VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

31.08.18

M.TECH. HIGHWAY TECHNOLOGY

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination – 2018-19
M.Tech Highway Technology (CHT)
Choice Based Credit System (CBCS)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18CHT11	Applied Statistics for Highway Engineering	04	--	03	40	60	100	4
2	PCC	18CHT12	Highway Materials	04	--	03	40	60	100	4
3	PCC	18CHT13	Pavement Design and Analysis	04	--	03	40	60	100	4
4	PCC	18CHT14/ 18CIM14	Highway Construction and Maintenance	04	--	03	40	60	100	4
5	PCC	18CHT15	Traffic Engineering	04	--	03	40	60	100	4
6	PCC	18CHTL16	Highway Materials Lab-I	-	04	03	40	60	100	2
7	PCC	18RMI17	Research Methodology and IPR	02	--	03	40	60	100	2
TOTAL				**22**	**04**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination will be conducted during III semester and prescribed credit shall be included in the III semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination – 2018-19
M.Tech Highway Technology (CHT)
Choice Based Credit System (CBCS)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18CHT21	Pavement Deterioration and Evaluation	04	--	03	40	60	100	4
2	PCC	18CHT22	Road Projects	04	--	03	40	60	100	4
3	PCC	18CHT23	Highway Planning and economic Analysis	04	--	03	40	60	100	4
4	PEC	18CHT24X	**Professional Elective 1**	04	--	03	40	60	100	4
5	PEC	18CHT25X	**Professional Elective 2**	04	--	03	40	60	100	4
6	PCC	18CHTL26	Highway Materials Lab-II	--	04	03	40	60	100	2
7	PCC	18CHT27	Technical Seminar	--	02	--	100	--	100	2
TOTAL				**20**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective

Professional Elective 1		**Professional Elective 2**	
Course Code under 18CHT24X	**Course title**	**Course Code under 18CHT25X**	**Course title**
18CHT241	Construction Planning, Equipment & Management	18CHT251/ 18CIM251	Planning and design of Rural Roads
18CHT242	Design of Bridge And Grade Separated Structures	18CHT252/ 18CIM252	Pavement Management System
18CHT243/ 18CIM243	Ground Improvement Techniques	18CHT253	Urban Public Transport
18CHT244/ 18CIM244	Soil Mechanics for Engineers	18CHT254	Road Safety Engineering & Management

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide in any and a senior faculty of the department. Participation in seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination will be conducted during III semester and prescribed credit shall be included in the III semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18CHT31	Special Problems in Road Construction	04	--	03	40	60	100	4
2	PEC	18CHT32X	Professional elective 3	04	--	03	40	60	100	4
3	PEC	18CHT33X	Professional elective 4	04	--	03	40	60	100	4
4	Proj	18CHT34	Evaluation of Project phase -1	--	02	--	100	--	100	2
5	INT	18CHTI35	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)		03	40	60	100	6
TOTAL				**12**	**02**	**12**	**260**	**240**	**500**	**20**

Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective, Proj: Project, INT: Internship

Professional elective 3		Professional elective 4	
Course Code under 18CHT33X	**Course title**	**Course Code under 18CHT34X**	**Course title**
18CHT321	Construction Contract Management	18CHT331	Transportation Planning
18CHT322/18CIM322	Maintenance and Rehabilitation of Structures	18CHT332	GIS and Remote Sensing applications in Transportation Engineering
18CHT323/18CIM323	Construction & demolition waste management	18CHT333/ 18CIM333	Airport Planning & Design
18CHT324	Road Construction Equipment	18CHT334	Intelligent Transportation Systems

Note:

1. Project Phase-1: Students in consultation with the guide/co-guide if any shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide and a senior faculty of the department. The CIE marks awarded for project work phase -1 shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship, shall be declared as failed and have to complete during subsequent University examinations after satisfy the internship requirements.

Internship SEE (University examination) shall be as per the University norms.

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Scheme of Teaching and Examination – 2018-19
M.Tech Highway Technology (CHT)
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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Proj	18CHT41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note: Proj: Project.

Note:

1. Project Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
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SCHEME OF TEACHING AND EXAMINATION 2018-2019

COURSE TITLE: APPLIED STATISTICS FOR HIGHWAY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

Semester I

Subject Code	18CHT11	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the use of statistical tools to express the traffic data for better interpretation.
2. Apply probability concept to understand the vehicular flow behavior helping the planners to predict traffic flow.
3. Use appropriate statistical testing tools to check the degree of accuracy in the traffic data analysis.
4. Test the hypothesis and assess the error involved in the data analysis.
5. Use software tools like MATLAB, MINITAB etc., for analysis of traffic data and also use curve fitting techniques for predicting the performance trends.

Modules	Teaching Hours
Module -1	
Introduction to statistical methods, scope aim and limitations, sample, attribute and types of data, sources and collection of data. Accuracy of data. Representation and summarizing data. Frequency distribution, histogram and frequency curves. Ogive curve, Measure of central tendency – arithmetic mean, median and mode dispersion- range, standard deviation, variance and co-efficient of variation, skewness and kurtosis.	**10 Hours**
Module -2	
Introduction to probability & statistics for Traffic Engineering Design – Introduction, Random variables and statistical measures: arithmetic mean, measures of dispersion, basic laws of probability, probability laws for discrete random variables: binomial and Poisson distribution, probability laws for continuous random variables: normal distribution, Poisson distribution.	**10 Hours**
Module -3	
Sampling Techniques – objective, basics of sampling, advantages of sampling, sampling techniques, sampling distributions – sampling distribution of the sample mean, central limit theorem, chi square, t and F – distributions. Sampling error, sample size and design.	**10 Hours**
Module -4	
Statistical decisions – point estimation, properties of parameters, Testing of Hypothesis – Type I and II errors. **Tests of significance** – tests for mean and variance. Tests for proportions.	**10 Hours**
Module -5	
Chi-square test of goodness of fit, student's t test, Confidence interval. Curve fitting by the method of least squares, Linear correlation & regression, multiple linear regression. Analysis of variance **Use of soft-wares in statistical analysis** – MATLAB, MINITAB	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Use statistical tools to express the traffic data for better interpretation.
2. Apply probability concept to understand the vehicular flow behavior helping the planners to predict traffic flow.
3. Use appropriate statistical testing tools to check the degree of accuracy in the traffic data analysis.
4. Test the hypothesis and assess the error involved in the data analysis.
5. Use software tools like MATLAB, MINITAB etc., for analysis of traffic data and also use curve fitting techniques for predicting the performance trends.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Critical thinking*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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 New Delhi

Reference Books:

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

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COURSE TITLE: HIGHWAY MATERIALS

[As per Choice Based Credit System (CBCS) scheme]

Semester I

Subject Code	18CHT12	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the basic construction materials and their suitability as road materials.
2. Analyse the aggregates and design aggregate gradation for construction of pavement layers.
3. Characterize the binder material for bituminous roads and provide an optimum bituminous mix design.
4. Understand mix design using different materials for various components of a CC pavement.
5. Understand and propose soil stabilization techniques for highway construction using locally available materials.

