

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

Group-1		
Sl. No.	CODE	NAME OF THE SUBJECT
1	16CSE11/ 16CCS12	Computational Structural Mechanics
2	16CCS152/ 16CEM154	Composite and Smart Materials
3	16CCS153	Action and Response of Structural Systems
4	16CEE11/16CWM11	Advanced Computational Methods and Optimization
5	16CEE12/16CWM12	Applied Environmental Chemistry and Microbiology
6	16CEE151	Water Resources Engineering and Applied Hydraulics
7	16CGI151	Geospatial Database Management Systems
8	16CCT11	Mechanization In Construction
9	16CCT12/ 16CEM22/ 16CTM23/ 16CIM23	Construction Project Management
10	16CGT12/ 16CCT152/ 16CGT154/ 16CTM153	Theoretical Soil Mechanics
11	16CHT11/ 16CTM11/ 16CTE 252	Applied Statistics In Transportation Engineering
12	16CHT12/ 16CTE12	Highway and Pavement Materials
13	16CSE12/ 16CCT151/ 16CIM152/ 16CSE151/16CCS24	Advanced Design of R C Structures
14	16CSE153/16CCS421	Design of Precast and Composite Structures
15	16WLM11	Optimization Techniques
16	16WLM12	Surface Water Hydrology
17	16CEM11/ 16WLM152	Spatial Planning and Regional Analysis

Group-2		
Sl. No.	CODE	NAME OF THE SUBJECT
1	16CSE14/16CCS13	Structural Dynamics
2	16CEE13/ 16WLM252	Advanced Water Treatment Technology
3	16CEE14/ 16WLM21/ WLM22	Solid and Hazardous Waste Management
4	16CEE153/ 16CWM21/ 16CHT423/ 16CEM41	Occupational Safety and Health
5	16CGI153	Advanced Geographic Information Systems
6	16CCT13	Advanced Techniques In Concrete Construction
7	16CCT154/ 16CWM422/ 16CCT424	Sustainable Materials and Green Buildings
8	16CGT13/ 16CTE131/16CIM253/16WLM253/16CHT253	Subsurface Investigation and Ground Improvement Techniques
9	16CHT153/16CTM421	Planning And Design of Low Volume Roads
10	16CHT154/ 16CTM151	Urban Public Transport
11	16CSE13/16CCS14/ 16CGT153	Mechanics of Deformable Bodies
12	16CSE154/16CCS251	Reliability Analysis of Structures
13	16CSE151/ 16CIM11/ 16CCT423/ 16CCS423	Advanced Design of Pre-Stressed Concrete Structures
14	16CTE14/16CTM13	Urban Transport Planning
15	16CEM13/ 16CIM12	Construction Equipments and Management
16	16CEM14 /16CIM422/ /16CCT41/16CSE252	Repair and Rehabilitation of Structures

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

Group- 3		
Sl. No.	CODE	NAME OF THE SUBJECT
1	16CCS252	AI And Expert Systems In Structural Engineering
2	16CEE21/16CWM41	Atmospheric Environmental Pollution and Control
3	16CGI21	Satellite Data Image Processing
4	16CGI22/16CGI253	Applications of Geoinformatics In natural Resources and Environmental Management
5	16CCT22	Construction Economics and Finance
6	16CGT21/ 16CCS424	Soil Dynamics
7	16CGT252	Soil Structure Interaction
8	16CHT21/ 16CTE422	Pavement Evaluation and Management
9	16CHT22	Traffic Engineering
10	16CIM21/16CSE152/ 16CEM21/ 16CTE 153	Advanced Concrete Technology
11	16CIM22/ 16CCT254	Construction Costing and Material Management
12	16CSE21/16CCT251	Advanced Design of Steel Structures
13	16CSE22/ 16CCS22/ 16CCT253	Earthquake Resistant Design of Structures
14	16CSE251	Design of Tall Structures
15	16CTE22/16CTM21/ 16CCT252	Pavement Design And Analysis
16	16CTE251/16CTM251	Road Safety Management
17	16CEM151	Advance Foundation Engineering

