L5
CO4	Describe the base layer and mix design process for a CC pavement.	L1, L2, L3, L4, L5
CO5	Propose soil stabilization techniques for highway construction using locally available materials	L1, L2

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	x	x	x		x	x		
CO2	x	x	x	x	x	x	x		
CO3	x	x	x	x	x	x	x		
CO4	x		x		x		x		
CO5	x		x		x		x		

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Semester- 1

HIGHWAY CONSTRUCTION TECHNOLOGY			
Course Code	**22CHT14/22CIM14**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand the various equipment used for road construction and difficulties associated with highwaydrainage.
- Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and sub baselayers.
- Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed forroads.
- Design the base course thickness and selection of materials as base layer for CCpavements.
- Analyse the defects in road construction and general pavement failures withremedies.

Module-1

Plants and Equipment: Components of pavement structure, functions and requirements,
Plants and equipment: Excavators, graders, compactors, crushers, bituminous hot mix plants, cement concrete mixers, pavers - uses in road construction.

Teaching-Learning Process	Students can be taken to the construction site. Assignments can be given to evaluate the details of different types of equipment used in road construction

Module-2

Construction of Subgrade and Sub base: Specifications and steps for construction of subgrade, sub base, quality control tests
Construction of granular layers: Specifications and steps of construction, WBM, WMM, CRM, quality control tests
Construction of Bituminous Layers: Different types of bituminous layers, specifications and construction of bituminous layers, quality control tests

Teaching-Learning Process	Students can be given the field assignment to evaluate the degree of compaction of different pavement layers. Practically involving them to observe the methodology of construction.

Module-3

Construction of Cement Concrete Pavements: Specifications and steps for construction of DLC, Paving Quality Concrete pavements, quality control tests Specifications and steps for construction of White topping, Interlocking concrete block pavements, quality control tests. **Safety during Construction**: Safety aspects during construction and maintenance works, road safety furniture.

Teaching-Learning Process	Students can be given the field assignments to make details note of How rigid pavements are constructed at the site. To make them understand the difference between DLC. PQC , Quality control checks, joints etc.

Module-4

Drainage: Assessment of drainage requirements for the road, design of various drainage components, drainage materials, surface and sub-surface drainage system for roads, drainage of urban roads.

Teaching-Learning Process	Ongoing projects field data can be given to evaluate the validity of the given type of drainage, its design or can be given assignment to redesign the drainage.

Module-5

MaintenanceandRehabilitationofbituminousandconcretepavements: Routineandperiodicmaintenance,preventiveandreactive maintenance for drainage and pavements, Preparation of existing pavement for patching, profile correction, special measures to deal with reflection cracks in pavement overlays, requirements for rehabilitation,recycling.
Recycling of pavements- cold recycling, hot recycling, Full Depth Reclamation, road construction in water logged areas, design and construction of RE walls to be added.

Teaching-Learning Process	Field studies can be offered to the students to evaluate the pavement condition with respect to the distress, and to suggest suitable maintenance program.

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks**to attaintheCOsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. "Highway Engineering", Khanna and CEG Justo, A. Veeraragavan, revised 10th edition, published by Nem Chand & Bros, Roorkee,ISBN:978-81-85240-80-0
2. Prithvi Singh Kandhal, "Bituminous Road Construction in India", ISBN: 978-8120352582
3. Delatte N. J., Concrete Pavement Design, Construction, and Performance, CRC Press, Taylor & Francis Group,2014

Reference Books:

1. MoRTH "Specifications for Roads and Bridge Works"- 2013 Fifth revision, Indian RoadsCongress
2. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian RoadsCongress
3. MoRTH "Manual for Maintenance of Roads"- 1989, Indian RoadsCongress
4. "Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, NivedyaMandankaraKottayi, Rajib Mallick, A.Veeraragavan
5. FreddyLRoberts,PrithviSKandhaletal,"HotMixAsphaltMaterials,mixturedesignandconstruction"-(2ndEdition),National Asphalt Pavement Association Research and Education Foundation, Maryland,USA
6. National Asphalt Pavement Association "Hot Mix Asphalt Paving Handbook"- 5100 Forbes Boulevard, Lanhm, Mary Land,USA
7. "HandbookonCementConcreteRoads"-CementManufacturersAssociation,NewDelhi

Relevant IRCCodes

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/105101087

Skill Development Activities Suggested

- Site visits when construction isongoing
- Working on casestudies

Course outcome (Course Skill Set) S

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the different types of equipment used in road construction and their importance at different stages of construction	L2
CO2	Understand the construction procedures of sub grade, sub base and base course and bituminous layers in flexible pavement. Acquire the knowledge of quality control checks on the materials before, during construction and after construction	L2
CO3	Understand the construction of CC pavements, quality control checks, concepts of white topping on distressed bituminous layers. Also introduced to the alternate materials being in used instead of conventional ones.	L2
CO4	Understand the importance of drainage in highway construction, design of drainages under different pavement conditions and rain fall data	L2, L3
CO5	Understandthecausesforpavementdistressofbothflexibleandrigidpavements,implementing suitable remedial measures at the site.	L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x		x	x					
CO2			x		x				
CO3			x						
CO4			x		x				
CO5						X			

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Semester- 1

ROAD GEOMETRIC DESIGN			
Course Code	**22CHT15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand the Geometrical design elements.
- Plan the geometric elements for varying conditions ofroads.
- Examine the geometric elements for highway geometricdesign.
- Judge and propose the geometric element facilities for varying highwayconditions

Module-1

Introduction: Importance, Factors governing geometric design, route selection, geometric design consistency, capacity of rural and urban roads.

Cross Section Elements: Right of way and width consideration, roadway, shoulders, Kerbs, traffic barriers, medians, service roads, pavement surface characteristics, cross slope, skid resistance, unevenness.

Teaching-Learning Process	Students can be exposed to practical assignments by collecting the details of road way elements, to evaluate the vehicular characters and its application in highway geometry

Module-2

Geometric Design Elements for inter-city highways and expressways**:** Sight Distances-SSD, ISD, OSD, factors governing sight distances, Design of horizontal alignment-overturning and skidding, super elevation, extra widening, transition curves, Design of vertical alignment, -gradient, vertical curves.

Teaching-Learning Process	Live data of the road way geometry can be an assignment and its proof checking will make the student to understand the deficiency. Student can able design SSD, OSD and super elevation.

Module-3

Intersection Design: At grade intersections- sight distance consideration and principles of design, Channelization, mini roundabout, roundabout, Inter-changes- major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes.

Teaching-Learning Process	Can understand the importance of controlled intersections, different types of roundabout, channelization of roads

Module-4

Roadway facilities: Pedestrian facilities, bus bay, truck lay bays, frontage roads, parking areas, cattle crossings, lighting, toll plazas, and maintenance center, landscaping and tree plantation.

Teaching-Learning Process	Can understand the necessity of pedestrian facility, parking areas, bus bays street lighting. Field assignments can be offered to investigate provision of such facility.

Module-5

Geometric Design of Hill Roads: Classification, width of road land, roadway, carriageway, design speed, sight distances, horizontal alignment, vertical alignment, hairpin bends, passing places, lateral and vertical clearances.

Use of software: Mx Roads/ Open roads, / Civil 3D

Teaching-Learning Process	Can understand the geometry of the hill roads, construction methods in hilly area, providing the passing sight distances, designing of curves, drainage

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse.

Semester EndExamination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Books

1) Highway Engineering, S.K. Khanna, C.E.G Justo and A. Veeraragavan, Nem Chand and Bros., Roorkee. Revised 10thEdition, ISBN: 978-8185240930

2) A Policy on Geometric Design of Highways and Streets, (The Green Book) 7thEdition, American Association of State Highway and Transportation Officials (AASHTO) Publishers, 2018, ISBN Number:978-1-56051-676-7

3) Geometric Design Projects for Highways: An Introduction, John G Schoon, 2ndEdition, American Society of Civil Engineers Press, ISBN:978-0-7844-7042-8,2000

4) Relevant Indian Road Congress Code Books(IRC)

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/105/107/105107220/

Skill Development Activities Suggested

- Design the geometrics with the data collected by surveying for a road project by mathematicalmeans
- Designthegeometricswiththedata collectedbysurveyingforaroadprojectbyusingCivil3Dorotherdesignsoftwares.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Cross sectional details of the road, road way geometry, concept of arriving at the widthofthe single lane and multilanes	L2
CO2	Calculate the stopping sigh distance, overtaking sight distance, designing of thesuperelevation, designing of vertical alignments	L4
CO3	Design the intersections, calculating thesightdistance	L4, L3
CO4	Understand the importance of road way facility- frontage, parking areas,pedestrianfacility	L2

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	x							
CO2	x		x		x	x			
CO3			x	x	x	x			
CO4		x			x				

ResearchMethodologyand IPR			
CourseCode	**22RMI16**	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	40	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

- Tointroducevarioustechnologiesofconductingresearch.
- Tochooseanappropriateresearchdesignforthechosenproblem.
- Chooseappropriatetoolfortheconductionofresearch.
- Toexplaintheartofinterpretationand theartof writingresearchreports.
- Toexplainvariousformsoftheintellectualproperty,itsrelevanceandbusinessimpactinthechangingglobalbusinesenvironment
- TodiscussleadingInternationalInstrumentsconcerningIntellectualPropertyRights.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research,TypesofResearch,ResearchApproaches,SignificanceofResearch,ResearchMethodsversusMethodology,Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria ofGood Research, and Problems Encountered by Researchers in India.**Defining the Research Problem:** ResearchProblem,SelectingtheProblem,NecessityofDefiningtheProblem,TechniqueInvolvedinDefiningaProblem, AnIllustration

Teaching-Learning Process	Chalkandtalk/PPT/casestudy

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your researchproblem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings,How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoreticalframework,Developingaconceptual framework,Writingaboutthe literaturereviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, ImportantConceptsRelatingtoResearchDesign,DifferentResearchDesigns,BasicPrinciplesofExperimentalDesigns,ImportantExperimental Designs.

Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample SurveyversusCensusSurvey,TypesofSamplingDesigns.**MeasurementandScaling:**QualitativeandQuantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources ofError in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, MultidimensionalScaling, Deciding the Scale.**Data Collection:** Experimental and Surveys, Collection of Primary Data,CollectionofSecondaryData,SelectionofAppropriateMethodforDataCollection,CaseStudyMethod.

Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, TestStatisticsandCriticalRegion,CriticalValueandDecisionRule,ProcedureforHypothesisTesting,HypothesisTestingforMean,Proportion,Variance,forDifferenceofTwoMean,forDifferenceofTwoProportions,forDifferenceofTwoVariances,P-Valueapproach,PowerofTest,LimitationsoftheTestsofHypothesis.**Chi-square**
Test: Testof Difference ofmorethanTwoProportions,Test ofIndependenceofAttributes,TestofGoodnessofFit,

CautionsinUsingChiSquareTests	
Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent

Module-5

InterpretationandReportWriting: MeaningofInterpretation,TechniqueofInterpretation,PrecautioninInterpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report,Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing ResearchReports.**IntellectualProperty:**TheConcept,IntellectualPropertySystem in India,DevelopmentofTRIPSComplied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The GeographicalIndications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varietiesand Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets,Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales forProtection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation(WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right ofPriority,CommonRules,Patents,Marks,IndustrialDesigns,TradeNames,IndicationsofSource,UnfairCompetition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection ofLiteraryandArtisticWorks,BasicPrinciples,DurationofProtection,TradeRelatedAspectsofIntellectualProperty Rights(TRIPS) Agreement, Covered under TRIPS Agreement,Features of the Agreement, Protection ofIntellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, IndustrialDesigns,Patents, Patentable Subject Matter, Rights Conferred,Exceptions, Term of protection, Conditions onPatentApplicants,ProcessPatents,OtherUsewithoutAuthorizationoftheRightHolder,Layout-Designsof IntegratedCircuits,ProtectionofUndisclosedInformation,EnforcementofIntellectualPropertyRights,UNSECO.

Teaching-Learning Process	Chalkandtalk/PPT

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation:

1. ThreeUnitTestseachof **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks** toattaintheCOsandPOs

Thesumofthreetests,twoassignments/skillDevelopmentActivities,willbe**scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedfor thecourse.

SemesterEndExamination:

1. TheSEEquestionpaperwillbe setfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question isfor 20marks. There willbe two full questions(with amaximum of foursub-questions)from eachmodule.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

TextBooks:

1. *Research Methodology: Methods and Techniques*, C.R. Kothari, Gaurav Garg,New Age International,4th Edition,2018..DouglasEComer,"InternetworkingwithTCP/IP,Principles,ProtocolsandArchitecture,"PHI,6thEdition

2. *Research Methodology a step-by-step guide for beginners.* (For the topic Reviewing the literature under module2),RanjitKumar,SAGEPublications,3rdEdition, 2011.