Modules	Teaching Hours
Module -1	
Basic road construction materials – types, source, functions, requirements, properties, tests and specifications for use in various components of road. 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.	**10 Hours**
Module -2	
Aggregates–Origin, classification, equipments, 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.	**10 Hours**
Module -3	
Bituminous binders – different types, properties and uses, physical tests on bitumen, Rheological and pavement performance related properties, Modified binders, ideal pavement binders, characteristics and applications in road construction, criteria for selection of different 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.	**10 Hours**
Module -4	
Portland cement and cement concrete for use in road works – requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.	**10 Hours**
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.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Identify and select based on their characteristics the basic construction materials for road construction.
2. Design aggregate gradation for construction of pavement layers keeping in mind the density and strength parameters.
3. Characterize the binder material for bituminous roads and provide an optimum bituminous mix design.
4. Provide mix design procedure and the base layer for a CC pavement.
5. Propose soil stabilisation techniques for highway construction using locally available materials.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Usage of modern tools*
- *Ethical practices and social responsibility*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee
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. "Bituminous materials in Road Construction"- HMSO Publication.

Reference Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
2. IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986
3. State of art, special report 3 – "compaction of earthwork and subrade"- IRC, HRB, 1999
4. IRC: 51-1992, 63-1976, 74 –1979, 88-1984, "Indian Roads Congress".
5. IRC SP: 53 – 2002, IRC SP: 58 – 2000, "Indian Roads Congress".
6. "Guidelines for use of Geotextiles in Road Pavements and Associated works"- 2002, Indian Roads Congress
7. Khanna and Justo, "Highway Materials Testing"- Nem Chand and Bros., Roorkee.
8. "Soil Mechanics for Road Engineers"- HMSO Publication
9. Highway Hand Book by FAW, Publication from NUS, Singapore.
10. Standard Data Book on Highway Technology issued by the University may be referred in the P.G Examination of VTU.

COURSE TITLE: PAVEMENT DESIGN AND ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	18 CHT13	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the factors affecting pavement design and performance
2. Evaluate the strength of soil subgrade soil and factors that affect the behavior of soil.
3. Compute the stresses and deflections in flexible pavement layers under the action of wheel loads.
4. Design the thickness of flexible pavements by different methods under different exposure conditions and materials.
5. Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.

Modules	Teaching Hours
Module -1	
Road Pavements and pavement layers - types, functions, choice Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution, ESWL, EWL,VDF due to varying loads and CSA.	**10 Hours**
Module -2	
Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation Pavement material Characteristics, climatic, drainage and environmental factors, their effects and evaluation. Factors affecting design and performance of airport pavements.	**10 Hours**
Module -3	
Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses, deflections / strains in single, two and three layer system, Applications in pavement design. problems	**10 Hours**
Module -4	
Flexible pavement design: Emperical, 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.	**10 Hours**
Module -5	
Rigid pavement design: Determination of ESWL, EWL for dual and dual tandem wheel loads in Rigid pavements, General design principle, Stresses in rigid pavements, stresses due to wheel loads and temperature variations, design of cement concrete pavements (joints and slab thickness) as per IRC guidelines. Design features of CRCP, SFRC and ICBP, Problems.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Get the knowledge of factors affecting pavement design and performance
2. Evaluate the strength of soil subgrade soil and identify the factors that affect the behavior of soil.
3. Compute the stresses and deflections in flexible pavement layers under the action of wheel loads.
4. Design the thickness of flexible pavements by different methods under different exposure conditions and materials.
5. Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.

Graduate Attributes (as per NBA)

11. Engineering Knowledge.

12. *Problem Analysis.*

13. *Design / development of solutions (partly).*

14. *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Yoder and Witczak, "Principles of Pavement Design"- John Wiley and sons Inc(second edition) 1975
2. Yang, "Design of functional pavements"- Mc Graw Hill Book Co.

Reference Books:

1. Huang, "Pavement Analysis"- Elsevier Publications
2. David Croney, Paul Croney, "Design & Performance of Road Pavements"- Mc Graw hill Book Co.
3. W.Ronald Hudson, Ralph Haas and Zeniswki "Modern Pavement Management"- Mc Graw Hill and Co
4. IRC 37-2001, IRC 81-1997, IRC 58 – 2002, IRC 59 – 1976, IRC 101-1988, Indian Roads Congress
5. Khanna and Justo "Highway Engineering"- Nemchand & Bros, Roorkee

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COURSE TITLE: HIGHWAY CONSTRUCTION AND MAINTENANCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT14/18CIM14	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the various equipment used for road construction and difficulties associated with highway drainage.
2. Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and sub base layers.
3. Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed for roads.
4. Design the base course thickness and selection of materials as base layer for CC pavements.
5. Analyse the defects in road construction and general pavement failures with remedies.

Modules	Teaching Hours
Module -1	
Components of road and pavement structure including subgrade, drainage system, functions, requirements and sequence of construction operations **Plants and equipment for production of materials -** crushers, mixers, bituminous mixing plants, cement concrete mixers – various types, advantages and choice. **Drainage** – Assessment of drainage requirements for the road and design of various components, drainage materials, Construction of surface and subsurface drainage system and design of filter materials for roads. Drainage of urban roads, problems.	**10 Hours**
Module -2	
Pre-construction surveys and marking on ground - Specifications and steps for the construction of road formation in embankment and cut, construction steps for subgrade (preparation of subgrade) in cutting, filling and at grade. Construction steps for granular sub-base, quality control tests.	**10 Hours**
Module -3	
Different types of granular base course – WMM, CRM, WBM, specifications, construction method and quality control tests. Different types of bituminous layers for binder and surface courses, their specifications (as per IRC and MORTH), construction method and quality control tests. Special structural courses like stone matrix asphalt and mastic asphalt and construction of porous asphalt.	**10 Hours**
Module -4	
Different types of sub-base and base course for cement concrete (CC) pavement and construction method. Construction of cement concrete (PQC) pavements and joints, quality control during construction. Construction of special Cement concrete pavements like interlocking concrete block pavements (ICBP), Continuously reinforced cement concrete pavements (CRCP), Fibre reinforced cement concrete pavements (FRCP), white topping, Ultra thin white topping etc. **General Aspects:** Quality assurance, statistical approach, quality system for road construction. Safety aspects during road construction and maintenance works. Installation of various traffic safety devices and information system Principle of construction planning, application of CPM and PERT(Problems not included)	**10 Hours**

Module -5

Road maintenance works – day to day and periodic maintenance works of various components of road works and road furniture. Preventive maintenance of road drainage system, pavements and other components of road. Preparation of existing pavement – patching, profile correction, Special measures to deal with reflection cracks in pavement layers, slipperiness of surface, etc. Requirements for rehabilitation, recycling and re-construction.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Gain the knowledge on the equipment used for road construction and difficulties associated with highway drainage.
2. Select suitable equipment for preparation of subgrade and preparation stages for base and sub base layers.
3. Design bituminous surfacing and other layers along with safety aspects needed during construction.
4. Design the base course thickness and select materials for base layer in CC pavements.
5. Analyse the defects in road construction and general pavement failures and propose suitable remedies.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Critical thinking.*
- *Ethical practices and social responsibility*
- *Use of modern tools*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee
2. Dr. L.R.Kadyali, Dr. N.B.Lal, "Principles and Practices of Highway Engineering,, Khanna Publishers
3. Sharma S.C., "Construction Equipment and its Management"- Khanna Publishers

Reference Books:

1. MoRTH "Specifications for Roads and Bridge Works"- 2001,fourth revision, Indian Roads Congress
2. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian Roads Congress
3. MoRTH "Manual for Maintenance of Roads"- 1989, Indian Roads Congress
4. IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27-1967, 29-1988, 34- 1970, 36-1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94-1986, 95-1987, 98-1997, 105-1988.
5. 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
6. National Asphalt Pavement Association "Hot Mix Asphalt Paving Hand book"- 5100 Forbes Boulevard, Lanhm, Mary Land, USA
7. "Hand Book on Cement Concrete Roads"- Cement Manufacturers Association, New Delhi

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

COURSE TITLE: TRAFFIC ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	18CHT15	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Analyse the factors affecting performance of road traffic and the various traffic studies needed for the analysis of traffic flow.
2. Evaluate level of service and capacity of roadways and intersections using traffic data.
3. Propose and design suitable traffic regulatory system based on traffic requirements such as signs, signals, markings, etc.
4. Analyse and design intersections at-grade and grade separated types for smooth and safe movement of vehicles.
5. Propose parking facilities, pedestrian facilities and general safety measures required for highways and expressways.