Group-4		
Sl. No.	CODE	NAME OF THE SUBJECT
1	16 CCS254/ 16CHT252/ 16CEM423	Design Of Structural Systems for Bridges
2	16 CEE23/16CWM13	Advanced Waste Water Treatment Engineering
3	16CGI252	Applications of Geoinformatics In Urban Planning And Management
4	16CGT23	Design of Deep Foundations
5	16CGT253	Offshore Geotechnical Engineering
6	16CHT23/ 16CTE24/ 16CTM24	Highway Planning and Economic Analysis
7	16CIM254	Building Services & Maintenance
8	16CSE23/16CGT11	Finite Element Method of Analysis
9	16CSE253/ 16CCS23	Stability Analysis of Structures
10	16CSE254/ 16CCS21	Theory of Plates And Shells
11	16WLM23	Advanced Irrigation Engineering
12	16CTE154	Intelligent Transportation Systems
13	16CEM23/ 16CCT421	Disaster Mitigation and Management
14	16CEM253	Reuse & Recycle Technology
15	16CEM254/ 16WLM251	Urban Hydrology, Storm Drainage And Management

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

Group-5		
Sl. N.	CODE	NAME OF THE SUBJECT
1	16 CEE24	Environmental Geo-Technology
2	16 CEE422	Toxicology & Environmental Risk Assessment
3	16CGI24	Web Applications In Geoinformatics
4	16CGI421	Applications of Geoinformatics In Disaster Management
5	16CGI422	Emerging Trends In Geoinformatics
6	16CCT24	Construction Contracts and Specifications
7	16CGT24/16CCS154	Earth and Earth Retaining Structures
8	16CGT422	Reinforced Soil Structures
9	16CHT24	Road Construction Planning and Management
10	16CIM24/ 16CCT23	Pre-Engineered Structures
11	16CSE24/ 16CCT21	Design Concepts of Substructures
12	16CSE421/16CGT421/ 16CTE254/16CCS11	Optimization Techniques
13	16CSE422	Design of Industrial Structures
14	16CEM421/ 16CWM253/ 16CEE22/16WLM41/ 16CWM151	Environmental Impact Assessment and Management
15	16CEM422	Steel and Composite Construction Technology
16	16WLM24/16WLM422	Ground Water Hydrology

Group-6		
Sl. No.	Course code	Course Name
1	16CEE41/ 16CWM24/ 16WLM423/16CWM252	Industrial Wastewater Treatment
2	16CEE424	Environmental Legal Aspects and Policy Guidelines
3	16CCT422/ 16CIM423	Construction Demolition and Waste Management
4	16CGT41	Forensic Geotechnical Engineering
5	16CGT423	Rock Mechanics
6	16CHT41	Special Problems In Road Construction
7	16CHT424	Airport Planning and Design
8	16CSE41	Design of Concrete Bridges
9	16CSE423	Theory of Plasticity And Fracture Mechanics
10	16CSE424	Design of Masonry Structures
11	16CTM41	Transportation Infrastructure Design
12	16CTM424	Intelligent Transportation Systems
13	16WLM424	Global Warming and Climate Change
14	16CTE423	Applications of Soft Computing Techniques

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16CSE11/ 16CCS12	GROUP-1	COMPUTATIONAL STRUCTURAL MECHANICS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Direct Stiffness Method – Trusses Degrees of Static and Kinematic indeterminacies, Concepts of Stiffness and Flexibility, Local and Global Coordinate System, Analysis of indeterminate Trusses, with and without initial strains for different types of boundary conditions such as Fixed, Hinged, Roller, Slider, Elastic (Spring) supports, support settlement.</p>			
<p>Module -2 Direct Stiffness Method - Continuous Beam, 2D Frames Analysis of Continuous beams, for different types of boundary conditions such as Fixed, Hinged, Roller, Slider, Elastic (Spring) supports, support settlement. Analysis of Simple 2D Frames with and without sway, Element stiffness matrix for 3D frames and Grids</p>			
<p>Module -3 Basic Concept of Finite Element Method Concept of FEM, Formulation using principle of virtual work, Principles minimum potential energy, Method of Weighted Residuals (Galerkin's), Choice of displacement function, Degree of continuity. Generalized and Natural coordinates.</p>			
<p>Module -4 FE Analysis using Bar Elements Derivation of Shape Function for Linear and Higher order elements using Inverse and Lagrange Interpolation formula, Element Stiffness matrix Two and Three noded elements. Examples with constant and varying cross sectional area subjected to concentrated loads, distributed body force and surface traction and Initial strains due to temperature. Isoparametric formulation</p>			
<p>Module -5 FE Analysis using Beam Element Derivation of Shape Function for two noded beam element, Hermitian Interpolation, Element Stiffness matrix, Consistent Nodal loads,, Concept of Reduced or Lumped Loads, Examples : Cantilever and Simply Supported beams.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Rajasekaran.S, "Computational Structural Mechanics" , PHI, New Delhi 2001. 2. Reddy.C.S, "Basic Structural Analysis," TMH, New De lhi 2001 3. Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3 rd Edition, John Wiley and Sons, New York 4. Beaufait.F.W. et al., Computer Methods of Structural Analysis, Prentice Hall, 1970. 5. Weaver.W and Gere.J.H., Matrix Analysis of Framed Structures, Van Nastran, 1980. 6. Rubinstein M.F, Matrix Computer Methods of Structural Analysis Prentice-Hall. 7. Bathe.K.J, Finite element procedures in Engineering Analysis. PHI. New Delhi. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