ReferenceBooks:

1. *ResearchMethods:theconciseknowledgebase,* Trochim,AtomicDogPublishing,2005.

2. *ConductingResearchLiteratureReviews:FromtheInternettoPaper,*FinkA,SagePublications,2009.

WeblinksandVideoLectures(e-Resources):

- https://www.youtube.com/watch?v=A7oioOJ4g0Y&list=PLVf5enqoJ-yVQ2RXUl6mCfLPf3J_JUfoc

Courseoutcome(CourseSkillSet)

Attheend ofthecoursethestudentwillbeableto:

Sl. No.	Description	Bloom's Level
CO1	Conduct research independently	L2
CO2	Choose research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	L2
CO3	Statistically interpret the data and draw inferences	L2

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X							
CO2	X	X							
CO3	X	X							

PAVEMENT ENGINEERING LAB -I			
Course Code	**22CHTL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1	SEE Marks	50
Credits	2	Exam Hours	03

Course objectives: The objective of this course is to make students learn

- The procedure and test the basic properties of soil, aggregates, cement andconcrete

Sl.NO	Experiments
	Test on soil
1	Grain size analysis - Wet sieve analysis
2	Liquid limit, plastic limit & Shrinkage limit, FSI
3	Compaction test
4	Shear tests on soil
5	California bearing ratio test and Determination of Effective CBR
6	Unconfined Compression Strength Test
7	Field density by sand replacement & Core cutter method
8	Soil-Cement Mix Design as per IRC:SP:89-2010
	Test on aggregates
1	Shape tests - Elongation, Flakiness Index & Combined Index, Angularity Number
2	Aggregate impact value test
3	Los Angeles abrasion value test
4	Specific gravity & Water absorption test
5	Stripping value test
6	Polished stone value test
7	Sand equivalent test
	Tests on cement & concrete
1	Fineness of Cement
2	Standard consistency & setting time of cement
3	Soundness

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4	Fresh concrete – workability, Slump test, Compaction Factor test and Flow Table test.
5	Compressive strength of cement

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6	Concrete Mix design
7	Compressive Strength of concrete
8	Flexural strength of concrete

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Acquired the expertise to conduct various tests on soil, aggregates, cement and concrete

CO2: Acquired the expertise to conduct various traffic surveys in the field, analyse and interpret the data collected.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Eachexperimentto beevaluated forconductionwithobservationsheetandrecordwrite-up.Rubricsfortheevaluationofthe journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practicalsession.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximummarks).
- Weightage to be given for neatness and submission of record/write-up ontime.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8thweek of the semester and the second test shall be conducted after the 14thweek of thesemester.
- Ineachtest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarryaweightageof 60% and the rest 40% forviva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learningability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximummarks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly byexaminers.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly byexaminers.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

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Semester- 2

DETAILED PROJECT REPORT PREPARATION			
Course Code	**22CHT21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Prepare project report for new and up-gradation type road works by conducting necessary feasibility/detailedstudies.
- Conduct the soil and material investigations to understand their behavior andperformance.
- Perform various traffic related studies helping to finalize the project preparations and methods of forecasting trafficdata.
- Analyse the social impact of road projects and also determine the economic feasibility analysis for justification ofinvestments.
- Prepare DPR on road projects with relevant drawings and get the knowledge of tendering process for theconstruction.

Module-1

Introduction: Various steps of preparation and execution of road projects, Investigations for preparation of project reports for new and up-gradation of roads. Objects and scope of pre – feasibility, feasibility and detailed studies for project preparation. Typical HR structure for preparations and implementation of road projects, Key Acts related to Road Projects. Salient features of ongoing road projects in India.

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3. Compliment the understanding of casestudies. 4. Engage in making mind-maps of DPRreports

Module-2

Topographic surveys and investigations for finalization of horizontal alignment and vertical profile of roads, Application of GIS. Soil and other Material surveys and investigations for availability and choice of basic and alternate materials for road construction and for soil stabilization. Cross drainage structures and drainage surveys, Interpretation of survey results.

Traffic Surveys and Traffic forecasting: classified traffic volume, growth rate, projected traffic for assessing roadway requirements, origin-destinationcharacteristicsandstudies,Axleload/wheelloadstudiesusingweighbridgesandanalysisofdataforpavementdesign

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3. Compliment the understanding of surveys by fielddemos 4. Plan for site visits for students, where pavement construction is goingon. 5. Engage in conduction of traffic surveys andreporting

Module-3

Geometric Design and General elements: Geometrical elements of rural and urban roads Cross sectional elements, horizontal and vertical alignment, Intersections-requirements, capacity of roads, roadway facilities: Pedestrian facilities, bus bays, truck lay byes, traffic, medical and vehicle aid posts, street lighting, road safety audit, road safety furniture, Mx ROAD

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass.

Module-4

Environmental Impact Assessment: Objectives, procedure of environmental impact assessment, socio economic survey, mitigation measures, Landscaping and tree plantation, implementation of environment management plan, Key environmental legislations, clearances required for road project- environmental, forest, CRZ, wildlife, air, noise quality standards

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3. Compliment the understanding by discussing casestudies

Module-5

Preparation of DPR design details, estimates, BOQ, drawings and detailed project, report, use of software, Tendering process - Preparation of tender documents for different types of road projects, Tender evaluation. Salient clauses of tender document, tender evaluation – technical and Financial.

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3. Compliment the understanding by discussing casestudies

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks**to attaintheCOsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse.

Semester End Examination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. L.R.Kadyali, N.B.Lal, "Principles and Practices of Highway Engineering,, Khanna Publishers

Reference Books:

1. IRC: SP:19 - 2001, Manual for Survey, "Investigation and Preparation of Road Projects"- (first revision), Indian RoadsCongress
2. IRC: SP: 30 - 1993, "Manual on Economic Evaluation of Highway"- Projects in India (first revision), Indian RoadsCongress
3. IRC SP – 38," Manual for Road Investment Decision Model"-1992, Indian RoadsCongress
4. IRC : 9-1972, 35 – 1997,38-1988, 39-1986, 52-2001, 54-974, 62-1976, 64-1990, 66-1976, 67-2001, 69-1977, 73-1980, 79-1981, 80-1981, 86-1983, 98-1997, 99-1988, 103-1988, 104- 1988, 110-1996
5. MoRTH "Specifications for Road Bridge Works"- 2001, fourth revision, Indian RoadsCongress
6. MoRTH"StandardandBiddingDocumentProcurementofCivilWorks"-PartIandII,2000,IndianRoadsCongressMoRTH"Model Concession Agreement for Small Road Projects"-2000, Indian Roads Congress

Web links and Video Lectures (e-Resources):

https://www.youtube.com/channel/UC5fUyyuRnwi7H4DPXUwW4sg

Skill Development Activities Suggested

- Prepare the BOQ of minor and major projects and compare thecost.
- Prepare excels sheets for growth factor estimation as per IRC:105-2015
- Carry out the traffic studies specific to a project and infer from the datacollected
- Preparemind-mapsafterstudyingvariousDPRsforRoadprojectsto understandthevariousstages ofDPRpreparation.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Prepareprojectreportfornewandup-gradationtyperoadworksbyconductingnecessary Feasibility/detailed studies.	L3
CO2	Conduct the soil and material investigations to understand their behaviourandperformance	L2
CO3	Analyse the surveys and investigations and select geometryofroad	L4
CO4	Understand the contract document, evaluation and contract management for road projects Analysethesocialimpactofroadprojectsandalsodeterminetheeconomicfeasibilityanalysisfor justification ofInvestments.	L2, L4
CO5	PrepareDPRonroadprojectswithrelevantdrawingsandgettheknowledgeoftendering process for theConstruction.	L6

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X					X	X	X
CO2	X	X	X					X	X
CO3	X	X	X	X		X			
CO4	X	X	X		X	X			
CO5	X	X	X			X	X		X

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Semester - 2

TRAFFIC ENGINEERING AND MANAGEMENT			
Course Code	**22CHT22**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	4	Exam Hours	03

Course objectives: This course will enable students to

- Analyze the factors affecting performance of road traffic and the various traffic studies needed for the analysis of trafficflow.
- Evaluate level of service and capacity of roadways and intersections using trafficdata.
- Propose and design suitable traffic regulatory system based on traffic requirements such as signs, signals, markings,etc.
- Analyze and design intersections at-grade and grade separated types for smooth and safe movement ofvehicles.
- Propose parking facilities, pedestrian facilities and general safety measures required for highways andexpressways.

MODULE-1

Traffic Studies & Analysis: Scope, traffic elements - Characteristics-vehicle, road user: and road - Traffic studies-speed & delay, traffic volume, O & D, parking and accidents - Sample size, study methodology - Data analysis & inferences.

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3.Engage in conduction of traffic surveys andreporting

MODULE-2

Traffic Flow Analysis: Macroscopic, Microscopic & Mesoscopic approach – Types of Flow- Traffic stream characteristics – Space – Time diagram – Relationship between speed, flow & density-Level of service & capacity analysis – Shockwave theory

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass.

MODULE-3

Intersection Design: Types of intersections - Conflict diagrams –Control hierarchy- Design of rotaries & at-grade intersections – Signal design - Grade separated intersections & their warrants.

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass.

MODULE-4

Geometric Design: Cross sections – Sight distances – Super elevation – Horizontal & vertical alignments – Safety considerations

Road Safety Audit: Global & Local perspective – Road safety issues – Road safety programs – Types of RSA, planning, design, construction & operation stage audits – Methodology – Road safety audit measures

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass.

MODULE 5

Traffic Regulation & Traffic Safety Management: Speed, vehicle, parking, enforcement regulations - Mixed traffic regulation - Management techniques, one-way, tidal flow, turning restrictions etc. – Transportation System Management Process – TSM planning & Strategies

Use of software: PTV VISSIM / VISUM (Traffic Flow Simulations), SIDRA (intersections), etc.

Teaching-Learning Process	1. Blackboard teaching/PowerPoint presentations (ifneeded) 2. Regular review of students by asking questions based on topics covered in theclass. 3. Practice sessions and hands on experience using trafficsoftware

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PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.No	Experiments
1	Traffic Volume Count at Mid-Block Section
2	Conflict points at different types of intersections
3	Turning Movement Count at an Intersection
4	Registration Number Plate Survey
5	Spot Speed Survey
6	Speed and Delay Study by Moving Observer Method
7	Video graphic studies
8	Origin and Destination Study- Road Side Questionnaire Survey
9	Parking Inventory & Usage Survey by Patrol
10	Road safety audit: Construction & Operation stage
11	Axle load studies
12	Signal design

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20marks**
3. TotalMarksoftwotestsandtwoassignments/oneSkillDevelopmentActivityaddedwillbeCIEfor60marks,marksscoredwill be proportionally scaled down to **30marks**.

CIE for the practical component ofIPCC

- Oncompletionofeveryexperiment/programinthelaboratory,thestudentsshallbeevaluated,andmarksshallbeawardedonthe same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of thesemester.
- TheCIEmarksawardedinthecaseofthePracticalcomponentshallbebasedonthecontinuousevaluationofthelaboratoryreport. Eachexperimentreportcanbeevaluatedfor10marks.Marksofallexperiments'write-upsareaddedandscaleddownto15marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50marks.
2. The question paper will have ten questions. Each question is set for 20marks.