Modules	Teaching Hours
Module -1	
Traffic Characteristics, road user characteristics – human factors including reaction time and vehicular characteristics affecting road design and traffic flow **Traffic studies** - data collection, analysis and interpretation of results of classified traffic volume, spot speed, speed and delay, origin and destination. Sampling in traffic studies – sampling techniques, sampling theory, accuracy and sample size.	**10 Hours**
Module -2	
Accident characteristics, causes, studies, investigations and analysis of individual accidents, statistical analysis, measures to improve road safety. Problems on above. **Traffic flow characteristics, traffic flow variables, speed** – flow – density relationship, PCU values, level of service, factors influencing roadway capacity, capacity of roads at various levels of service, capacity of intersections	**10 Hours**
Module -3	
Traffic forecast - traffic growth estimation from past trends, econometric models. Common methods of traffic forecast **Traffic regulations and control** - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators.	**10 Hours**
Module -4	
Design of signalized intersections including signal timings as per IRC guidelines. Signal system, use of software. Problems. Design of other types of intersections at grade such as intersections with markings, channelized intersections and traffic rotary. Traffic design of grade separated intersections and interchange facilities.	**10 Hours**
Module -5	
Design of on-street and off-street parking facilities, pedestrian facilities, bus bays, safety devices. Design features of expressways and different types of Urban Roads	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Gets the knowledge of factors affecting performance of road traffic and also the traffic studies needed for the analysis.
2. Evaluate level of service and capacity of roadways and intersections.
3. Propose and design suitable traffic regulatory system such as signs, signals, markings, etc.
4. Analyse and design intersections at-grade and grade separated types for smooth and safe movement of vehicles.

5. Propose parking facilities, pedestrian facilities and general safety measures required for highways and expressways.

Graduate Attributes (as per NBA)

15. Engineering Knowledge.

16. *Problem Analysis.*

17. *Critical thinking*

18. *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Kadiyali L.R. "Traffic Engineering and Transportation Planning"-Khanna Publication, New Delhi
2. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning

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. Pignataro , " Traffic Engineering", John wiley & sons. Nicholas J Garber, Lester A Hoel, "Traffic & Highway Engineering"- Third edition,
6. IRC: SP:41-1994, IRC SP:31-1992, IRC 43-1994, Indian Roads Congress
7. MoRTH "Type Designs for Intersections on National Highways"-Indian Roads Congress
8. MORTH "Manual for Road Safety in Road Design"-Indian Roads Congress
9. IRC3-1983,9-1972,62-1976,64-1990,65-1976, 66-1976,67-2001,69-1977,70-1977,73-1980,79-1981,80-1981,86-1983,92-1985,93-1985,99-1988,102-1988,103-1988,106-1990,110-1996 Indian Roads Congress
10. Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee
11. Indian Highway Capacity Manual (Indo-HCM) CSIR, New Delhi, 2012-2017

COURSE TITLE: HIGHWAY MATERIALS LAB -1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	18 CHT L16	CIE Marks	40
Practical /field work/Assignment	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 02

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

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

Modules

Tests on soil

1. Grain size analysis - Wet sieve analysis
2. Liquid limit, plastic limit & Shrinkage limit
3. Compaction test
4. California bearing ratio test and
5. Unconfined Compression Strength Test
6. Field density by sand replacement & Core cutter method

Tests 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

Tests on cement& concrete

1. Fineness
2. Std consistency & setting time of cement
3. Soundness
4. Compressive strength

Concrete

1. Concrete Mix design
2. Compressive Strength
3. Flexural strength

Course outcomes:

After the completion of the course students should have

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

Text Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Materials and Pavement Testing', Nem Chand and Bros, Roorkee
2. Gambhir, M. L., 'Concrete Manual', Dhanpat Rai and sons New Delhi

Reference Books:

1. Relevant IS and IRC codes

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: RESEARCH METHODOLOGY AND IPR [As per Choice Based Credit System (CBCS) scheme] SEMESTER – I			
Subject Code	18RM117	CIE Marks	40
Number of Lecture Hours/Week	02	SEE Marks	60
Total Number of Lecture Hours	25	Exam Hours	03
CREDITS – 02			

Course objectives:

Modules	**Teaching Hours**
Module -1	
	10 Hours
Module -2	
	10 Hours
Module -3	
	10 Hours
Module -4	
	10 Hours
Module -5	
	10 Hours

Course outcomes:

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem solving.*
- *Critical thinking*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

COURSE TITLE: PAVEMENT DETERIORATION AND EVALUATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18 CHT 21	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the structural and functional requirements of pavements and also to carry out the structural and functional evaluation of both flexible and rigid pavements
2. To evaluate new pavement materials through various approaches such as model pavement studies, test track studies etc.

Modules	Teaching Hours
Module -1: Introduction to pavement evaluation	
Structural and functional requirements of flexible and rigid pavements. Distress and different types of failures in pavements. Functional and structural deterioration of flexible and rigid pavements, Deterioration models.	**10 Hours**
Module -2:	
Structural and functional evaluation of pavements- Structural deterioration of pavements, causes, effects, methods of treatment. Structural evaluation of flexible pavements by Rebound deflection method, Analysis of data, interpretation and applications, design of overlay. "Use of FWD and other methods for evaluation of flexible and rigid pavements and their application. Problems. Rating methods. Use of modern equipment for pavement surface condition measurements.	**10 Hours**
Module -3	
Functional deterioration of pavements, causes, effects, methods of treatment. **Pavement surface condition** - Causes, effects, methods of measurement. Functional evaluation and treatment of: a) Pavement slipperiness b) Riding quality and unevenness c) Rutting d) Cracking e) Potholes f) Edge breaking etc. Rating methods. Use of modern equipment for pavement surface condition measurements. Analysis of data, interpretation and application.	**10 Hours**
Module -4:	
Discussion on choice of overlay type and pavement materials over existing flexible and rigid pavements, with different degrees of distress.	**10 Hours**
Module -5:	
Evaluation of new pavement materials, model studies, pavement testing under controlled conditions, accelerated testing and evaluation methods. **Test track studies**. Instrumentation for pavement testing.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Understand the failure mechanism in pavements and suggest suitable corrective measures.
- Analyse and evaluate structural and functional adequacy of pavements

Graduate Attributes (as per NBA)

1. *Scholarship of Knowledge.*
2. *Problem Analysis.*
3. *Critical thinking*
4. *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Hass R., Hudson. W. R., Zaniewisti .J. "Modern Pavement Management" – Krieger Publishing Company, Florida, 1994.
2. David and Paul Croney, "Design and performance of road pavements"- third edition, Mc Graw hill, 1998.