2	16CCS152/ 16CEM154	GROUP-1	COMPOSITE AND SMART MATERIALS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Composite materials Classifications and applications. of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices, coupling			
Module -2 Anisotropic elasticity Unidirectional and anisotropic lamina, thermo-mechanical properties, micro-mechanical analysis, classical composite lamination theory, Cross and angle-ply laminates, symmetric, antisymmetric and general asymmetric laminates, mechanical coupling, laminate stacking,			
Module -3 Analysis of simple laminated structural elements Ply-stress and strain, lamina failure theories - first ply failure, environmental effects, manufacturing of composites.			
Module -4 Smart materials, Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation.			
Module -5 Beam modeling with strain actuator, bending extension relation			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Robert M Jones, "Mechanics of Composite Materials", McGraw Hill Publishing Co. 2. Bhagwan D Agarwal, and Lawrence J Brutman, "Analysis and Performance of Fiber Composites", John Wiley and Sons. 3. 3.Lecture notes on "Smart Structures", by Inderjit Chopra, 5. Crawley, E and de Luis, J., "Use of piezoelectric actuators as elements of intelligent structures", AIAA Journal, Vol. 25 No 10, Oct 1987, PP 1373-1385. 6. Crawley, E and Anderson, E., "Detailed models of Piezoceramic actuation of beams", Proc. of the 30th AIAA /ASME/ASCE/AHS/ASC Structural dynamics and material conference, AIAA Washington DC, April 1989. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

3	16CCS153	GROUP-1	ACTION AND RESPONSE OF STRUCTURAL SYSTEMS
Exam Hours:03		Exam Marks:100	
<p>Module -1 IS 875 PART 1, 2, 4, 5 Sources, Nature and Magnitude, Probabilistic assessment, Characteristic and Design values. IS 875 PART 1 and 2 code provisions. Load combination rules for design. Load path for gravity loads- Tributary Area and Stiffness based approaches. Estimation of DL and LL on structural elements such as Slab, Beams, Columns, in different types of structural systems, Joint Loads on Trusses, Distributed load on Purlins- Numerical examples. Accidental loads – Impact and collisions, Numerical examples</p>			
<p>Module -2 Wind Load - IS 875 PART 3: Buildings Nature and Magnitude, Factors influencing wind loads, Internal and External pressure distribution, Design Wind Speeds and Pressure, Numerical Examples to calculate external and internal pressure for different types of buildings and regions – Pitched Roof, Sign board, Structural glazing, Multistory Frames - Load path for Lateral loads</p>			
<p>Module -3 Seismic Loads: IS 1893: Buildings Nature and Magnitude, Centre of mass and rigidity, Calculation of Design Seismic Force by Static Analysis Method, Dynamic Analysis Method, Location of Centre of Mass, Location of Centre of Stiffness, and Lateral Force Distribution as per code provisions. - Load path for Lateral loads – Floor diaphragm action</p>			
<p>Module -4 Vehicles Loads as per IRC 6 - 2010 on Road Bridges – Class 70 R, Class AA, Class A, Class B, Tracked Vehicle, Wheeled Vehicle, Load Combinations, Impact, Wind, Water Currents, Longitudinal Forces: acceleration, braking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads. Load Combinations – Simple Numerical examples</p>			
<p>Module -5 Types of Analysis and Structural forms of Tall Buildings: Linear, Nonlinear behavior, Material nonlinearity, Geometric nonlinearity, Rigid and Elastic Supports, First Order Elastic Analysis, Second Order Elastic Analysis, First order Inelastic Analysis, Second order Inelastic Analysis – Concepts and Brief descriptions. Structural forms in Tall buildings – Rigid frame, Braced Frames, Shear Walls, Core walls, Tubular, Belt truss, Outrigger</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. • <p>The students will have to answer 5 full questions, selecting one full question from each module.</p>			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Action and Response of Structural systems, Classical Work, Dr. H. Ananthan 2. An explanatory Handbook on IS 875 (PART 3); Wind Load on Building and Structures, Document No: IITK-GSDMA Wind 07 V1.0- IITK-GSDMA Project on Building Codes 3. Explanatory Examples on Indian Seismic Code IS 1893 (Part I): Document No. : IITK-GSDMA-EQ21-V2.0 - IITK-GSDMA Project on Building Codes 4. Matrix Analysis of Structures, Aslam Kassimali, Cengage Learning, 2012 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