3. Therewillbe2questionsfromeachmodule.Eachofthetwoquestionsunderamodule(withamaximumof3sub-questions),**shouldhave a mix of topics** under thatmodule.
4. The students have to answer 5 full questions, selecting one full question from eachmodule.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However,inSEE,thequestionsfromthelaboratorycomponentshallbeincluded.Themaximumof04/05questionstobesetfrom the practical component of IPCC, the total marks of all questions should not be more than the 20marks.
- SEEwillbeconductedfor100marksandstudentsshallsecure40%ofthemaximummarkstoqualifyintheSEE.Markssecuredwill be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Text Books:

1. Kadiyali L.R. "Traffic Engineering and constru "-Khanna Publication, NewDelhi
2. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition ThompsonLearning

Reference Books

1. Salter RJ and Hounsell NB, "Highway, Traffic Analysis and Design"- Macmillan Press Ltd., London.
2. Matson T M, Smith W S , Hurd F W, " Traffic Engineering, Mc graw Hill Book Co, NY , USA.
3. Drew D R ," Traffic Flow Theory and Control", McGraw Hill Book Co, NY,USA.
4. Wohl and Martin, "Traffic System Analysis of Engineers and Planners"-Mcgraw Hill Book Co, New York,USA.
5. May,A.D.,*TrafficFlowFundamentals*,Prentice–Hall,Inc.,NewJersey,1990.
6. O'Flaherty C A, *Highways- Traffic Planning & Engineering*, Edward Arnold,UK
7. Pignataro,"TrafficEngineering",Johnwiley&sons.NicholasJGarber,LesterAHoel,"Traffic &Highway Engineering"- Thirdedition,
8. IRC: SP 43 1994 and other Relevant IRCcodes
9. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised10th Edition.
10. Indian Highway Capacity Manual (Indo-HCM) CSIR, New Delhi,2012-2017

Web links and Video Lectures (e-Resources):

(1)https://archive.nptel.ac.in/courses/105/105/105105107/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

(2) Conduction of the various trafficstudies
(3) Computational procedures for safetyeffectiveness
(4) Interpretation of trafficstudies

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Gets the knowledge of factors affecting performance of road traffic and also thetrafficstudies needed for theanalysis.	L2
CO2	Evaluate level of service and capacity of roadwaysandintersections.	L5
CO3	Propose and design suitable traffic regulatory system such as signs, signals,markings,etc.	L4
C04	Analyseand design intersections at-grade and grade separated types for smooth and safe movement of vehicles.	L4
CO5	Propose parking facilities, pedestrian facilities and general safety measures requiredforhighways andExpressways.	L3

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X			X	X	X			
CO2	X	X	X	X		X			X
CO3	X		X	X	X				
CO4	X	X	X	X		X			
CO5	X	X	X	X	X				

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Semester- 2

SPECIAL CONCRETES			
Course Code	**22CHT231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- To understand the factors affecting pavement design and performance of RuralRoads.
- To relate the concepts of Highway Geometric design to that ofRuralroads
- To design the Special pavements which form alternatives for RuralRoads.
- To understandtheconceptsof designofdrainage,CDworksandsmallbridgeswhichformessentialstructuresof Ruralroads

Module-1	
Salient features of concrete mix design as per Indian standard (IS: 10262:2019). High Strength Concrete: Definition, Mix Proportioning as per IS 10262-2019, Properties and Applications. SDA: Preparation of design spreadsheets of different Concrete Mixes.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

Module-2	
Light Weight Concrete: Introduction, Definition, types, Properties and Applications. Geo-polymer Concrete: Brief history of development, Definition, material characterization, mix proportioning, properties, and applications. SDA: Characterisation of light weight and geo-polymer concrete / blocks	
Teaching-Learning Process	. Black board, LCD, Skill enhancement through problem solving, case studies

Module-3	
Self-compacting concrete: Introduction, Materials, Mix design of SCC as per IS 10262-2019, Fresh Properties of SCC - Filling, Passing and Segregation resistance, Hardened Properties of SCC – Compressive strength, Production and transportation, Placement and SCC application. SDA: Group activity - Developing SCC mixes by other than IS method.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

Module-4	
Fiber-reinforced Concrete: Brief Introduction on FRC, Properties of fibres and matrices, Theoretical stress–strain curves in uniaxial tension, Fresh concrete and Hardened concrete, Applications. Roller Compacted Concrete: Introduction, Materials, Mix design as per IS 10262-2019, Fresh and Hardened Properties of mass concrete. SDA: Group activity - Application of the fibers in construction materials.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

Module-5	
Recycled concrete: Introduction, Properties of recycled aggregate, Methods of recycling and quality, Applications. CLSM: Brief Introduction, Materials and Properties as per ACI 229R, Applications. SDA: Group activity – Develop concrete for low strength applications using un-conventional and recycled materials	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. A. M. Neville, Properties of Concrete, Pearson Education (Singapore)Pvt.Ltd.
2. P. Kumar Mehta and Paulo J. M. Monteiro, "Concrete Microstructure, Properties, and Materials"-McGraw HillEducation

References:

1. John Newman and Ban Seng Choo, Advanced Concrete Technology, ISBN 0 7506 5105 9, ElsevierLtd.
2. Concrete Construction Engineering Handbook by Dr. Edward G. Nawy, CPC Press, 2nd Edition, ISBN9780849374920.
3. Joseph A. Daczko, Self-Compacted Concrete by-Applying what we know, CPC Press, ISBN-13: 978-0-203-84422-9

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce09/preview

Skill Development Activities Suggested

- Visit to RMCPlants
- Conduct tests on various type of concretemixes

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Identify ingredient of concrete material characteristics and different types ofconcretefor their appropriate use inconstruction.	L2, L3
CO2	Design special concrete mixes like Self-compacted concreteandGeo-polymer	L3,L4
CO3	Concrete mixes and asses the fresh and hardened properties usingvariousguidelines.	L2, L3, L4
CO4	Determine the compressive strength of concrete structures byNon-DestructiveMethods.	L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			X						
CO2				X	X	X			
CO3	X					X			
CO4			X	X					

01.02.2023

Semester- 2

DESIGN OF BRIDGE AND GRADE SEPARATED STRUCTURES			
Course Code	**22CHT232/22CIM232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand historical evolution of bridges and types ofbridges.
- Understand the elements of bridge design i.e, forces on bridges, IRC loading standards for road and railwaybridges.
- Know in detail about flyovers, their types and related IRC code provisions on geometricaldesigns.
- Understand substructures, piers, abutments, and appurtenances.
- Explain the quality assurance, bridge inspection and healthmonitoring

Module-1

Historical evolution of bridges, classification of bridges, conceptual bridge design, site investigation, preliminary data to be collected, preliminary drawings, economic span of a bridge, ideal bridge, location of piers and abutments, traffic projection, investigation report, importance of proper investigation.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-2

Standard specifications for road bridges, clearances, loads to be considered, dead load, IRC standard live loads, other type of loads. General design considerations, minimum reinforcement in beams and slabs, concreting operations, pre-stressed concrete, notations for detailing concrete bridges, traffic aspects of highway bridges, aesthetics of bridges, relative costs of bridge components.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-3

Flyovers, differences between flyovers and bridges, necessity for flyovers, types of flyovers: over pass, trumpet type, diamond shaped, cloverleaf shaped, rotary type, and directional advantages and disadvantages of each. Factors to be considered while building a flyover. Geometric design features, land requirement, spacing, design vehicle, ramps, typical pier and abutment dimensions. Concepts of congestion factor and reduction factors. Landscaping of flyovers.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-4

Bridge substructures, Piers, abutments, foundation types. Bridge bearings, joints and appurtenances, functions rendered by bearings, types of bearings, expansion bearing, fixed bearing, elastomeric pot bearings, bearings for skew bridges, joints, expansion joints, appurtenances, foot paths, hand rails, drainage arrangements, wearing course, approach slab. Relevant IRC standards.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-5

Construction of bridges, quality assurance of bridge projects, bridge construction inspection- data to be collected. Construction of short span and long span bridges. Construction of continuous concrete bridges. Formwork and false work for concrete bridges, numbering f bridges, bridge management system. Smart structural health monitoring (SSHM)of bridges. Components of SSHM. Types of monitoring and metrics of monitoring. IoT in bridge health monitoring.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. D.Johnson Victor, "Essentials of bridge Engineering"- Oxford, IBH publishingcompany.
2. Ponnuswamy, "Bridge Engineering"-McGraw Hill Publication,1989.
3. T. R. Jagadeesh, M.A. Jayaram "Analysis and design of Bridges"- III edition, Prentice Hall of India, New Delhi, 2020.

Reference Books:

1. Relevant IRCcodes
2. VaziraniRatwani&M.G.Aswani, "Design of Concrete Bridges"- Khanna Publishers, NewDelhi
3. "Design of Bridges"- Dr. Krishna Raju, Oxford & IBH Publishing Company Limited. T.R

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce63/preview

Skill Development Activities Suggested

- Visual inspection of the grade separatedstructures.
- Construction Sitevisit

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	Elaborate on conceptual bridge design, identify suitable bridge for a given scenario,andbe able to prepare a suitable report upon doing siteinvestigation.	L1, L2, L3
CO2	Demonstrate the knowledge on bridge loading standards andIRC-codeprovisions.	L1, L2, L3
CO3	Identify different types of flyovers and recommend particular type dependingonthe constraints.	L2, L3, L4
CO4	Differentiate between different types of bearings and recommend a suitabletypeof bearing.	L2, L3, L4
CO5	Explainconstructionmethodsfordifferenttypesofbridges,andabletodecideonsuitable health Monitoringprocedure	L2, L3, L4, L5

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Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2	X	X							
CO3	X								
CO4	X								
CO5	X					X			

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Semester- 2

GROUND IMPROVEMENT TECHNIQUES			
Course Code	**22CHT233/22CIM233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Introduce the various types of improvement methods of engineering propertiessoils
- Introduce the application of engineering methods to ground improvementprojects
- Basic knowledge on various 323 and their suitability for various types of soilconditions
- The skills of implementation of geotechnical knowledge in fieldsituations

Module-1

Introduction - Need and objectives of ground improvement, classification of ground modification techniques, trends in ground improvement, Engineering properties of soft, weak and compressible deposits; Principles of treatment; **Methods of compaction:** Blasting, dynamic consolidation, pre-compression and compaction piles.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-2

Methodsofdewatering: Opensumpsandditches,wellpointsystem,electro-osmosis,Vacuumdewateringwells;pre-loadingwithout and with sand drains, strip drains and ropedrains.

Stabilization: With admixtures like cement, lime, calcium chloride, fly ash and bitumen. Methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-3

Soil reinforcement: Reinforcing materials, concept of confinement, Gabion walls; Dynamic consolidation, Vibro flotation, Pre-consolidation with vertical drains, Granular piles, Soil nailing, Anchors & Thermal methods.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-4

Improvement of Foundation Soils

a) Improvement of granular soils: Terms used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods-Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact atdepth.

b) Improvementofcohesivesoils:Preloading,ordewatering,methodsofinstalling:sanddrains,drainwicks,electricalandthermal methods.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-5

Grouting: Materials of grouting, grouting techniques and control; purpose, functions, types of grouts; soil bentonite - cement mix; Emulsions & solutions; grout injection methods; Geo-synthetics: types, functions & Classification of geo-textiles. Specific Applications: Bearing capacity improvement, reinforcement, Retaining walls, embankment etc.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse.

Semester End Examination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Manfred R. Hansmann - Engineering principles of ground modification - Me. Graw-Hill pub. Co.,NewYork.
2. RobertM.Koerner-Construction andGeotechnicalmethodsin FoundationEngineering-MC.Graw-HillPub.Co.,NewYork.

Reference Books:

1. Winterkorn and Fang - Foundation Engineering Hand Book - Van Nostrand Reinhold Co.,NewYork.
2. Aris C. Stamatopoulos&Panaghiotis C. Kotzios - Soil Improvement by Preloading – John Wiley & Sons Inc.Canada.

P. Purushothama Rao - Ground Improvement Techniques - Laxmi Publications.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105108075

Skill Development Activities Suggested

- Visit to site where ground improvement techniques areadopted
- Laboratory tests on ground improvementtechniques

Sl.No.	Description	Blooms Level

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	DESCRIPTION	BOs
1	Analyse the need for ground improvement in weak and soft soils with likely modifications to improve their performance.	CO1
2	Decide on suitable dewatering method in soils to improve their performance as highway material	CO2
3	Apply appropriate soil strengthening by stabilization techniques	CO3
4	Evaluate the strengthening techniques by reinforcing bars or anchoring methods depending on the type of soil.	CO4
5	Use ground improvement techniques such as geo-synthetics or grouting for cohesive soils.	CO5

CO1	the various types of improvement methods of engineering properties soils	L1, L2 , L3
CO2	the application of engineering methods to ground improvement projects	L2, L3, L4
CO3	Basic knowledge on various ground improvement techniques and their suitability for various types of soil conditions	L2, L3, L4
C04	The skills of implementation of geotechnical knowledge in field situations	L3, L5

Mapping of COs and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2		X	X						
CO3					X	X			
CO4						X	X	X	

Semester- 2

SOIL MECHANICS FOR PAVEMENT ENGINEERS			
Course Code	**22CHT234/22CIM234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand the properties and behavior as a highway material under the application of wheelloads.
- Understand and compare the shear strength of soil and stability of slopes when used as subgrade soil and embankment fills or cut slopes
- Understandthepermeabilitycharacteristicsofsoilstodesignproperdrainagesystemandvariousinvestigationsrequiredtoassess the soilproperties.
- Understand the type and soil composition affecting the surface runoff and sub-surface water flow in order to design proper drainagesystem.
- Analyselackofstrengthorinstabilityproblemsinsoils dueto soilformationoranyotherreasonsandproposesuitablestrengthening methods for the same.

Module-1

Introduction: SoilMechanicsapplicationstoHighway/InfrastructureEngineering.Soilformations,Types,RegionalSoildepositsofIndia,Indexproperties,theirdetermination,importance,varioussoilclassificationsystems,HRBclassification,problemsonthese.

Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engineering behaviour of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipment used for compaction, their choice.

Teaching-Learning Process	Black board, LCD, , data collection through field/site investigation, lab demonstration on certain experiments on properties of soil

Module-2

Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus.

Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu+0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

Teaching-Learning Process	Black board, LCD, , data collection through field/site investigation ,

Module-3

Permeability of soil: Darcy's Law, Validity, Soil-water system,Types, Determination of permeability, problems.

Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Teaching-Learning Process	Black board, LCD, data collection through field/site investigation , application of modern equipment's for field studies and laboratory studies

Module-4

Special attention for subgrade condition: Problematic soils, compressible &collapsible soils, swelling, subsurface water, frost-susceptible soils.

Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, soil stabilization, soil encapsulation. Base layer requirement-erodibility of bases, bound bases, modified or treated bases, base reinforcement

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation , application of modern equipment's for field studies and laboratory studies

Module-5

Reinforced Earth structures Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses. Landslides – definition, classifies, factors producing.

Teaching-Learning Process	Black board, LCD, laboratory studies.

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age InternationalPublishers.
2. "SoilMechanics&FoundationEngg",Dr.B.C.Punmia,AshokKumarJain,ArunKumarJain,LaxmiPublications(P)Ltd,16th edition.
3. S.K.Khanna,C.E.GJustoandA.Veeraragavan,"HighwayEngineering"-NemChandandBros.,Roorkee.Revised10thEdition.

Reference Books:

1. "Geotechnical aspects of pavement reference manual", US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI courseno:132040
2. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard PublishersDistributors.
3. "Soil Mechanics for road Engineers" – HMSO, London.

IRC – RelevantCodes.

Web links and Video Lectures (e-Resources):

- https://youtu.be/V1m3cB-Aqy8
- https://youtu.be/ldNt_O1obP0
- https://nptel.ac.in/courses/105103097

Skill Development Activities Suggested

- Data collection through site investigation
- Carrying out field tests and laboratorytests

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Able to understand different types of soil and their basic properties, analyse the wheelload effects on pavement materials	L1, L2, L3, L4
CO2	Evaluate and compare the shear strength of soil and stability of slopes when usedas pavement component.	L1, L2, L3, L4, L5
CO3	Design proper drainage system by knowing the permeability characteristics ofsoils.	L1, L2, L3, L4
CO4	Design surface runoff and sub-surface drainage system as per fieldconditions	L1, L2
	CO5 Proposesuitablestrengtheningmethodsforsoilfromtheknowledgeoflackofstrengthor instability in soils.	L2, L3

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X		X			X	X	X	X
CO2	X		X		X	X	X		X
CO3	X	X	X		X	X			X
CO4	X	X	X		X	X			
CO5	X		X		X	X	X		X

01.02.2023

Semester- 2

CONSTRUCTION & DEMOLITION WASTE MANAGEMENT			
Course Code	**22CHT235/22CIM235**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Focus on the principles of sustainable construction and demolition waste management and resourceefficiency
- Examining the environmental impact of buildingmaterials.
- Formulating and designing pre−construction and site waste managementplans

Module-1

EnvironmentalImpactofBuildingMaterialsEmbodiedenergyofmaterials;impactonthelocalenvironment;toxicityofthematerial;life cycle assessment. Nature and Source Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potentialofbuildingmaterials.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-2

ConstructionandDemolitionWasteManagementPlansInternationalgoodpractice;planningrequirements;DoEHLGguidancedocument; company policy; demolition plans; site implementation; supplier agreements; sub−contractor management; role of waste management contractor;training;auditing;skipmanagement;currentmarkets;currentdisposaloptions;healthandsafety;reportingtolocalauthorities.

TreatmentofConstructionandDemolitionWaste,wastepermits;wastelicenses;wastetransferfacilities;landfills;treatment technologies; hazardous waste facilities; reporting toEPA

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-3

Designing for Waste Prevention and Minimization, Waste prevention and minimization; client, contractor and designer attitudes; propermaintenanceofexistingbuildings;reuseofexistingbuildingstructure;designflexibility;designforreuseandrecycling;dimensional co−ordinationandstandardization;modulardesign;materialselectionandcontrol.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-4

Waste Forecasting Tools Application of WRAP's designing out waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-5

Future developments Potential future markets; ‘smart' materials; use of eco−materials.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age InternationalPublishers.
2. "SoilMechanics&FoundationEngg",Dr.B.C.Punmia,AshokKumarJain,ArunKumarJain,LaxmiPublications(P)Ltd,16th edition.
3. S.K.Khanna,C.E.GJustoandA.Veeraragavan,"HighwayEngineering"-NemChandandBros.,Roorkee.Revised10thEdition.

Reference Books:

1. "Geotechnical aspects of pavement reference manual", US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI courseno:132040
2. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors.
3. "Soil Mechanics for road Engineers" – HMSO,London.

Web links and Video Lectures (e-Resources):

- http://www.digimat.in/nptel/courses/video/105105160/L48.html

Skill Development Activities Suggested

- Visit to Recycleplants.
- Studies of International standards on wastemanagement

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Theycanabletounderstandthebasicconceptofembodiedenergyofconstructionmaterials.	L2, L3, L4
CO2	Understand the application of construction and demolition waste to various concrete structures	L3, L4

01.02.2023

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			**X**						
CO2			**X**	**X**					

01.02.2023

Semester- 2

PAVEMENT MANAGEMENT SYSTEM			
Course Code	**22CHT241/22CIM241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- learn evaluation and prediction of pavement performance, to learn Ranking and economic optimization of pavementmaintenance and rehabilitation and management.

Module-1

Introduction: Components & principals of pavement management systems, pavement maintenance measures, planning investment, research management. Pavement Management Data Needs, Inventory Data Needs, Project level and network level data needs

Structural and functional requirements of flexible and rigid pavements. Pavement Distress survey and different types of failures in pavements.

EvaluationofPavementSurfacedistressconditionsurveys–purpose,methods-manualandautomated,typesofdistress,distresssurvey procedures, equipmentused,

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation.

Module-2

Functional Evaluation of Pavements:

Importance of pavement evaluation, functional condition evaluation techniques, network, project level, roughness measurement methods, Identification of uniform sections, serviceability concepts, visual and rating procedures, data collection technologies, pavement deterioration, factors affecting pavement deterioration, modelling, and comparison of different deterioration models.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation , application of modern equipment's for field studies

Module-3

Structural deterioration of pavements: causes, effects, methods of treatment. Structural evaluation of flexible pavements by rebound deflection method, analysis of data, design of overlay, use of FWD and other methods for evaluation of flexible and rigid pavements and their application.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation , application of modern equipment's for field studies and laboratory studies

Module-4

Evaluation of new pavement materials, model studies, pavement testing under controlled conditions, accelerated testing and evaluation methods, Test track studies. Instrumentation for pavement testing.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation , application of instrumentation for pavement testing through test track / Case studies

Module-5

Rehabilitation: Introduction, benefits of recycling, methods, recycling strategies, cold milling, ripping, crushing, recycling batch plant, drum mix plant, mix design, hot in place recycling techniques, cold in place recycling, full-depth reclamation, and current practices for improving riding quality.

Ranking and optimization methodologies, life cycle costing

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.

Use of software : HDM-4/dTIMS

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Pavement asset management using modern software

01.02.2023

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Ralph Hass, W.Ronald Hudson with LyneCowe Falls., "Pavement Asset Management"-Scrivner Publisher, copyright2015
2. RalphHass,W.RonaldHudson.W.R.,Zaniewisti.J."ModernPavementManagement"–KriegerPublishingCompany, Florida,1994.

Reference Books:

1. Proceedings of North American Conference on ManagingPavement.
2. Proceedings of International Conference on Structural Design of AsphaltPavements.
3. NCHRP, TRR and TRB SpecialReports.
4. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland,USA.
5. Highway Hand Book by FAW, Publication from NUS,Singapore.
6. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition ThompsonLearning
7. IRC 81, 1997, GUIDELINES FOR STRENGTHENING OF FLEXIBLE ROAD PAVEMENTS USING BENKELMAN BEAM DEFLECTION TECHNIQUE
8. IRC SP 16, 2004 Guidelines for Surface Evenness of HighwayPavements

Web links and Video Lectures (e-Resources):

- https://youtu.be/hiAmA74ya-o

Skill Development Activities Suggested

- Assessing pavement surface condition for a selected stretch of a road (Visual Road inventorysurvey)
- Demonstration on portable pendulum skid resistance tester for measuring skid resistance and dataanalysis
- Data Analysis from Structural and Functional evaluation
- Use of computer applications likeHDM-4/dTIMS.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Understand the structural and functional requirements of pavements, componentsofPMMS and pavementsurface	L1, L2, L4
CO2	Functional condition evaluation ,condition survey ,pavementdeteriorationmodelling	L5, L3, L4
CO3	Structural evaluation –BBD andFWDanalysis	L5, L3, L4
CO4	Evaluation of new pavement materials,model studies,	L5, L3, L4
CO5	Recycling strategies ,life cycle cost ,Expert system andpavement management	L4, L5, L6

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X				X	X	X
CO2	X	X	X		X	X	X	X	X
CO3	X	X	X	X		X		X	X
CO4	X	X		X	X				X
CO5	X	X	X	X	X	X	X		X

01.02.2023

Semester- 2

LOW VOLUME ROADS ENGINEERING			
Course Code	**22CHT242/22CIM242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- To understand the factors affecting pavement design and performance of RuralRoads.
- To relate the concepts of Highway Geometric design to that ofRuralroads
- To design the Special pavements which form alternatives for RuralRoads.
- Tounderstandtheconceptsofdesignofdrainage,CDworksandsmallbridgeswhichformessentialstructuresofRuralroads

Module-1

Introduction to Low-Volume Roads (LVR). Significance of LVR, Definition, Design Environments. Planning of rural road, planning data base, concept of network planning Rural roads plan, guidelines laid down in recent 20 year plans and in PMGSY Road alignment and surveys, governing factors for route selection Factors controlling alignment; obligatory points, traffic , geometric designs, economy, special considerations in hilly areas.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation.

Module-2

Geometric design standards: classification of rural roads, terrain classification, design speed, basic principles of geometric design cross sectional elements, camber, sight distances

Horizontal alignment: general guidelines, super elevation, transition curve, widening and set back distances, vertical alignment: gradient, grade compensation at curves, valley curves, alignment compatibility, lateral and vertical clearances.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.

Module-3

Soil and material surveys, soil investigations for low embankment, high embankment, cut sections, subgrade, Survey for marginal materials and aggregates/ low grade materials Artificial aggregates, waste materials, new materials and stabilizers Design parameters, pavement components Design of flexible pavement: pavement thickness, pavement surfacing Design of semi rigid pavement: dry lean concrete / lime fly ash concrete bases Design of rigid pavement: cement concrete pavement Design of special pavements: concrete block pavement , interlocking concrete block pavement Choice of pavement type and materials, maximize use of Locally available materials, Use of Geo-synthetics in LVR

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving , data collection through field/site investigation.

Module-4

Typesofroaddrainage,requirementsofsurfacedrain;roadsidedrains,shoulderdrains,catchwaterdrains.Requirementssubsurface drainCrossdrains;types,requirements,choiceofdifferenttypesofcrossdrainsStandarddesignsofculvertsStandarddesignofsmallbridges.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-5

Selection of materials and methodology, construction techniques, machinery and tools.

Construction of Embankment / subgrade; materials, requirements and construction operations. Choice and requirements of coarse sand sub base, gravel roads. Innovative technology for Low volume roads.

Pavement Maintenance and Rehabilitation Management System (RMS) for LVR. Unpaved, climate resilience LVR.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.

01.02.2023

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**

2. Twoassignmentseachof**20MarksoroneSkillDevelopmentActivityof40marks**toattainthe COsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books:

1. S.K.Khanna,C.E.GJustoandA.Veeraragavan,"HighwayEngineering"-NemChandandBros.,Roorkee.Revised10th Edition.
2. Robert A. Douglas, Low-Volume Road Engineering, Design, Construction, and Maintenance, I edition, CRCPress

Reference Books:

1. IRC: SP:72-2015, Guidelines for the design of Flexible Pavements for Low Volume Roads, FirstRevision
2. IRC: SP:62-2014, Guidelines for Design & Construction of CC pavements for low volumeroads
3. IRC SP 20 Rural RoadsManual
4. Relevant IRCPublications

Web links and Video Lectures (e-Resources):

- http://omms.nic.in/

Skill Development Activities Suggested

- Understand the PMGSY's three-tier Quality Control & Quality Monitoringmechanism.
- Visit nearby roads constructed under PMGSY scheme and evaluate the performance over a period oftime.
- Study the various technology demonstration projects executed underPMGSY

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Get the knowledge of factors affecting pavement design and performance ofruralroads	L2
CO2	Thestudentwillbeabletodifferentiatethedesignandconstructionof Lowvolumerural roads with that of the Highways	L2,L3
CO3	The students will be able to infer and review the DPRs prepared for constructionofRural Roads such underPMGSY	L2, L3, L4

01.02.2023

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					X				
CO2			X		X				
CO3		X			X	X			

01.02.2023

Semester- 2

URBAN PUBLIC TRANSPORT			
Course Code	**22CHT243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand the various options for urban public transportation and recommend suitable mode for the givensituation.
- Conducteconomicanalysisbetweendifferenttransportmodesandsuggestmost economicalandefficientmodeunderthegiven set ofconditions.
- Understand the management of public transport system and developing strategies for efficient functioning of thesystem.
- Carry out the evaluation of capacities of the system parameters such as routes, junctions, stations etc, to know the performance of thesystem.
- Forecast the future transportation needs and variations in system components so as to plan for the transportationsystem requirements.