Reference Books:

1. Per Ulitz "Pavement Analysis" - Elsevier Amsterdam.
2. Highway Hand Book by FAW, Publication from NUS, Singapore.
3. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
4. IRC 81, 1997, GUIDELINES FOR STRENGTHENING OF FLEXIBLE ROAD PAVEMENTS USING BENKELMAN BEAM DEFLECTION TECHNIQUE
5. IRC SP 16, 2004 Guidelines for Surface Evenness of Highway Pavements
6. IRC SP 17, Recommendation about Overlays on Cement concrete Pavements

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: ROAD PROJECTS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT22	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Prepare project report for new and up-gradation type road works by conducting necessary feasibility/detailed studies.
2. Conduct the soil and material investigations to understand their behavior and performance.
3. Perform various traffic related studies helping to finalize the project preparations and methods of forecasting traffic data.
4. Analyse the social impact of road projects and also determine the economic feasibility analysis for justification of investments.
5. Prepare DPR on road projects with relevant drawings and get the knowledge of tendering process for the construction.

Modules	Teaching Hours
Module -1: Introduction	
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.	**10 Hours**
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 road way requirements, origin- destination characteristics and studies, Axle load / wheel load studies using weigh bridges and analysis of data for pavement design	**10 Hours**
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, road way facilities: Pedestrian facilities, bus bays, truck lay byes, traffic, medical and vehicle aid posts, street lighting, road safety audit, road safety furniture, Mx ROAD	**10 Hours**
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, wild life, air, noise quality standards	**10 Hours**
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.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Prepare project report for new and up-gradation type road works by conducting necessary feasibility/detailed studies.
2. Conduct the soil and material investigations to understand their behavior and performance.
3. Analyze the surveys and investigations and select geometry of road
4. Understand the contract document, evaluation and contract management for road projects Analyse the social impact of road projects and also determine the economic feasibility analysis for justification of investments.
5. Prepare DPR on road projects with relevant drawings and get the knowledge of tendering process for the construction. .

Graduate Attributes (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Dr. L.R.Kadyali, Dr. 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 Roads Congress
2. IRC: SP: 30 - 1993, “Manual on Economic Evaluation of Highway”- Projects in India (first revision), Indian Roads Congress
3. IRC SP – 38,”Manual for Road Investment Decision Model”-1992, Indian Roads Congress
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 Roads Congress
6. MoRTH “Standard and Bidding Document Procurement of Civil Works”- Part I and II, 2000, Indian Roads Congress MoRTH “Model Concession Agreement for Small Road Projects”-2000, Indian Roads Congress

COURSE TITLE: HIGHWAY PLANNING AND ECONOMIC ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18 CHT 23	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The objective of this course is to make students learn Highway Planning, Highway Engineering Economics, principle, supply and demand models, equilibrium & sensitivity of travel demand Elasticity, Economic analysis & Highway financing

Modules	**Teaching Hours**
Module -1	
Highway Planning – Objects, need for highway planning, types of planning, planning surveys, Interpretation, Preparation of Master plans, NTP and NTPC in India. Traffic studies – Volume study, types of volume counts viz, key count, control counts, coverage counts etc. Estimation of future traffic by different approaches, speed studies, load meter study.	**10 Hours**
Module -2	
20 year road development plan including 1st and 2nd 20 year plan in brief and 3rd and 4th 20 year plan in detail, Land use planning, Land use development – models, problems on the above topics, Highway Planning in India.	**10 Hours**
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.	**10 Hours**
Module -4	
Economic analysis, different methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, Examples of economic analysis for different types of road improvement measures, pavement options, construction of bypasses and upgrading of intersections. Project priorities, methods of dealing with uncertainties.	**10 Hours**
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.	**10 Hours**

Course outcomes:

On completion of this course, Students would be able to prepare highway plans, Land use planning and development models. They will be able to carry out economic and financial analysis of highway projects.

Graduate Attributes

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Critical thinking*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Kadiyali L.R. "**Traffic Engineering and Transport Planning"-**Khanna Publishers, New Delhi.
2. Jotin Chisty.C and Kent Lall B "**Transportation Engineering An Introduction**"- PHI, New Delhi.

Reference Books:

1. Prasanna Chandra "**Financial Management**"-Tata McGraw, New Delhi.
2. Woods K.B, Berry, D.S. and Goetz W.H, "**Highway Engineering"-**McGraw Hill Book Co.
3. Hewes C.I. and Oglesby, C.H., "**Highway Engineering"-**Asia Publishing House.
4. Ian G. Heggie, "**Transportation Engineering Economics"-**McGraw Hill Book Co.
5. **"Road User Cost Study in India"-** Final Report, Central Road Research Institute, New Delhi, 1982.
6. Kadiyali, L.R., 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.

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

Course Title: CONSTRUCTION PLANNING, EQUIPMENT AND MANAGEMENT
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – II

Subject Code	18 CHT 241	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the highway planning process and difficulties or failures associated with planning process.
2. Understands the cost of materials, man power and equipment in budget preparations for highway projects.
3. Identify suitable equipment and their selection in the production of pavement materials.
4. Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.
5. Use the software or management tools to manage the resources, cost and duration of equipment.

Modules	Teaching Hours
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. **Planning of Road Projects** –project management framework, scope, project objectives, project environment, causes of project failure, project development process	**10 Hours**
Module -2	
Resource planning – human resources, project man power grouping, structuring site organisation, construction materials- classification of construction materials, materials usage, materials inventory, cost and budget	**10 Hours**
Module -3	
Road construction equipment and choice – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice Problem on equipment usage charges. Type, capacity and number, task considerations, cost considerations, engineering considerations, equipment acquisition options, optimum location of crushing and mixing plants, problems.	**10 Hours**
Module -4	
Time planning – project work breakdown, determining activities involved, assessment of duration, CPM / PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, Problems.	**10 Hours**
Module -5	
Planning Control System – resource production, project cost, project time, codification and project management, information system, use of software	**10 Hours**

Course outcomes:
After studying this course, students will be able to:

1. Understand the highway planning process and difficulties or failures associated with planning process.
2. Understands the cost of materials, man power and equipment in budget preparations for highway projects.
3. Identify suitable equipment and their selection in the production of pavement materials.
4. Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.

5. Use the software or management tools to manage the resources, cost and duration of equipment.

Graduate Attributes

- *Critical thinking.*
- *Problem Analysis.*
- *Use of modern tools*
- *Project management and finance*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling"- Tata McGraw Hill publications
2. S.C. Sharma "Construction Equipment and its Management"- Khanna Publishers

Reference Books:

1. Peurifoy / Schexnayder "Construction Planning, Equipment and Methods"-Tata Mc Graw Hill Publications
2. IRC "A Manual for the Application of Critical Path Method to Highway Projects in India"
3. Nhai.org, pmgsy.nic.in websites

Course Title: DESIGN OF BRIDGE AND GRADE SEPARATED STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT242	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the types and components of a bridge with specifications for designing them for highways.
2. Understand the use of different types of bridge bearings, their installation and maintenance aspects under the action of vehicular loads.
3. Understand the design aspects of bridge approaches for RCC, PSC and Steel bridges.
4. Analyse the loading conditions on the bridges and design the elements as per IRC load specifications.
5. Understand the quality control measures during the execution of bridges both for substructure and super structure portions of the bridge.

Modules	Teaching Hours
Module -1	
Introduction to Bridges: Basic Elements of a Bridge. **Types of bridges and grade separated structures for highways,** standard specifications for road bridges and grade separated structures to fulfill traffic and Structural and Hydraulic design requirements.	**10 Hours**
Module -2	
Bridge bearings, joints, approaches, construction and maintenance aspects.	**10 Hours**
Module -3	
Basic design approaches of RCC, PSC and steel bridges superstructure. Types of bridges for IRC loading conditions	**10 Hours**
Module -4	
General Design Considerations for grade separated structures and their choices, IRC Class AA Tracked and Wheeled Loading Analysis, Problems.	**10 Hours**
Module -5	
Introduction to Construction Specification and quality control: for foundations and substructures of bridges and Grade separated Interchanges – Types, warrants and Design standards. Concept of evaluation of existing bridge structures. Methods of rehabilitation and widening.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Design the components of a bridge following the specifications for highways.
2. Get the knowledge of bridge bearings, their installation and maintenance aspects to withstand vehicular loads.
3. Understand the design aspects of bridge approaches for RCC, PSC and Steel bridges.
4. Analyse the IRC loading conditions for the design of bridges.
5. Understand the quality control measures during the execution of bridges both for substructure and super structure portions of the bridge.