4	16CEE11/ 16CWM11	Group-1	ADVANCED COMPUTATIONAL METHODS AND OPTIMIZATION
Exam Hours:03		Exam Marks:100	
Module -1 Numerical Methods - Partial differential equations, Newton-Raphson method, Finite difference, finite element, method of characteristics, different methods, Successive over relaxation methods.			
Module -2 Optimization – classification and importance in Environmental Studies. Single and multivariable optimization without and with constraints			
Module -3 Linear Programming – different methods, linear approximation of non-linear optimization.			
Module -4 Statistics - Significance Tests , Frequency Distribution, Characteristics of Distributions, Method of Least Squares and Regression, Multiple Regression			
Module -5 Probability – Concepts, Methods, Binomial, Poisson and Normal distribution, Risk and uncertainty analysis			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Rao. S.S.” Optimization: Theory & Applications Techniques, Wiley Eastern Ltd New Delhi. 2. Taha H.A., “Optimization Research”:An introduction, Pearson Prentice Hall, 8th Edition 3. Shanthakumar M.S., Numerical Methods and Analysis, Tata McGrawhill Pubs. 4. Ross S.M., “Introduction to Probability and Statistics for Engineers and Scientists”, John Wiley publications. 3rd Edition, Academic press 5. Stanton R.G –“ Numerical methods for science and engineers”. Prentice Hall, Trade Edition 6. Kreyszig Erwin ” Advanced Engineering Mathematics”, Wiley Eastern Publications. 7. Berthouex P M., and Brown L. C., “Statistics for Environmental Engineers”, Lishers publication, 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

5	16CEE12/ 16CWM12	Group-1	APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Importance of Environmental Chemistry, types of reactions, redox reactions, reaction kinetics. Electrochemistry and its applications. Physical and equilibrium chemistry – fundamentals and applications. Trace Contaminants and their analyses. pH – Principle, Measurement, Numerical Examples, Buffers and Buffer index.			
Module -2 Colloidal Chemistry: Properties of colloids, colloidal dispersions, stability of colloids and applications. Applications of Organic Chemistry in Environmental Engineering.			
Module -3 Colourimetry: Principles and applications. Applications of Analytical Chemistry – emission and absorption techniques.			
Module -4 Water & wastewater analysis: Fluoridation, defluoridation, chlorination, BOD, DO, types and measurement of BOD, rate of BOD & theoretical oxygen removal, COD- determination & its application in wastewater treatment			
Module -5 Microbiology - Microorganisms of importance in air, water and soil environment Principles and applications of microscopy, microscopic flora and fauna of importance. Metabolism and metabolic pathways, Bioconcentration, Biomagnification and Bioaccumulation. Bacteria – Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probability and Thomas methods), MFT. Monod's equation and its applications. Algae - morphology, classification and their importance. Fungi - Protozoa - morphology, classification and their importance. Enzymes - classification, kinetics – Michaelis - Menten equation, factors influencing enzyme reaction. Virology - Types, characteristics and enumeration methodology.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Pelczar M.J, Chan ECS, Krieg, NR “Textbook of Microbiology” 5th edition Tata McGrawHill Publishing Co. Ltd., New Delhi			
2. McKinney R.E. “Microbiology for Sanitary Engineers”, New York McGraw Hill.			
3. Sawyer C.N. and McCarty, P.L. , , “Chemistry for Environmental Engineering and Science”, 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.			
4. Gaudy and Gaudy, “Microbiology for Environmental Scientists and Engineers”, McGrawHill.			
5. APHA, “Standard Methods for Examination of Water and Wastewater”; 21st Edition.			
6. Stumm and Morgan, “Aquatic Chemistry”, John Wiley & Sons New York. Relevant Journals			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