Module-1	
System and Technologies: Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Metro and Mono Rail, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, field studies
Module-2	
Comparing Alternatives: Comparing costs, comparative analysis, operationalandTechnological characteristics of different rapid transit modes, evaluating rapid transit,Problems.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving
Module-3	
Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public Transportation marketing.	
Teaching-Learning Process	Black board, LCD, Skill ,enhancement through problem solving, case studies
Module-4	
Transit System Evaluation: Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical Capacities of major transit modes, quantification of performance, Problems.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving
Module-5	
Urban traffic: Classification of transportation systems, conventional transportation systems, non-conventional transportation systems, prototypes and tomorrow's solutions, analysis and interpretation of information on transportation systems, perspectives of future transportation.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

01.02.2023

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. George E. Gray and Lester A. Hoel, 'Public Transportation', Prentice Hall, NewJersey.
2. Vukan R. Vuchic, 'Urban Public Transportation Systems andTechnology',PrenticeHall Inc.,New Jersey.

Reference Books:

1. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York
   John W. Dickey,' Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co. New Delhi.

Web links and Video Lectures (e-Resources):

- https://dult.karnataka.gov.in/en
- https://archive.nptel.ac.in/courses/105/107/105107067/

Skill Development Activities Suggested

- work on casestudies
- Formulate the Parking Action Plan for a studyarea
- Visit to Multimodal Integration of Traffic and Transit Management Centre (TTMC) and understand theiractivities.
- Mini projects on efficiency of public transport system in urbanareas.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Understand the various options for urban public transportation andrecommendsuitable mode for the givensituation.	L1, L2
CO2	Conduct economic analysis between different transport modes andsuggestmost economical and efficient mode under the given set ofconditions.	L2, L3
CO3	Understand the management of public transport system and developingstrategiesfor efficient functioning of thesystem.	L2, L3, L4
CO4	Carry out the evaluation of capacities of the system parameters such asroutes,junctions, stations etc., to know the performance of thesystem.	L2, L3, L4
CO5	Forecast the future transportation needs and variations in system components so astoplan for the transportation systemrequirements.	L2, L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2					X	X			
CO3					X				
CO4						X			
CO5					X	X			

01.02.2023

Semester- 2

ROAD SAFETY ENGINEERING AND MANAGEMENT			
Course Code	**22CHT244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Analyze the effect of driver characteristics, roadway characteristics, and climatic factors on highwaysafety.
- Plan and design a road safety improvementprogram.
- Analyze accident data and suggest safetymeasures.
- Conduct road safetyaudit.
- Interpret accident data using statisticalanalysis.

Module-1

Highway Safety in India: traffic crashes on Indian highways, traffic on national highways and state highways, safety on national highways.

Introduction to safety: Road accidents, Trends, causes, Collision and Condition diagrams, Highway safety, human factors, Vehicle factors Road Safety Management System: Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-2

Statistical Interpretation and Analysis of Crash Data: Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification & Investigations, Case Studies. Urban Safety and Mobility, Traffic Calming.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

Module-3

Road Safety Audits: Key elements of a road safety audit, Road Safety Audits & Investigations, Crash investigation and analysis, Describe methods for identifying hazardous road locations, Vulnerable Road Users, Case Studies.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-4

Crash Reconstruction: Describe the basic information that can be obtained from the roadway surface, understand basic physics related tocrashreconstruction,speedforvariousskid,friction,drag,andaccelerationscenarios,variablesinvolvedinjumpandflipcrashes,variables involved in pedestrian crashes, CaseStudies.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

Module-5

Mitigation Measures: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry andsafety.

Road safety management, road safety policy-making, stakeholders involved, developing the road safety management system, capacity building.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, case studies

01.02.2023

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. V.F. Babkov "Road Conditions and Traffic Safety", MirPublishers.
2. Pignataro , " Traffic Engineering", John wiley&sons.
3. Nicholas J Garber, Lester A Hoel, "Traffic & Highway Engineering"- Third edition, ThompsonLearning
4. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering. Avebury Technical,1996.
5. Martin Belcher, Steve Proctor and Phil Cook, Practical Road Safety Auditing, Third edition, ICE Publications,2015
6. GitamTiwari,DineshMohan,"TransportPlanningandTrafficSafety-makingcities,roads&vehiclessafer",PublishedbyCRCPress, ISBN-9781498751452

Reference Books:

1. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press,1997
2. (reprinted2002)
3. Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE,1999.
4. J. Stannard Baker, Traffic Collision Investigation, Northwestern University Center for Public Safety,2002.
5. Leonard Evans, Traffic Safety, Science Serving Society,2004.
6. Lynn B. Fricke, Traffic Accident Reconstruction, Northwestern University Center for Public Safety,1990.
7. Popkess C.A, Traffic Control and Road Accident Prevention, Chapman and Hall,1997
8. Rune Elvik and TrulsVaa,, The Handbook of Road Safety Measures, Elsevier,2004.
9. SimonWashington,MatthewKarlaftis,andFredMannering,StatisticalandEconometricMethodsforTransportationDataAnalysis, Chapman & Hall/CRC Press,2003.
10. Towards Safe Roads in Developing country, TRL – ODA,2004.

Web links and Video Lectures (e-Resources):

- https://www.icevirtuallibrary.com/isbn/9780727760166
- https://www.routledge.com/Transport-Planning-and-Traffic-Safety-Making-Cities-Roads-and-Vehicles/Tiwari-Mohan/p/book/9781498751452
- https://www.amazon.in/Highway-Design-Traffic-Engineering-Handbook/dp/0070382956

Skill Development Activities Suggested

- Conduct a Road safety audit for a given stretch of SH/NH or ruralroads
- Participate / conduct in safety awarenesscampaigns
- Conduct road safety signage audit for a project stretch and giverecommendations.

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Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Analyze the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety.	L1, L2, L3
CO2	Plan and design a road safety improvement program.	L1, L2, L3
CO3	Analyze accident data and suggest safety measures.	L4, L5
CO4	Conduct road safety audit.	L2, L3, L4, L5
CO5	Interpret accident data using statistical analysis.	L4, L5

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2		X							
CO3					X	X			
CO4					X	X			
CO5					X	X			

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Semester- 2

Construction Equipment & Safety Management			
Course Code	**22CHT245/22CIM245**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours Theory + 25 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:
This course will enable students to
- **Understand the importance of safety in constructionindustry.**
- **Understand different types of equipment used in construction and its economicconsideration.**

Module-1	
Plants and Equipment for production of materials: Crushers, mixers, bituminous mixing plants, concrete mixing plants, advantages, choice	
Teaching-Learning Process	Black Board, Slides on Projector, Listing of Equipment Manufacturers
Module-2	
Construction Equipment: Operations, applications and performance of Dozers, Excavators- Power Shovels, Back Hoe, Back Hoe Loader, Graders, compactors, Pavers for Flexible and Rigid Pavement, Crawler, wheel tractors and its attachments, Cranes, Hauling Equipment's.	
Teaching-Learning Process	Black Board, Slides on Projector, Comparing Different Equipment Manufacturers, performance and its uses
Module-3	
Selection of Construction Equipment: Task considerations, Cost considerations, Engineering considerations, Equipment Acquisition options, Maintenance of Equipment: Repairs, log maintenance, safety during operation, economical life of equipment	
Teaching-Learning Process	Black Board, Slides on Projector, Field Examples
Module-4	
Safety in Use of Construction equipment's: Human Factors in Construction Safety Management Motivation: Management, Supervisors,Workers,Motivationalschemes,Roleoffirstlinesupervisors,Roleofmiddlemanagers,Roleofworkers,topmanagement practices	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies
Module-5	
Safety Management: Safety audit, Safety in site preparation, Design, safety culture, Top Management, Company Activities and Safety – Safety Personnel, Sub-contractual Obligation - Project Coordination and Safety Procedures	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies

Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.Theminimumpassingmark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnot less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) takentogether.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
7. The question paper will have ten full questions carrying equalmarks.
8. Eachfullquestionisfor20marks.Therewillbetwo fullquestions(withamaximumoffoursub-questions)fromeachmodule.

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Suggested Learning Resources:

Reference Books

- Peurifoy, R.L., Ledbette. W.B., Construction Planning, Equipment and Methods, McGraw HillCo.
- Antil J.M., Civil Engineering Construction, McGraw Hill BookCo.
- SC Sharma, 'Construction equipment and its Management', KhannaPublications.
- Hand Book on Construction Safety Practices, SP 70, BIS2001.
- Jimmy W. Hinze, Construction Safety, Prentice Hall Inc.,1997
- Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety andHealth.

Web links and Video Lectures (e-Resources):

1. NPTEL Lecture Series Construction Methods and Equipment Management, Coordinated by IIT Guwhati.
   https://archive.nptel.ac.in/courses/105/103/105103206/

Skill Development Activities Suggested

- Comparing different manufacturers Construction Equipment-its performance, maximum ability and costconsideration

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1	Identify and understand use of equipment anditsbenefits.	L1, L2
CO2	Selection of Equipment's anditsapplication.	L1, L2, L3, L4,L5
CO3	Understand necessity ofsafetymanagement.	L1,L2,L3, L4,L5
CO4	Identifyimportance,needofsafetywithrespecttoClient,contractorandsubcontractorsandsite workers.	L1,L2,L3,L4,L5
CO5	Safety Implementationat Sites	L2,L3,L4,L5

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X							
CO2	X								
CO3			X		X				
CO4				X	X				
CO5		X				X		X	

PAVEMENT ENGINEERING LAB -II			
Course Code	**22CHTL26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1	SEE Marks	50
Credits	2	Exam Hours	03

Course objectives: The objective of this course is to make students learn

- The procedure and test the basic properties of bitumen and modified binders, learn bituminous mixdesign
- Learn field tests on pavementevaluation

Sl.NO	Experiments
	Tests on bitumen / polymer modified binders
1	Penetration test
2	Viscosity test
3	Specific gravity test
4	Flash and fire point test
5	Ductility and elastic recovery test
6	Softening point test and separation test
7	Tests on bitumen Emulsion & Cutback bitumen
	Tests on bituminous mixes
1	Proportioning of materials by Rothfutch's method and Mix design by Marshall Method.
2	Bitumen Extraction, bitumen content and aggregate gradation
	Field Tests on Pavement evaluation
1	Benkelman Beam deflection studies & analysis
2	Measurement of Unevenness by Merlin & Bump integrator - Calibration of Bump Integrator
3	Surface Distress measurements – visual & wind shield survey – Determination of PCI
4	Dynamic Cone Penetration Test
5	Non-destructive test on concrete by: (Demonstration) (a) Rebound Hammer Test; (b) Ultrasonic Pulse Velocity Test; (c) Profometer
	Software Lab
1	Design of Flexible pavements using IIT-PAVE software
2	Design of Rigid Pavements as per IRC:58-2015(MS-Excel)

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Acquired the expertise to conduct various tests on binder, modified binders and bituminous mixes.

CO2: Gained knowledge on various field tests for the pavement evaluation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Eachexperimentto beevaluated forconductionwithobservationsheetandrecordwrite-up.Rubricsfortheevaluationofthe journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practicalsession.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximummarks).
- Weightage to be given for neatness and submission of record/write-up ontime.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8thweek of the semester and the second test shall be conducted after the 14thweek of thesemester.
- Ineachtest,testwrite-up,conductionofexperiment,acceptableresult,andproceduralknowledgewillcarryaweightageof 60% and the rest 40% forviva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learningability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximummarks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly byexaminers.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly byexaminers.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

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Semester- 3

SPECIAL PROBLEMS IN ROAD CONSTRUCTION			
Course Code	**22CHT31**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory+25 T/SDA	Total Marks	100
Credits	4	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understandthedifficultiesofroadconstructioninweakandmarshysoilsandnecessaryprecautionstobetakenduringdesign andconstruction.
- Understand the methods of strengthening soil fills and embankments to improve their performance as pavement component layer.
- Understand the difficulties associated with construction of high embankments and maintaining stability of hill slopes with precautions to betaken.
- Understand the use of recycled materials in road construction including milled bituminous waste with necessary design methodology.
- Understand the design and construction of roads in coastal and desert environments with exclusive exposureconditions.

Module-1

Problems of construction of roads in marshy areas and weak / expansive soils and water- logged - areas. Various effective measures for solving the problems, machinery required and method of construction. Control of water table, capillary rise and seepage flow in road construction. Design and construction of filter drains and capillary cut-off. Construction of subgrade in marshy areas and weak / expansive soils and water- logged - areas.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-2

Methods of strengthening weak foundation soil, acceleration of consolidation and settlement of compressible embankment foundation, vertical sand drains -Application, design and construction method.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving.