Graduate Attributes

- *Critical thinking*
- *Problem solving.*
- *Collaborative and multidisciplinary work*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. D.Johnson Victor, "Essentials of bridge Engineering"- Oxford, IBH publishing company.
2. Ponnuswamy, "Bridge Engineering"-McGraw Hill Publication, 1989.

Reference Books:

3.Vazirani Ratwani & M.G.Aswani, "Design of Concrete Bridges"- Khanna Publishers, New Delhi
4. "Design of Bridges"- Dr. Krishna Raju, Oxford & IBH Publishing company Limited.
5. "Analysis and design of Bridges"- M.A.Jayaram, Sapna Publishers, Bangalore.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: GROUND IMPROVEMENT TECHNIQUES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT243/18CIM243	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course will enable students to:

- Introduce the various types of improvement methods of engineering properties soils
- Introduce the application of engineering methods to ground improvement projects
- Basic knowledge on various ground improvement techniques and their suitability for various types of soil conditions
- The skills of implementation of geotechnical knowledge in field situations

Modules	Teaching Hours
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.	**10 Hours**
Module -2	
Methods of dewatering: Open sumps and ditches, well point system, electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains. **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.	**10 Hours**
Module -3	
Soil reinforcement: Reinforcing materials, concept of confinement, Gabbion walls; Dynamic consolidation, Vibroflotation, Pre-consolidation with vertical drains, Granular piles, Soil nailing, Anchors & Thermal methods.	**10 Hours**
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 at depth. (b) Improvement of cohesive soils: Preloading, or dewatering, methods of installing: sand drains, drain wicks, electrical and thermal methods.	**10 Hours**
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. (b) Improvement of cohesive soils: preloading, or dewatering, methods of installing sand drains drain wicks, electrical and thermal methods. (c) Grouting: purpose, functions, types of grouts; soil bentonite - cement mix, cement mix, emulsions, solutions: grout injection methods. (d) Geo-synthetics: types, functions, manufacturing of geo-textiles, Classification of geo-textiles. Specific Applications: Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and case study.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Analyse the need for ground improvement in weak and soft soils with likely modifications to improve their performance.
2. Decide on suitable dewatering method in soils to improve their performance as highway material.
3. Apply appropriate soil strengthening techniques by stabilisation using either by lime, cement, flyash or bitumen.
4. Evaluate the strengthening techniques by reinforcing bars or anchoring methods depending on the type of soil.
5. Use ground improvement techniques such as geo-synthetics or grouting for cohesive soils.

Graduate Attributes

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Critical thinking*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Manfred R. Hansmann - Engineering principles of ground modification - Me. Graw-Hill pub. Co., NewYork.
2. Robert M. Koerner - Construction and Geotechnical methods in Foundation Engineering - MC.Graw-Hill Pub. Co., New York.

Reference Books:

1. Winterkorn and Fang - Foundation Engineering Hand Book - Van Nostrand Reinhold Co.,New York.
2. Aris C. Stamatopoulos & Panaghiotis C. Kotzios - Soil Improvement by Preloading – John Wiley & Sons Inc. Canada.
3. P. Purushothama Rao - Ground Improvement Techniques - Laxmi Publications

Course Title: SOIL MECHANICS FOR ENGINEERS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – I

Subject Code	18CHT244/18CIM244	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the properties and behavior as a highway material under the application of wheel loads.
2. Understand and compare the shear strength of soil and stability of slopes when used as subgrade soil and embankment fills or cut slopes
3. Understand the permeability characteristics of soils to design proper drainage system and various investigations required to assess the soil properties.
4. Understand the type and soil composition affecting the surface runoff and sub-surface water flow in order to design proper drainage system.
5. Analyse lack of strength or instability problems in soils due to soil formation or any other reasons and propose suitable strengthening methods for the same.

Modules	Teaching Hours
Module -1	
Introduction: Soil Mechanics applications to Highway / Infrastructure Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these. **Soil Compaction:** Introduction, Lab Tests, Factors affecting, Structure & Engg behavior of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipments used for compaction, their choice.	**10 Hours**
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.	**10 Hours**
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.	**10 Hours**
Module -4	
Highway Drainage: Introduction, Importance, Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, Road construction in water logged areas, Landslides – definition, classifies, factors producing.	**10 Hours**
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.	**10 Hours**

Course outcomes:
After studying this course, students will be able to:

1. Analyse the wheel load effects on pavement materials
2. Evaluate and compare the shear strength of soil and stability of slopes when used as pavement component.
3. Design proper drainage system by knowing the permeability characteristics of soils.

4. Design surface runoff and sub-surface drainage system as per field conditions
5. Propose suitable strengthening methods for soil from the knowledge of lack of strength or instability in soils.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "Soil Mechanics & Foundation Engg", Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16th edition.
3. "Highway Engg", S.K. Khanna, C.E.G. Justo, 5th edition.

Reference Books:

1. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors.
2. "Soil Mechanics for road Engineers" – HMSO, London.
3. IRC – Relevant Codes.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

COURSE TITLE: PLANNING AND DESIGN OF RURAL ROADS

[As per Choice Based Credit System (CBCS) scheme]

Semester -II

Subject Code	18CHT251/ 18CIM251	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. To understand the factors affecting pavement design and performance of Rural Roads.
2. To relate the concepts of Highway Geometric design to that of Rural roads
3. To design the Special pavements which form alternatives for Rural Roads.
4. To understand the concepts of design of drainage, CD works and small bridges which form essential structures of Rural roads

Modules	Teaching Hours
Module -1	
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	**10 Hours**
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	**10 Hours**
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 flyash 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	**10 Hours**
Module -4	
Types of road drainage, requirements of surface drain; road side drains, shoulder drains, catch water drains. Requirements subsurface drain Cross drains; types, requirements, choice of different types of cross drains Standard designs of culverts Standard design of small bridges	**10 Hours**
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 subbase, gravel roads	**10 Hours**

Course outcomes:

1. Get the knowledge of factors affecting pavement design and performance of rural roads
2. The student will be able to differentiate the design and construction of Low volume rural roads

with that of the Highways.

3. The students will be able to infer and review the DPRs prepared for construction of Rural Roads such under PMGSY

Graduate Attributes (as per NBA)

- *Critical thinking.*
- *Problem Analysis.*
- *Use of modern tools*
- *Project management and finance*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A.,`Highway Materials and Pavement Testing', Nem Chand and Bros, Roorkee

Reference Books:

1. IRC SP 20 Rural Roads Manual
2. Ministry of Rural Road Development

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: PAVEMENT MANAGEMENT SYSTEM
[As per Choice Based Credit System (CBCS) scheme]
Semester -II

Subject Code	18CHT252/18CIM252	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 03

Course objectives:
To make students learn evaluation and prediction of pavement performance, to learn Ranking and economic optimization of pavement maintenance and rehabilitation and management.

Modules	Teaching Hours
Module -1	
Introduction: Components & principals of pavement management systems, pavement maintenance measures, planning investment, research management. **Pavement Performance Evaluation:** general concepts, serviceability, pavement distress survey systems, performance evaluation	**10 Hours**
Module -2	
Pavement Performance Prediction: Concepts, modeling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. Functional condition deterioration models, unevenness prediction models and other models, comparison. Modeling in rehabilitation budget planning, case studies, Problems.	**10 Hours**
Module -3	
Ranking and Optimization Methodologies: Recent developments, sample size selection, economic optimization of pavement maintenance and rehabilitation	**10 Hours**
Module -4	
Design alternatives and Selection: Design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, reliability concepts in pavement engineering, life cycles costing, analysis of alternate pavement strategies based on distress and performance, case studies and Problems.	**10 Hours**
Module -5	
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.	**10 Hours**

Course outcomes:
On completion of this course, Students would be able to design alternate pavement management systems based on life cycle cost analysis.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem solving.*
- *Usage of modern tools*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ralph Hass, Ronald Hudson and Zanieswki, "Modern Pavement management"- Krieger Publications.
2. W. Ronald Hudson, Ralph Haas and Waheed Uddin, 'Infrastructure Management'- Mc Graw Hill

Reference Books:

1. Proceedings of North American Conference on Managing Pavement.
2. Proceedings of International Conference on Structural Design of Asphalt Pavements.
3. NCHRP, TRR and TRB Special Reports.
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.

Course Title: URBAN PUBLIC TRANSPORT
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – I

Subject Code	18CHT253	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to

1. Understand the various options for urban public transportation and recommend suitable mode for the given situation.
2. Conduct economic analysis between different transport modes and suggest most economical and efficient mode under the given set of conditions.
3. Understand the management of public transport system and developing strategies for efficient functioning of the system.
4. Carry out the evaluation of capacities of the system parameters such as routes, junctions, stations etc, to know the performance of the system.
5. Forecast the future transportation needs and variations in system components so as to plan for the transportation system requirements.

Modules	Teaching Hours
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.	**10 Hours**
Module -2	
Comparing Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit, Problems.	**10 Hours**
Module -3	
Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing.	**10 Hours**
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.	**10 Hours**
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.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the various options for urban public transportation and recommend suitable mode for the given situation.
2. Conduct economic analysis between different transport modes and suggest most economical and efficient mode under the given set of conditions.
3. Understand the management of public transport system and developing strategies for efficient functioning of the system.
4. Carry out the evaluation of capacities of the system parameters such as routes, junctions, stations etc, to know the performance of the system.
5. Forecast the future transportation needs and variations in system components so as to plan for the transportation system requirements.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem solving.*
- *Critical thinking*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. George E. Gray and Lester A. Hoel, 'Public Transportation', Prentice Hall, New Jersey.
2. Vukan R. Vuchic, 'Urban Public Transportation Systems and Technology', Prentice Hall 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
2. John W. Dickey,' Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co.. New Delhi

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: ROAD SAFETY ENGINEERING AND MANAGEMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT 254	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Analyze the effect of driver characteristics, roadway characteristics, climatic factors on highway safety.
2. Plan and design a road safety improvement program..
3. Analyze accident data and suggest safety measures.
4. Conduct road safety audit..
5. Interpret accident data using statistical analysis.

Modules	Teaching Hours
Module -1	
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.	**10 Hours**
Module -2	
Statistical Interpretation and Analysis of Crash Data: Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification & Investigations, Case Studies.	**10 Hours**
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, Case Studies.	**10 Hours**
Module -4	
Crash Reconstruction: Describe the basic information that can be obtained from the roadway surface, Understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies.	**10 Hours**
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 and safety.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Analyze the effect of driver characteristics, roadway characteristics, climatic factors on highway safety..
2. Plan and design a road safety improvement program..
3. Analyze accident data and suggest safety measures.
4. Conduct road safety audit..
5. Interpret accident data using statistical analysis.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Critical thinking.*
- *Ethical practices and social responsibility*
- *Use of modern tools*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. V.F. Babkov "Road Conditions and Traffic Safety", Mir Publishers.
2. Pignataro , " Traffic Engineering", John wiley & sons.
3. Nicholas J Garber, Lester A Hoel, "Traffic & Highway Engineering"- Third edition, Thompson Learning

Reference Books:

1. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997
2. (reprinted 2002)
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. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering. Avebury Technical, 1996.
8. Popkess C.A, Traffic Control and Road Accident Prevention, Chapman and Hall, 1997
9. Rune Elvik and Truls Vaa, The Handbook of Road Safety Measures, Elsevier, 2004.
10. Simon Washington, Matthew Karlaftis, and Fred Mannering, Statistical and Econometric Methods for Transportation Data Analysis, Chapman & Hall/CRC Press, 2003.
11. Towards Safe Roads in Developing country, TRL – ODA, 2004

COURSE TITLE: HIGHWAY MATERIALS LAB - 2

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	18CHT L26	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 02

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 mix design
- Learn field tests on pavement evaluation

Modules

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
3. Calibration of Bump Integrator

Course outcomes:

After the completion of the course students should have

- Acquired the expertise to conduct various tests on binder, modified binders and bituminous mixes.
- Gained knowledge on various field tests for the pavement evaluation

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Critical thinking.*
- *Ethical practices and social responsibility*
- *Use of modern tools*

References:

1. Relevant IS and IRC codes
2. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Materials and Pavement Testing', Nem ChandandBros,Roorkee
3. Gambhir, M. L., 'Concrete Manual', Dhanpat Rai and sons New Delhi

Course Title: SPECIAL PROBLEMS IN ROAD CONSTRUCTION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	18CHT 31	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the difficulties of road construction in weak and marshy soils and necessary precautions to be taken during design and construction.
2. Understand the methods of strengthening soil fills and embankments to improve their performance as pavement component layer.
3. Understand the difficulties associated with construction of high embankments and maintaining stability of hill slopes with precautions to be taken.
4. Understand the use of recycled materials in road construction including milled bituminous waste with necessary design methodology.
5. Understand the design and construction of roads in coastal and desert environments with exclusive exposure conditions.

Modules	Teaching Hours
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.	**10 Hours**
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.	**10 Hours**
Module -3	
Problems in construction of high embankments, stability of foundation and embankment slopes. Stability of hill slopes, control of erosion.	**10 Hours**
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.	**10 Hours**
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.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Get the knowledge about the difficulties of road construction in weak and marshy soils and the precautions to be taken.
2. Suggest improvement methods of strengthening soil fills and embankments to be a pavement layer.
3. Know the difficulties associated with construction of high embankments and maintaining hill slopes stability.
4. Use recycled materials in road construction with appropriate design methods.

5. Provide design and construction methods for roads in coastal and desert environments.

Graduate Attributes (as per NBA)

- *Critical thinking.*
- *Problem solving.*
- *Ethical practices and social responsibility*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. R.M. Koerner "Designing with Geosynthetics"- 4th Edition Prentice Hall, New Jerssey, 1997.
2. DSIR "Soil Mechanics for Road Engineers"– HMSO, London, 1954.

Reference Books:

1. IRC-75 "Guidelines for the design of High embankments"- IRC, 1979.
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.

Course Title: CONSTRUCTION CONTRACT MANAGEMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	18 CHT 321	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

- Course objectives:
- This course will enable students to
  - Understand the various types of contracts
  - Understand the use and effect of contracts in construction industry

Modules	Teaching Hours
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.	10 Hours
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.	10 Hours
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.	10 Hours
Module -4	
Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages.	10 Hours
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.	10 Hours

Course outcomes:
After studying this course, students will be able to:
The Students will be able to understand the need of contract management
Steps involved in preparing contracts and types of contracts
Importance of arbitration

Graduate Attributes (as per NBA)
Scholarship of Knowledge.
Problem Analysis.
Design / development of solutions (partly).
Ethical practices and social responsibility

Question paper pattern:
The question paper will have ten questions.