Module-3

Problems in construction of high embankments, stability of foundation and embankment slopes. Stability of hill slopes, control of erosion.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-4

Use of special materials such as geo-synthetics for drainage and in pavement layers. Use of reinforced earth retaining walls, Nailing Technique, Techniques of pavement construction using recycled materials – cold and hot mix recycling of bituminous materials.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-5

Special construction techniques - construction techniques of cell filled concrete Pavements – design, economics and construction method, and its application. Road construction on desert region and coastal areas, alternative methods, **Special problems** in construction & maintenance of hill roads, land slide, causes, investigation, and preventive and remedial measures, protection of embankment and cut slopes.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1.R.M. Koerner "Designing with Geosynthetics"- 4th Edition Prentice Hall, New Jerssey, 1997.
2. Geotechnical Aspects of Pavements Reference Manual / Participant Workbook U.S. Department of Transportation Publication No. FHWA NHI-05-037 Federal Highway Administration May 2006,https://www.fhwa.dot.gov/engineering/geotech/pubs/05037/05037.pdf
3. Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, NivedyaMandankaraKottayi, Rajib Mallick,A. Veeraragavan, CRC Press

Reference Books:

1. IRC-75 "Guidelines for the design of High embankments"- IRC,2015
2. Leonards G.A. "Foundation engineering"- McGraw Hill Book Company, New York,1962.
3. Cedgreen H.R. "Drainage of highway and airfield pavement"- John Willey and Sons.Inc., New York,1974.
4. G. Kassiff M. Livnet. G. Wisemen "Pavements on Expansive clays"– Jerusalem Academy Press, Jerusalem. Israel,1969.
5. R.D. Krebs &R.D.Walker "Highway Materials"- McGraw Hill Book House, New York,1971.

Web links and Video Lectures (e-Resources):

- https://www.maccaferri.com/in/case-histories/

Skill Development Activities Suggested

- Literature study on real-time case studies of special problems encountered andmitigation.
- Sitevisits

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	Blooms Level
CO1	Get the knowledge about the difficulties of road construction in weak and marshysoilsand the precautions to betaken	L2, L3
CO2	Suggest improvement methods of strengthening soil fills and embankments tobea pavementlayer.	L3, L4
CO3	Know the difficulties associated with construction of high embankments andmaintaininghill slopesstability.	L2, L3, L4
CO4	Use recycled materials in road construction with appropriatedesignmethods.	L2, L3
CO5	Provide design and construction methods for roads in coastal anddesertenvironments.	L2, L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	X									
CO2				X	X					
CO3					X	X				
CO4				X	X					
CO5				X	X	X				

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Semester- 3

INTELLIGENT TRANSPORTATION SYSTEMS			
Course Code	**22CHT321**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control.
- Learn how Intelligent transport systems (ITS) involve the application of information technology and telecommunications to controltraffic,informtravellersanddrivers,operatepublictransport,automatingpayments,handleemergenciesandincidents, operate commercial fleets and freight exchange, and automate driving andsafety.

Module-1

Introduction to Intelligent Transport System: Definition, Objectives, Historical Background, Benefits of ITS – Introduction to Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), Traffic control and monitoring aspects. **Intelligent Supporting Technologies :** Wireless communications, Standards and Cellular Technology, ITS Data acquisition and processing, Hardware and Software--Micro-Controllers

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Field studies and analysis using relevant software

Module-2

Intelligent Supporting Technologies: PLC, Embedded systems, Ubiquitous Computing, Sensing Technologies, Detectors/Detection Techniques—Triangulation Technique, Inductive loop detection, Video vehicle detection, Microwave detection etc. Global Positioning System (GPS)

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Field studies and analysis using software

Module-3

Components of ITS: Theories of elastic and plastic behaviour of soils. Function: Stability of embankment, Reinforcing embankment and fibres, Methods of reducing settlement due to consolidation in foundations of road embankment. Vertical Sand Drains: Design criteria, constriction and uses. **Advanced Traveller Information Systems (ATIS):** Traffic density, Variable message signs, Parking guidance, Weather information, **Advance Vehicle Monitoring Systems :** Security CCTV systems, Wireless Sensor Network and RFID

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving and analysis through software

Module-4

Commercial Vehicle Operations (CVO): Emergency Vehicle Notification Systems, Automatic Road Enforcement, Variable Speed Limits, Collision Avoidance Systems, Dynamic Traffic Light Sequence, Cooperative Systems On The Road, Automatic Number Plate Recognition By Image Processing.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving and analysis through software

Module-5

ITS Applications: Advanced Traffic Management Systems (ATMS) Advanced Vehicle Control Systems (AVCS), Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS), Automated Highway Systems **ITS Programs In the World:** Overview of ITS implementations in developed countries, ITS in developing countries.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Field studies and analysis through software

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module. 4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. SumitGhos and Tony Lee, *Intelligent Transportation Systems*, CRC Press, ISBN:0849300673.
2. Chris DraneandC. R. Drane, *Positioning Systems in Intelligent Transportation Systems*, Artech House Publishers, ISBN: 0890065365.
3. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" ArtechHouse.

Reference Books:

1. Kan Paul Chen, John Miles, "Recommendations for World Road Association (PIARC)" ITS Handbook2000.
2. Sussman, J. M., "Perspective on ITS", Artech House Publishers,2005.
3. USDepartmentofTransportation,"NationalITSArchitectureDocumentation",2007(CDROM).
4. Turban. E and Aronson. J. E, "Decision Support Sys tems and Intelligent Systems", PrenticeHall
5. JudyMcQueenandBobMcQueen,*IntelligentTransportationSystemandArchitecture*,ArtechHousePublishers,ISBN:089006525X

Asad J. Khattak **,** *Intelligent Transportation Systems: Planning, Operations, and Evaluation*, CRC Press

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105105204
- https://onlinecourses.nptel.ac.in/noc21_ce72/preview
- https://www.edx.org/course/intro-to-traffic-flow-modeling-and-intelligent-tra

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Analyse the appropriate system/s in various functional areas of transportation	L1, L2, L3, L4
CO2	Combine the various systems, plan and implement ITS applications	L1, L2, L3
CO3	Application of communications and information technologies to manage traffic	L1, L2, L3
CO4	Providing travellers with early notice	L2, L3, L4, L5, L6
CO5	Automatic handling of emergencies and to improve safety	L1, L2, L3, L4, L5, L6

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	X	X	X	X		X			X	
CO2	X	X	X	X		X			X	
CO3	X	X	X	X		X			X	
CO4	X	X	X	X		X		X	X	
CO5	X	X	X	X		X			X	

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Semester- 3

GIS AND REMOTE SENSING APPLICATIONS IN TRANSPORTATION ENGINEERING			
Course Code	**22CHT322**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Identify the geospatial data and tools required for understanding the transportationsystems.
- Use geospatial methods to analyze the transportation networkproblems.
- Apply the geospatial methods in transportation modellingsystems.
- Demonstrate the use of geospatial methods in transportation safety and air qualityanalysis

Module-1	
Concept of GIS and RS. Development of GIS and RS over the period. GIS for transportation in perspective. GIS, GPS and Transportation. Land use and Transportation Data: Spatial and Non spatial data for land use and transportation. Traffic Analysis Zone (TAZ) and screen lines. Network and Routes.	
Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of design software.

Module-2	
Data base Development: Database domains and transactions. RDBMS and Entity Relationship (ER) diagram. Data base design. Map Generation and Analysis Concept of map layers. Land cover analysis. Network creation and linear route building. Map accuracy and location expression. Generation of Themes and charts.	
Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of design software.

Module-3	
Transportation Network Development and Algorithms: Network development and management. Network properties. Shortest path algorithms. Transit network and paths.	
Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of design software.

Module-4	
GIS-T applications: Background and trends of GIS-T application. GIS-T application areas. Intelligent Transport Systems (ITS): Components of ITS. Architecture and integration with GIS. Analysis and visualizations of traffic data in GIS. Integration of GPS and GIS. Case Studies**.**	
Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of design software.

Module-5	
Transportation, Environment and Hazards: Mapping sensitive Environmental features; GIS and Transportation related Air Quality; Accidents and Safety Analysis; Transportation of hazardous Materials.	
Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of design software, Field visit for data collection.

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. O'sullivan David, Geographic Information Analysis, John Wiley & Sons,2003.
2. Longley P. A., Barnsley M. J., Donnay Jean-Paul, Remote Sensing and Urban Analysis, Taylor & Francis,2001.

Reference Books:

1. HensherD.A.,ButtonK.J.,HaynesK.E.,andStopherP.R.(Eds.),HandbookofTransportGeographyandSpatial Systems, Elsevier,2004.
2. Thill Jean-Claude, Geographical Information Systems in Transportation Research, Pergamon,2000.
3. Caliper Corporation, Travel Demand Modelling with TransCAD,1998.
4. Michael W., GIS - A Computing Perspective, CRC Press,2004.
5. Miller HJ and Shaw SL, Geographic Information Systems for Transportation: Principles and Applications, Oxford UniversityPress,2001.
6. Implementation of GIS in State DOTs, NCHRP ReportNo:180.
7. SimlowitzHJ.GISSupportTransportationSystemPlanning.InternationalGISSourcesBook. Hill JC, GIS in Transportation, Transportation Research Part C &2000.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/103/105103193/
- https://www.youtube.com/watch?v=4Rn0M39HOPU&list=PLLy_2iUCG87CDlroZBlwwBllYwz7KxVtA

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Recognize the geographical data and tools needed to understand the transportation networks.	L1, L2
CO2	Use geospatial techniques to examine the problems with the transportation network.	L1, L2, L3, L4
CO3	Use geospatial techniques in systems for transportation modelling.	L1, L2, L3, L4
CO4	Recognize several GIS in Transportation (GIS-T) applications, including Intelligent Transportation Systems (ITS), and explore a few case studies.	L1, L2, L4
CO5	Showcase the application of geospatial techniques to study of air quality and safety in transportation.	L1, L2, L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	-	-	X	-	X	-	-	X
CO2	X	X	-	X	-	X	-	X	X
CO3	X	X	-	X	-	X	-	X	X
CO4	X	-	-	X	-	X	-	-	X
CO5	X	X	-	X	-	X	-	X	X

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Semester- 3

CONSTRUCTION PLANNING AND ECONOMICS			
Course Code	**22CHT323**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

This course will enable students to make students learn Highway Planning, Highway Engineering Economics, principle, supply and demand models, equilibrium & sensitivity of travel demand Elasticity, Economic analysis & Highway financing

Module-1

Various types of highway development projects in progress in India and their scope. Factors to be considered in planning of new highway /expressway / bypass and up-gradation of existing roads.

PlanningofRoadProjects–projectmanagementframework,scope,projectobjectives,projectenvironment,causesofprojectfailure, project developmentprocess

Resource planning – human resources, project man power grouping, structuring site organization, construction materials- classification of construction materials, materials usage, materials inventory, cost and budget.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-2

Time planning – project work breakdown, determining activities involved, assessment of duration, CPM / PERT network analysis,workscheduling,methodsofworkscheduling,factorsaffectingworkscheduling,Problems.

Planning Control System – resource production, project cost, project time, codification and project management, information system, use of software**Use of softwares: Primavera V8i, MSP (Microsoft project), PPM (Project Portfolio Management)**

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of planning software

Module-3

Highway Engineering Economics, principle, supply and demand models, equilibrium, sensitivity of travel demand, Elasticities – types, models (Kraft demand model) consumer surplus cost – cost elasticity pricing and subsidy policies, rates of interest, Vehicle operation cost, direct and indirect benefits due to road improvement, Total transportation cost, fixed and variable costs. Road user cost studies in India.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-4

Economic analysis, different methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, Examplesofeconomicanalysisfordifferenttypesofroadimprovementmeasures,pavementoptions,constructionofbypassesandupgrading of intersections. Project priorities, methods of dealing withuncertainties.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies

Module-5

Highway financing, various options for road and bridge projects, special cess, tolling, BOT, BOOT and other options. Economic and financial analysis of highway projects and use of computer software packages. Road investment decision packages.