Each full question consists of 12 marks.
There will be 2 full questions (with a maximum of four sub questions) from each module.
Each full question will have sub questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Albett Robert W., (1961/Latest Edition) "Engineering Contracts and Specifications", John Willey and Sons, New York.
2. Patil B. S. (2009) "Civil Engineering Contracts and Estimates", University Press.

Reference Books:

1. John G. Betty (1993/ Latest Edition) "Engineering Contracts", McGraw Hills.
2. Vasavada B. J., (1997), "Engineering Contracts and Arbitration", (Self Publication by Jyoti B. Vasavada).
3. Vaid K.N., (1998) "Global perspective on International Construction Contracting Technology and Project Management", NICMAR, Mumbai
4. Prakash V. A., (1997) "Contracts Management in Civil Engineering Projects", NICMAR, Mumbai.

Course Title: MAINTENANCE & REHABILITATION OF STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	18CHT322/18CHT322	/CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Learning the structural properties for causing failures
- Identification of failure phenomenon; New approach in the design aspects

Understanding the concept of serviceability and durability

Modules	Teaching Hours
Module -1	
Maintenance, Repair and Rehabilitation: Facets of maintenance - Assessment procedure for evaluating a damaged structure; Inspections, study of soil report, existing as built drawings, variation in design loads etc. Causes of distress - foundation, floor, walls, roof etc. Durability of materials - types of problems in components such as foundations, roofs, floors, walls, etc., Safety evaluation of existing structures - failure patterns and controls. Causes of Deterioration, preventive measurements and maintenance.	**10 Hours**
Module -2	
Investigation and Diagnosis: General Considerations - Observation - Characteristics of materials; Diagnosis of construction failures; Field and Laboratory Testing: Destructive Testing; Non-Destructive Testing – Rebound Hammer, Ultrasonic Pulse Velocity, Pachometer; Semi-Destructive Testing: Probe Test, Pull-Out Test, Pull-Off Test, Break-Off Test, Core Test, Half-Cell Potential Measurements, Resistivity Measurements, Carbonation Depth Testing, Tests for determining cement content, chloride content and sulphate content.	**10 Hours**
Module -3	
Repair Materials: Dealing with cracks; Methods of repair in concrete; Corrosion damage of reinforced concrete, repair and prevention measures. Corrosion of steel reinforcement: Factors influencing corrosion, corrosion protection. Masonry deterioration - Surface deterioration, Efflorescence, causes, prevention and protection.	**10 Hours**
Module -4	
Grouting - Strengthening of existing structures; Special repair methods; Patching Materials - Resurfacing Materials, Sealing Materials, Water Proofing Materials, Substrate Preparation. Refurbishment and Protection Techniques - Routing and Sealing, Stitching, External Stressing, Resin Injection, Overlays, Sprayed Concrete, Pre-packed Concrete, Dry packing, Jacketing, Plate Bonding, Protective Coatings, Vacuum Impregnation; Chloride Extraction; Cathodic Protection.	**10 Hours**
Module -5	
Maintenance: Detection methods and remedial measures; Concrete pavement maintenance measures and preservation techniques. Examples of repair (case studies) - Strengthening of flexural members (slabs & beams), compression members (column), deflection and cracking.	**10 Hours**
Course outcomes:	

After studying this course, students will be able to:

- They can able to understand the mechanisms of degradation of concrete structures and design durable concrete structures.
- They can learn how to conduct field monitoring and non-destructive evaluation of concrete structures.
- They can formulate a strategy for repair and rehabilitation by selecting appropriate repair materials and techniques.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Peter H. Emmons, “Concrete Repair and Maintenance”, Galgotia Publishers.
2. S. Champion, “Failure and Repair of Concrete Structures”, John Wiley &Sons.

References:

1. Ted Kay, “Assessment and Renovation of Concrete Structures”, Longman Scientific & Technical
2. R. T. L. AIlen and S. C. Edwards, “Repair of Concrete Structures”, Blackie & Son,1987
3. Sidney M. Johnson ,” Deterioration, Maintenance and Repair of Concrete Structures”, McGraw-Hill Book
4. P. H. Perkins, “Repair, Protection and Water proofing of Concrete Structures”, E & FN Spon
5. R. N. Raikar, “Diagnosis and Treatment of Structures in Distress” ,Structwel D & C Pvt. Ltd
6. Ransem W. H, “Building Failures”, E & F.N, SPON Ltd, 1981.
7. Ralph Haas, Ronald Hudson and Zaneiswki, “Modern Pavement Management”, Kreiger Publications.

Course Title: CONSTRUCTION & DEMOLITION WASTE MANAGEMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	18CHT323/18CIM323	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Focus on the principles of sustainable construction and demolition waste management and resource efficiency
2. Examining the environmental impact of building materials;
3. Formulating and designing pre−construction and site waste management plans

Modules	Teaching Hours
Module -1	
Environmental Impact of Building Materials Embodied energy of materials; impact on the local environment; toxicity of the material; life cycle assessment. Nature and Source Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potential of building materials.	**10 Hours**
Module -2	
Construction and Demolition Waste Management Plans International good practice; planning requirements; DoEHLG guidance document; company policy; demolition plans; site implementation; supplier agreements; sub−contractor management; role of waste management contractor; training; auditing; skip management; current markets; current disposal options; health and safety; reporting to local authorities. Treatment of Construction and Demolition Waste, waste permits; waste licenses; waste transfer facilities; landfills; treatment technologies; hazardous waste facilities; reporting to EPA	**10 Hours**
Module -3	
Designing for Waste Prevention and Minimization Waste prevention and minimization; client, contractor and designer attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuse and recycling; dimensional co−ordination and standardization; modular design; material selection and control.	**10 Hours**
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	**10 Hours**
Module -5	
Future developments Potential future markets; ‘smart' materials; use of eco−materials.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- They can able to understand the basic concept of embodied energy of construction materials. Understand the application of construction and demolition waste to various concrete structures.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Springer, "Recycling and Resource Recovery Engineering", Springer – Verlag, Berlin Heidelberg (1996)
2. Greg Winkler, "Recycling Construction and Demolition waste: A LEED - Based Toolkit (Green Source) (Google ebook), McGraw Hill Professional

References:

1. V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science Publishers, 2008.
2. Current Literature.

Course Title: ROAD CONSTRUCTION EQUIPMENT
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – II

Subject Code	18CHT324	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand major equipment used for road construction works along with their working principle.
2. Distinguish the advantages and limitations of the equipment used for earth excavation and grading.
3. Evaluate the production capacity of the plants producing aggregates
4. Understand the knowledge of pavers and form works used to lay flexible and rigid pavements.
5. Workout the cost of hiring the equipment and evaluate optimum turnout from the equipment.

Modules	Teaching Hours
Module -1	
Introduction: Working principle, capacity, rate of production, applications, advantages and limitations of various types of construction equipment	**10 Hours**
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	**10 Hours**
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	**10 Hours**
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	**10 Hours**
Module -5	
Equipment Management: Equipment planning, forecasting equipment requirement, maintenance, workshop, work study, Selection of Construction Equipment - task considerations, cost considerations, equipment acquisition options	**10 Hours**

Course outcomes:
After studying this course, students will be able to:

1. Get the knowledge of major equipment used for road construction works along with their working principle.
2. Distinguish the earth excavation and grading equipment based on their advantages and limitations for use in road construction.
3. Work out the production capacity of the mixing plants for flexible and rigid pavements producing different sizes of aggregates.
4. Understand the use of pavers and form works to lay flexible and rigid pavements and the precautions to be taken while using them.
5. Estimate and find the cost of hiring equipment for construction activity.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Usage of modern tools*
- *Project management and finance*

- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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

Reference Books:

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

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: TRANSPORTATION PLANNING
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	18CHT331	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the different modes of transportation and factors affecting planning process for an effective transportation system.
2. Understand the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility.
3. Understand and sources of zonal trip generation or attraction and then inter-zonal trip distribution methods.
4. Analyse the mode of transport and its impact on transport system and also the methods of assigning travel trips to various routes for effective management.
5. Understand the mass transportation options and evaluation of the systems for economic sustainability.

Modules	Teaching Hours
Module -1	
Introduction: Characteristics of different modes of transportation; Principles of co-ordination and operation control, Elements in urban transit system **Transportation Planning Process:** Factors to be considered; land use transportation planning; Systems approach.	**10 Hours**
Module -2	
Transport Surveys: Planning of different types of surveys and interpretation, travel demand; Traffic surveys for mass transit system planning.	**10 Hours**
Module -3	
Trip Generation and Distribution: Factors governing trip generation and attraction; Zonal models; Category analysis; Methods of trip distribution; Application of gravity model.	**10 Hours**
Module -4	
Modal Split and Assignment: Factors affecting modal split; Modal split in transport planning; principles of traffic assignment; Assignment techniques	**10 Hours**
Module -5	
Evaluation: Identification of corridor; Formulation of plans; Economic Evaluation. **Mass Transit Systems:** capacity, Fleet planning and Scheduling.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Get the knowledge of different modes of transportation and factors affecting the planning process for the different modes.
2. Propose effective transport facility for the mass transportation after collecting the data required.
3. Compute the inter-zonal trip generations or attractions and also the trip distributions.
4. Analyse the impact of transport mode on the transport system to understand effective management along the routes.
5. Evaluate the economic sustainability of the mass transportation systems.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem solving.*
- *Usage of modern tools*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Hutchinson, B.G., "Principles of Urban Transport System Planning"– McGraw Hill Book Co.
2. Kadiyali, L.R., "Traffic Engineering and Transportation Planning"– Khanna Publication.

Reference Books:

1. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
2. Institute of Traffic Engineers – "An Introduction to highway Transportation Engineering", ITE, USA

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

COURSE TITLE: GIS AND REMOTE SENSING APPLICATIONS IN TRANSPORTATION ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

Semester -II

Subject Code	18CHT332	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. To learn the basic concepts Geographical Information System (GIS), Remote Sensing (RS),
2. To understand these basic concepts in context of transportation and transportation networks.
3. To learn the data needs and database development for doing transportation analysis in GIS environment.
4. To understand the concepts of transportation networks and algorithms and how they are incorporated into GIS.
5. To understand how GIS processes can be used for efficient transportation modeling and analysis.
6. To understand various applications of GIS in Transportation (GIS-T) including Intelligent Transport Systems (ITS) and learn from some case studies.

Modules	Teaching Hours
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.	**10 Hours**
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.	**10 Hours**
Module -3	
Transportation Network Development and Algorithms: Network development and management. Network properties. Shortest path algorithms. Transit network and paths.	**10 Hours**
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:	**10 Hours**
Module -5	
Transportation, Environment and Hazards: Mapping sensitive Environmental features; GIS and Transportation related Air Quality; Accidents and Safety Analysis; Transportation of hazardous Materials.	**10 Hours**

Course outcomes:

4. Identify the geospatial data and tools required for understanding the transportation systems
5. Use geospatial methods to analyze the transportation network problems

6. Apply the geospatial methods in transportation modelling systems
7. Demonstrate the use of geospatial methods in transportation safety and air quality analysis

Graduate Attributes (as per NBA)

- *Critical thinking.*
- *Problem Analysis.*
- *Use of modern tools*
- *Project management and finance*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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. Hensher D. A., Button K. J., Haynes K. E., and Stopher P. R. (Eds.), Handbook of Transport Geography and Spatial 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 University Press,2001.
6. Implementation of GIS in State DOTs, NCHRP Report No:180.
7. Simlowitz HJ. GIS Support Transportation System Planning. International GIS Sources Book.
8. Hill JC, GIS in Transportation, Transportation Research Part C & 2000.

Course Title: AIRPORT PLANNING AND DESIGN [As per Choice Based Credit System (CBCS) scheme]			
Subject Code	18CHT333/18CIM333	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 03			

Course objectives: This course will enable students to

1. Understand the various components of an airport and aircraft characteristics affecting the design of airports.
2. Design the runway and taxiway geometrics based on the likely aircrafts using the airport.
3. Plan the requirements of terminal area and suggest an optimum layout for the terminal area based on passenger and baggage volume.
4. Provide a suitable method of grading and leveling work involved in the area along with drainage provisions for surface and subsurface water flows.
5. Understand the various air traffic control aids required for safe landing and take-off of aircrafts at the airport.

Modules	**Teaching Hours**
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	**10 Hours**
Module -2	
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.	**10 Hours**
Module -3	
Planning and Design of the Terminal area: Operational concepts, space relationships and area requirements, vehicular traffic and parking at airports. **Capacity and Delay:** Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, taxiway capacity	**10 Hours**
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.	**10 Hours**
Module -5	
Air Traffic Control and Aids: Runways and taxiways markings, day and night landing aids, airport lighting, ILS and other associated aids.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Analyse the various components of an airport and aircraft characteristics affecting the design of airports.
2. Design the runway and taxiway geometrics based on the likely aircrafts using the airport.
3. Plan the requirements of terminal area and suggest an optimum layout for the terminal area based on passenger and baggage volume.
4. Provide a suitable method of grading and leveling work involved in the area along with drainage provisions for surface and subsurface water flows.
5. Understand the various air traffic control aids required for safe landing and take-off of aircrafts at the airport.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*

- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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.
3. "Airport Planning and Design"- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee

Reference Books:

1. Harry.R.Cedergern. "Drainage of Airfield pavements"- John Wiley and Sons.
2. Virender Kumar and Satish Chandra, "Airport Planning and Design"- Galotia Publication press.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2018-2019

Course Title: INTELLIGENT TRANSPORTATION SYSTEMS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – II

Subject Code	18CHT334	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control.
2. Learn how Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic, inform travelers and drivers, operate public transport, automating payments, handle emergencies and incidents, operate commercial fleets and freight exchange, and automate driving and safety.

Modules	Teaching Hours
Module -1	
Basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.	**10 Hours**
Module -2	
Advanced traveler information systems; transportation network operations; commercial vehicle operations and intermodal freight;	**10 Hours**
Module -3	
Public transportation applications, ITS and regional strategic transportation planning, including regional architectures	**10 Hours**
Module -4	
ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility,	**10 Hours**
Module -5	
Travel demand management, electronic toll collection, and ITS and road-pricing. Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries.	**10 Hours**

Course outcomes:

After studying this course, students would be able to suggest the appropriate system/s in various functional areas of transportation.

Would be able to amalgamate the various systems, plan and implement the applications of ITS. Would have learnt the application of information technology and telecommunication to control traffic and also provide advance information to the travelers, automatic handling of emergencies and to improve safety.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Critical thinking.*
- *Ethical practices and social responsibility*
- *Use of modern tools*

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 12 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House.

Reference Books:

1. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2000.
2. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
3. US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CDROM).
4. Turban. E and Aronson. J. E, “Decision Support Sys tems and Intelligent Systems”, Prentice Hall