Use of software: HDM-4 software, Primavera V8i, MSP (Microsoft project), PPM (Project Portfolio Management)

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, Demo and learning of planning software

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. L.R. Kadiyali "Traffic Engineering and Transport Planning"-Khanna Publishers, NewDelhi.
2. K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling"- Tata McGraw Hillpublications
3. Winfrey, "Economic analysis for Highways", International Textbook Company,Pennslyvania,1969
4. Dr.VinayMaitriandDr.P.K.Sarkar"TheoryandApplicationsofEconomicsinHighway&Transport Planning"StandardPublishers Distributors,Delhi

Reference Books:

1. Prasanna Chandra "Financial Management"-Tata McGraw, NewDelhi.
2. Woods K.B, Berry, D.S. and Goetz W.H, "Highway Engineering"-McGraw Hill BookCo.
3. Hewes C.I. and Oglesby, C.H., "Highway Engineering"-Asia PublishingHouse.
4. Ian G. Heggie, "Transportation Engineering Economics"-McGraw Hill BookCo.
5. "Road User Cost Study in India"- Final Report, Central Road Research Institute, New Delhi,1982.
6. L.R. Kadiyali, et al, "Value of Travel Time Savings" - Traffic Engineering,HRB
7. Ministry of Road Transport and Highways, "Road Development Plan for India"- 2001-2021, Indian Roads Congress, New Delhi,2002.
8. IRC "A Manual for the Application of Critical Path Method to Highway Projects inIndia"
9. Nhai.org, pmgsy.nic.inwebsites

Standard Data Book on Highway Technology issued by the University may be referred in the PG Examination of VTU.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/106/105106188/
- https://nptel.ac.in/courses/105106115
- https://onlinepubs.trb.org/Onlinepubs/hrbbulletin/306/306-005.pdf

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Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	To prepare highway plans, Land use planning and development models.	L1, L2, L3
CO2	They will be able to carry out economic and financial analysis of highway projects.	L2, L3
CO3	Understand the highway planning process and difficulties or failures associated with planning process.	L2, L3
CO4	Understands the cost of materials, manpower and equipment in budget preparations for highway projects.	L3, L4
CO5	Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.	L3, L4, L5

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		X								
CO2					X	X	X			
CO3					X					
CO4					X	X	X			
CO5					X	X	X			

01.02.2023

Semester- 3

TRANSPORTATION PLANNING			
Course Code	**22CHT324/22CIM324**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understandthe differentmodes oftransportationandfactorsaffectingplanningprocessforaneffectivetransportationsystem.
- Understandthecharacteristicsofmasstransitsystemandmethodsofcollectingtrafficdatatoproposeaneffectivetransport facility.
- Understand and sources of zonal trip generation or attraction and then inter-zonal trip distributionmethods.
- Analysethemodeoftransportanditsimpactontransportsystemandalso themethodsofassigningtraveltripstovariousroutes for effectivemanagement.
- Understand the mass transportation options and evaluation of the systems foreconomicsustainability.

Module-1

Urbanization Process: Urban growth mechanism – Urban morphology - Urbanisation& travel demand Urban transport problems in India. **Urban Transport Planning Process:** Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving

Module-2

Travel Demand Estimate: Trip based and activity-based approach - Four stage travel demand modeling - Data needs and outputs - Quick response techniques - Survey designs.

Trip Generation: Productions & Attractions - Influential factors –Trip rate analysis-Category analysis- Simple & Multiple linear regression models – FHWA method.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving.

Module-3

Trip Distribution: Interchange matrix – Growth factor methods – Synthetic methods calibration of Gravity model.

Modal Split : Influential factors – FHWA Procedure – Diversion curves & surfaces- Discrete choice models, Concept, Types, BL,MNL & HL models.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving

Module-4

TripAssignment: TripAssignmentprocedure–Diversioncurves-BPRmodel-AllorNothingassignment-Multipathassignment-Capacity restraint assignment – User equilibrium and system equilibrium approach - Stochastic assignmentapproach.

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving

Module-5

Land Use Transport System: Urban system components - Urban spatial structure Accessibility - Location theory - Land use models - Land use transport models, Lowry &Garin – Lowry models**.**

Urban public transportation: Urban growth and public transport needs - Transit mode classifications – Transit characteristics - Fleet size and capacity estimation

Use of softwares: TransCAD, CUBE

Teaching-Learning Process	Black board, PowerPoint Presentations, Skill enhancement through problem solving, software learning

01.02.2023

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Hutchinson, B.G., "Principles of Urban Transport System Planning"– McGraw Hill BookCo.
2. L.R. Kadiyali, "Traffic Engineering and Transportation Planning"– KhannaPublication.
3. Khisty C J., LallB.Kent, *Transportation Engineering – An Introduction, Prentice*-Hall, NJ,2005
4. Ortuzar, J. D., Willumsen, L.G., *Modeling Transport*, John Wiley & Sons,1994
5. Papacostas C.S. and Prevedouros, P.D., *Transportation Engineering & Planning*, PHI, NewDelhi,2002
6. Chakroborty P., Das N., *Principles of Transportation Engineering*, PHI,NewDelhi,2003
7. Dickey J.W., *Metropolitan Transportation Planning*, Tata Mc-Graw Hill1980

Reference Books:

1. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition ThompsonLearning
2. Institute of Traffic Engineers – "An Introduction to highway Transportation Engineering", ITE,USA
3. Bowmen,J.andM.ben-Akiva,*ActivitybasedtravelForecasting;inActivitybasedtravelforecasting*.Washington,DC:U.S.Department of Transportation, ReportDOT-97-17.

Bruton M.J., *Introduction to Transportation Planning*, Hutchinson of London, 1988

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/105/105105208/
- https://archive.nptel.ac.in/courses/105/107/105107067/

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Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Learn about several forms of transportation and the elements that influence the planning process for each mode.	L1, L2, L4, L5
CO2	Propose effective transport facility for the mass transportation after collecting the data required.	L1, L2, L3, L4, L5, L6
CO3	Calculate the distributions of trips as well as the inter-zonal trip generations or attractions.	L2, L3, L4, L5, L6
CO4	Analyse the influence of each form of transportation on the transportation system to better understand optimal route management.	L1, L2, L4, L6
CO5	Evaluate the economic sustainability of the mass transportation systems.	L1, L2, L6

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X	X	X	X	-	X	X
CO2	X	X	-	-	X	X	-	X	X
CO3	X	X	X	X	X	X	-	X	X
CO4	X	X	-	-	X	X	-	X	X
CO5	X	X	X	X	X	X	-	-	X

Semester- 3

CONTRACT MANAGEMENT			
Course Code	**22CHT325**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:0:00	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	03	Exam Hours	

Course Learning objectives:
This Course will enable the students to
- **Understand the various types ofcontracts**
- **Understand the use and effect of contracts in constructionindustry**

Module-1

Introduction to contracts: Definitions, Essentials for a legally valid contract, Salient features of contract, Discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on Tendering Process, Economic Consideration, Applicability of the various types of contracts in Construction.

Teaching-Learning Process	Group based assignment on comparing contract documents of different Categories of project.

Module-2

Tendering process: Definitions, List of Documents, EMD, Security Deposit, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract–Letter of Award, Letter of Intent, Issues in tendering process: Pre -Registration, Pre-Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding.

Teaching-Learning Process	Group based study on preparing a contract agreement process for a given project.

Module-3

Administration/Performance of contract: Responsibilities (Duties and Liabilities) of Principal & Contractor, Monitoring and Quality control/assurance, Settlement of claims – Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements.

Teaching-Learning Process	Group based study on listing roles and responsibilities of principal and Contractor for a contract.

Module-4

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages.

Teaching-Learning Process	Group based assignment on case study of breaches.

Module-5

Dispute resolution: General, Methods for dispute Resolution–Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation /Adjudication by courts. Conciliation –Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation Dispute Resolution Boards (DRB), Constitution of DRB, Functioning of DRB, Procedure for Hearings, Status of Award.

Teaching-Learning Process	Group based assignment on preparing a contract document for a given project inclusive of DRB and its evaluating case studies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark fortheCIEis50%ofthemaximummarks.MinimumpassingmarksinSEEis40%ofthemaximummarksofSEE.Astudentshallbedeemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50%(50marksoutof100)inthesumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

Continuous Internal Evaluation:

5. Three Unit Tests each of **20Marks**
6. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)fromeachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.

Suggested Learning Resources:

Reference Books

1. Albett Robert W., (1961/Latest Edition) "Engineering Contracts and Specifications", John Willey and Sons, NewYork.
2. Patil B. S. (2009) "Civil Engineering Contracts and Estimates", UniversityPress.
3. John G. Betty (1993/ Latest Edition) "Engineering Contracts", McGrawHills.
4. Vasavada B. J., (1997), "Engineering Contracts and Arbitration", (Self Publication by Jyoti B.Vasavada).
5. VaidK.N.,(1998)"GlobalperspectiveonInternationalConstructionContractingTechnologyandProjectManagement", NICMAR,Mumbai
6. Prakash V. A., (1997) "Contracts Management in Civil Engineering Projects", NICMAR,Mumbai.

Web links and Video Lectures (e-Resources):

NPTEL Lecture Series Advanced Contracts, Tendering and Public Procurement.
https://archive.nptel.ac.in/courses/129/106/129106006/

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO 1	**The students will be able to understand the need ofcontractmanagement**	L2,L3
CO 2	**Steps involved in preparing contracts and typesofcontracts**	L3,L4
CO 3	**Importanceofarbitration**	L2, L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9
CO1		X			X				
CO2						X	X		
CO3		X							

Semester- 3

ROAD CONSTRUCTION EQUIPMENT			
Course Code	**22CHT331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives: The objective of this course is to make students learn

- The working principle and the advantages and limitations of various types of construction equipment's used and their maintenance and management measures

Module-1

Introduction: Working principle, capacity, rate of production, applications, advantages and limitations of various types of construction equipment

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-2

Equipment for earthwork excavation, hauling and spreading: Dozers; power shovels, Scrappers, Tippers and trucks, Motor graders, - application, types, production capacity, factors affecting production, optimum number of equipments for construction

Different types of soil compactors and their applications

Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-3

Plants for aggregates production – different types of crushers, Mixing plants: Pug mill for WMM, other cold mix plants, Hot mix Plants for bituminous mixes; factors affecting production capacity, Optimum number and location. Mixing plants for cement concrete

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-4

Paving and compacting equipment: Different types of pavers and compacting equipment for bituminous mixes, fixed form type paver and Slip form type paver for CC pavements – their advantages

Miscellaneous Equipment: Kerb casting equipment, road marking equipment, bitumen sprayers, water tankers

Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-5

Equipment Management: Equipment planning, forecasting equipment requirement, maintenance, workshop, work study, Selection of Construction Equipment - task considerations, cost considerations, equipment acquisition options

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.Theminimumpassingmark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnot less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) takentogether.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwo fullquestions(withamaximumoffoursub-questions)fromeachmodule.

Suggested Learning Resources:

Books

Text Books:

1. Peurifoy/ Schexnayder "**Construction Planning, Equipment and Methods"-** McGraw-Hill Higher Education
2. Sharma S.C. "**Construction Equipment and its Management"-** Khanna Publishers, Delhi

References

1. K.K. Chitkara, "**Construction Project Management, -Planning, Scheduling and Controlling"-** Tata McGraw –Hill Publications
2. **"Operation Manuals of various equipment manufacturers".**

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/103/105103206/

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	knowledge of the different construction equipments available.	L1, L2
CO2	Knowledge of equipments application different stages of road construction, their effective usage, maintenance and management	L2, L3

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Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2	X								

Semester- 3

AIRPORT PLANNING AND DESIGN			
Course Code	**22CHT332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives: This course will enable students to,

- Understand aircraft characteristics, airport characteristics – capacity of runway, taxiway.
- Learn planning and design of terminal area, grading of airport area, design of drainage system
- Learn marking of runway and taxiway, airport lighting

Module-1	
Introduction: Growth of air transport, airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas. **Aircraft Characteristics Related to Airport Design:** Components, size turning radius, speed, airport characteristics	
Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-2	
Capacity and Delay: Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, taxiway capacity**.**	
Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-3	
Airport planning, surveys and Design: Airport Site Selection, Runway length and width, sight distances, longitudinal and transverse grades, runway intersections, taxiways, clearances, aprons, numbering, holding apron, noise control, Problems. **Planning and Design of the Terminal area:** Operational concepts, space relationships and area requirements, vehicular traffic and parking at airports...	
Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-4	
Airport Grading and Drainage: Grading of airport area, hydrology, design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system, Problems	
Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-5	
Air Traffic Control and Aids: Runways and taxiways markings, day and night landing aids, airport lighting, ILS and other associated aids.	
Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.Theminimumpassingmark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnot less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) takentogether.

Continuous Internal Evaluation:

7. Three Unit Tests each of **20Marks**
8. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

11. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
12. The question paper will have ten full questions carrying equalmarks.
13. Eachfullquestionisfor20marks.Therewillbetwo fullquestions(withamaximumoffoursub-questions)fromeachmodule.

Suggested Learning Resources:

Books

Text Books:

1. **"Planning and Design of Airports"** - Robert Horenjeff, 2nd edition, McGraw Hill Book Co.
2. **"Airport Engineering"**- G. Glushkov, V.Babkov, Mir Publuishers, Moscow.

Reference Books:

1. **"Airport Planning and Design"**- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee
2. Harry.R.Cedergern. "**Drainage of Airfield pavements"-** John Wiley and Sons.
3. Virender Kumar and Satish Chandra, "**Airport Planning and Design**"- Galotia Publication press

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ae11/preview

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	knowledge on planning and design of various components of airports	L1, L2
CO2	Understand and design the pavement sections of runways	L2, L3

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X			X					
CO2	X			X					

Semester- 3

SUSTAINABLE MATERIALS AND CONSTRUCTION			
Course Code	**22CHT333/22CIM333**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students to

- Demonstrate competent knowledge of Sustainability, their potentials, their relation, pros andcons.
- Identify specific actions that can be taken to conserve energy and to promote the development and use of renewableenergy

Module-1

Overview of Civil Engineering Material - Material properties, Sustainable Construction Materials - Marginal materials, recycled materials, design aspects, construction practices using non-conventional materials and methods, milling and recycling techniques. Components of a material specification • Sustainability-based material specifications

Teaching-Learning Process	Black board, PowerPoint Presentations,

Module-2

Energy Savings in Construction - Fundamentals of energy - Energy production systems, Energy and resource conservation, Energy efficient design strategies, Renewable energy sources – advantages and disadvantages; Energy management and conservation: electrical equipment - Improvement of power factor -maximum energy demand.

Teaching-Learning Process	Black board, PowerPoint Presentations,

Module-3

Sustainable Civil Engineering Design Practice - ASCE Policy on the Role of the Engineer in Sustainability Other guidelines for sustainable design; Sustainability metrics for materials, Green building rating system: Introduction to IGBC and LEED rating systems – various criteria for building rating

Teaching-Learning Process	Black board, PowerPoint Presentations,

Module-4

Life-Cycle Assessment (LCA) - Use of sustainability metrics in LCA, Selection of materials using LCA

Teaching-Learning Process	Black board, PowerPoint Presentations,

Module-5

Application of sustainability concepts in a real project - Design a Highway/ Infra structure projects by integrating sustainability concepts

Teaching-Learning Process	Black board, PowerPoint Presentations,

01.02.2023

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedforthecourse. Semester EndExamination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3.Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4.Each full question will have a sub-question covering all the topics under a module.
5.The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. SustainableConstructionMaterials:RecycledAggregates(WoodheadPublishingSeriesinCivilandStructuralEngineering) byRavindra K. Dhir OBE(Author),Jorge de Brito(Author),Rui V. Silva(Author),Chao Qun Lye(Author)

Reference Books:

1. ASCE (2004), Sustainable Engineering Practice: An Introduction, Jorge A. Vanegas(Editor).
2. Sustainable Highway Construction Guide book – NCHRP – RP916

Web links and Video Lectures (e-Resources):

Sustainable road construction: current practices and future concepts | World Highways

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	Identify principles of sustainability and its role in constructionsector	L1,L2
CO2	Compute the life cycle energy of a typicalbuilding	L1,L2,L3,L4,L5
CO3	Develop recycling process for various types of marginalmaterials	L2,L3,L6
CO4	Carry out Life cycleAssessment	L1,L2,L3,L4
CO5	Learn to Apply Sustainability in Real timeprojects	L4,L5
CO6	Assess sustainability through ratingsystems	L1,L2,L3,L4

01.02.2023

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X	X	X		X		X
CO2	X			X	X	X	X		X
CO3	X	X	X	X	X	X		X	X
CO4	X				X	X		X	
CO5	X				X	X			

Semester 3

APPLICATION OF AI IN ENGINEERING INFRASTRUCTURE			
Course Code	**22CHT334/22CIM334**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence specifically to post graduate students. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environment. Specific objectives are, to:

- Gain a historical perspective of AI and itsfoundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in artificial neural networks and other machine learningmodels.
- Explore the current scope, potential, limitations, and implications of intelligentsystems.

Module-1

Introduction:

A brief history of AI, strong methods and weak methods, uses and limitations, AI in future, knowledge representation, the need for good representation, semantic nets, inheritance and frames. General applications of AI in civil engineering.

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-2

Search methodologies:

problem solving as search, data driven /goal driven search, depth first search, breadth first search, problem solving as search, propertiesofsuchmethods,whyhumansusedepthfirstsearch,illustrativeexamples(traversingaMaze,searchingforgift),informed and uninformed methods of searching. Illustrative real-world problems of civil engineeringinterest. Problems Related to Highway Engineering

Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-3

Introduction to Machine Learning, Concept learning, general-to-specific ordering, version spaces, inductive bias, general to specificordering,versionspaces,supervisedlearning,unsupervisedlearning,reinforcementlearning.Illustrativereal-worldexamples of machine learning of civil engineeringinterest.. Problems Related to Highway Engineering

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Module-4

Artificial Neural networks, introduction, neurons, perceptrons, the capabilities of a single perceptron, multilayer neural networks, capabilities of multilayer neural networks, back propagation, unsupervised learning networks, Kohonen maps. Illustrative real-world examples on applications of neural networks in highway/ infrastructure construction management. . Problems Related to Highway Engineering

Teaching-Learning Process	Black board, PowerPoint Presentations and Skill enhancement through SDA.

Module-5

Learning under uncertainty and ambiguity, fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering.. Problems Related to Highway Engineering

Teaching-Learning Process	Black board PowerPoint Presentations and Skill enhancement through SDA.

Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.Theminimumpassingmark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnot less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) takentogether.

Continuous Internal Evaluation:

9. Three Unit Tests each of **20Marks**
10. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**
    to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

14. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
15. The question paper will have ten full questions carrying equalmarks.
16. Eachfullquestionisfor20marks.Therewillbetwo fullquestions(withamaximumoffoursub-questions)fromeachmodule.

Suggested Learning Resources:

Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff/O'Reilly Publishers,2016
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python –Revised and updated for Python 3.2", Network Theory Ltd., 2011.
3. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
4. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
5. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education,2013
6. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", First Edition, Pearson,2018
7. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach" , Prentice Hall, Third Edition,2009.
8. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)",Jones and Bartlett Publishers, Inc.; First Edition, 2008
9. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press,2009.

Web links and Video Lectures (e-Resources):

- http://digimat.in/nptel/courses/video/106106213/L01.html
- http://digimat.in/nptel/courses/video/106106198/L01.html

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	Demonstratefundamentalunderstandingofthehistoryofartificialintelligence(AI)andits foundations.	L1, L2
CO2	Apply basic principles of AI in solutions that require problem solving, inference,perception, knowledge representation, and learning.	L2, L3
CO3	Demonstrate awareness and a fundamental understanding of various applications ofAI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	L2, L3
CO4	Identifycandidateproblemsexclusivetoaparticularengineeringdisciplinethatcanbe addressed under the ambit of AI.	L2, L3, L4
CO5	DemonstrateanabilitytoshareindiscussionsofAI,itscurrentscopeandlimitations,and societal implications.	L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						**X**			
CO2						**X**			
CO3						**X**			
CO4						**X**			
CO5						**X**			

Semester- 3

DATA ANALYTICS FOR ENGINEERS			
Course Code	**22CHT335/22CIM335**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: The objectives of the course are to:

- Get an overall view of data analysis based on CRISP-DM processmodel.
- Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data.
- Understand principles of modeling by going through various data modelingtechniques.
- Get a detailed account of data preparationphase.
- Study statistical concepts related to dataanalysis.
- Enablestudentstoindependentlyperformdataanalyticproceduresongivendatapertainingtocivilengineeringusing Excel.

Module-1

Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.

Teaching-Learning Process	Black board, PowerPoint Presentations, web resources

Module-2

Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one-dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to civil engineering infrastructure/ highway technology.

Teaching-Learning Process	Black board, PowerPoint Presentations, web resources

Module-3

The four steps of modeling, model classes, black-box models, fitting criteria and score functions, error functionsforclassificationproblems,measureofinterestingness,closedformalgorithmformodelfitting.Typesoferrors.Model validation (briefing on methods). Modeling on the data specific to civil engineering infrastructure/ highwaytechnology.

Teaching-Learning Process	Black board, PowerPoint Presentations, web resources

Module-4

Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation-based filter.Cleaningdata,improvingdataquality,dealingwithmissingvalues,constructdata,providingoperability,assuringimpartialityand maximize efficiency. Complex data types. Implementation of methods on data specific to civil engineering infrastructure/ highway technology.

Teaching-Learning Process	Black board, PowerPoint Presentations, web resources

Module-5

Clustering – methods. Hierarchical clustering. Dissimilarity measures; Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures. Association rules. Brief introduction to self-organizing maps. Implementation of methods on data specific to branch of specialization.

Teaching-Learning Process	Black board, PowerPoint Presentations, web resources

Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.Theminimumpassingmark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemedtohavesatisfiedtheacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnot less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) takentogether.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks**toattaintheCOsandPOs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)fromeachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Book:

1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London,2010

Reference:

1. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.

2. Allan Agresty, An Introduction to Categorical Data Analysis, 2 nd Edition, WileyPublication

Web links and Video Lectures (e-Resources):

- www.kdnuggets.com
- www.kaggle.com
- www.datameer.com

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Demonstrate a sophisticated understanding of the concepts and methods, know the exact scopes and possible limitations of each method and tasks involved. Apply CRISP-DM data analysis processes to civil engineering related data in decision making.	L2
CO2	Apply appropriate data visualization techniques and perform correlation analysis on the real-world data pertaining to allied areas of civil engineering / infrastructure / Highway technology	L3
CO3	Develop appropriate model for the data using the suitable algorithm and validate the so developed model using appropriate validation technique.	L4
CO4	Decide on appropriate method/ technique for data preparation and provide operability by assuring impartiality and integrity to the given real-world data drawn from various sub domains of civil engineering/ infrastructure/Highway technology	L5
CO5	Perform similarity analysis using similarity metrics and to implement simple clustering techniques of the given data set in one and multiple dimensions.	L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1						X		
CO2						X		
CO3						X		
CO4						X		
CO5						X		

Semester III

PROJECT WORK PHASE – 1			
Course Code	22CHT34	CIE Marks	100
Number of contact Hours/Week	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

- Support independentlearning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility andadaptability.
- Inspire independent and teamworking.
- Expand intellectual capacity, credibility, judgement,intuition.
- Adhere to punctuality, setting and meetingdeadlines.
- Instil responsibilities to oneself andothers.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit two copies of the typed report with a list ofreferences.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected projecttopic.
- Undertake problem identification, formulation, andsolution.
- Design engineering solutions to complex problems utilising a systemsapproach.
- Communicate with engineers and the community at large in written an oralforms.
- Demonstrate the knowledge, skills and attitudes of a professionalengineer.

SOCIETAL PROJECT			
Course Code	22CHT35	CIE Marks	100
Number of contact Hours/Week	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

- Support independentlearning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility andadaptability.
- Inspire independent and teamworking.
- Expand intellectual capacity, credibility, judgement,intuition.
- Adhere to punctuality, setting and meetingdeadlines.
- Instil responsibilities to oneself andothers.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the societal Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected societal project orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit two copies of the typed report with a list ofreferences.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected societal projecttopic.
- Undertake problem identification, formulation, andsolution.
- Design engineering solutions to complex problems utilising a systemsapproach.
- Communicate with engineers and the community at large in written an oralforms.
- Demonstrate the knowledge, skills and attitudes of a professionalengineer.

Semester III

INTERNSHIP			
Course Code	22CHTI36	CIE Marks	50
Number of contact Hours	06 Weeks	SEE Marks	50
Credits	06	Exam Hours	03

Course objectives:

Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory intopractice.
- To expand thinking and broaden the knowledge and skills acquired through course work in thefield.
- To relate to, interact with, and learn from current professionals in thefield.
- To gain a greater understanding of the duties and responsibilities of aprofessional.
- To understand and adhere to professional standards in thefield.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, andconfidentiality.
- To identify personal strengths andweaknesses.
- To develop the initiative and motivation to be a self-starter and workindependently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit the report duly certified by the externalguide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and becomeself-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship isdone.
- Acquire knowledge of the industry in which the internship isdone.
- Apply knowledge and skills learned to classroomwork.
- Develop a greater understanding about career options while more clearly defining personal careergoals.
- Experience the activities and functions ofprofessionals.
- Develop and refine oral and written communicationskills.
- Identify areas for future knowledge and skilldevelopment.
- Expand intellectual capacity, credibility, judgment,intuition.
- Acquire the knowledge of administration, marketing, finance andeconomics.

Semester IV

PROJECT WORK PHASE -2			
Course Code	22CHT41	CIE Marks	100
Number of contact Hours/Week(L:P:S)	00:08:00	SEE Marks	100
Credits	18	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintainingethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentationskills.
- To impart flexibility andadaptability.
- To inspire independent and teamworking.
- To expand intellectual capacity, credibility, judgement,intuition.
- To adhere to punctuality, setting and meetingdeadlines.
- To instil responsibilities to oneself andothers.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchangeideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defendit.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the projecttask.
- Habituated to critical thinking and use problem solvingskills
- Communicate effectively and to present ideas clearly and coherently in both the written and oralforms.
- Work in a team to achieve commongoal.
- Learn on their own, reflect on their learning and take appropriate actions to improveit.