6	16CEE151	Group-1	WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS
Exam Hours:03		Exam Marks:100	
Module -1 Hydrology: Water resources of the world, India and Karnataka,National Water Policy, Hydrologic cycle, estimation of missingprecipitation and rain gauge density.			
Module -2 Hydrograph theory: Unit hydrograph-derivation, flow routing,low flow analysis.Urban Hydrology - Run-off estimation – Design of Storm waterDrains.			
Module -3 Unsteady Flow through Conduits: Water hammer analysis,Water hammer protection methods - surge tanks, FlowMeasurements – Area –Velocity method, Weir method, flumes,end-depth method & chemical and radioactive tracers method			
Module -4 Groundwater:Basic equations of flow, confined and unconfinedaquifers, sea water intrusion, artificial recharge, groundwater pollution, borewells - types & design principles, open wells –types, yield tests			
Module -5 Basics and applications of Remote Sensing: in water resourcesmanagement, Hydraulic transients- flow through bends &constriction			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Raghunath H.M. “Advanced Hydrology”, Wiley Eastern Ltd New Delhi 2. Subramanya K.S, “Advanced Hydrology”.Tata Mc Graw Hill, New Delhi 3. David Keith Todd, “Ground Water Hydrology”.2nd Edition John Wiley & Sons NewDelhi 4. Sabins F.F., “Remote Sensing – Principles and Interpretations”, W.H. Freeman & Co. 5. Anji Reddy, “Remote Sensing and GIS”, B.S. Publications, Hyderabad. 6. Ven T. Chow, “Hand Book of Applied Hydrology”, 1st Edition Mc Graw HillPublications 7. Hammer M.J, and Mackichan K.A. “Hydrology and Quality of Water Resources”,Newyork:Wiley. 8. John Permankian, “Water Hammer Analysis”. 9. Linsley, Franzini, Freyberg, Tchobanoglous G. “Water Resources Engineering”, TATAMcGraw Hill Series. 10. Linsley, Kohler and Paulhes, “Hydrology for Engineers”, McGraw Hill. 11. Mays L.W. , “Water Resources Engineering”, John Wiley and Sons Publications 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

7	16CGI151	Group-1	GEOSPATIAL DATABASE MANAGEMENT SYSTEMS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Databases and Users: Introduction, characteristics of database approach, intended uses of a DBMS, implications of database approach. Database System Concepts and Architecture: Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems.</p>			
<p>Module -2 Data Modeling: High level conceptual data models for database design, ER model concepts, schema constructs and simple applications. Record Storage and Primary File Organizations: Secondary storage devices, buffering of blocks, placing file records on disk, operations on files – heap files and sorted files – hashing techniques. Index Structure of Files: Single-level and multilevel ordered indexes, dynamic multilevel indexes using B-trees and B+ trees. Relational Data Model: Concepts and constraints, update operations on relations, relational algebra, simple examples</p>			
<p>Module -3 Structured Query Language: Data definition in SQL, queries, update statements, views in SQL, simple examples. Introduction and basics of Relation Database Management System. Database design: Functional dependencies and normalization for relational databases, Normal forms based on primary keys, general definition of second and third normal forms, Boyce-Codd normal form. Query Processing: Basic algorithms for executing query operations. Transaction Processing Concepts: Introduction, transaction and system concepts, properties, schedules and recoverability</p>			
<p>Module -4 Concurrency and Recovery: Locking techniques for concurrency control, recovery concepts and techniques. Design and implementation of Geospatial database: Spatial database system, Spatial Indexing, SDBMS or RDBMS models</p>			
<p>Module -5: Advanced database concepts: Object-relational database management system (ORDBMS), Distributed databases, web services and XML, OLAP (Online Analytical Processing), OLTP (Online transaction processing). New Applications: Discussion on new applications like Decision Support System, Data Mining, Data Warehousing and Spatial Databases, Recent Developments.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> 1. Elmasri R. and Navathe S.B., “Fundamentals of Database Systems”, Benjamin/Cummings Publishing Co. Inc. (Addison- Wesley world student series), 2002 2. Trembley J.P. and Sirenson P.G., “An Introduction to Data Structures with Applications”, Tata McGraw-Hill. 3. Date C.J., “An Introduction to Database Systems”, Vol-I, Addison-Wesley. 4. A.Silberschatz, H.F.Korth and S.Sudarshan, “Database System Concepts”, McGraw-Hill International Editions, Computer Science Series. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

8	16CCT11	Group-1	MECHANIZATION IN CONSTRUCTION
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to mechanization: Definition, advantages and limitations of mechanization, Indian scenario and Global scenario. Mechanization through construction equipment: Equipment cost, Machine Power, Production cycle - Dozers, scrapers, Excavators, Finishing equipment, Trucks and Hauling equipment, Hoisting equipment, Draglines and Clamshells			
Module -2 Mechanization in aggregate manufacturing: Natural aggregates and recycled aggregates			
Module -3 Mechanization in rebar fabrication Mechanization in concrete production and placement Mechanization through construction: formwork and scaffolding types, materials and design principles.			
Module -4 Mechanization through construction methods/technologies: segmental construction of bridges/flyovers, box pushing technology for tunneling, trench-less technology. Pile Driving Equipment : Pile hammers, selecting a pile hammer, loss of energy due to impact, Energy losses due to causes other than impact.			
Module -5: Mechanization through construction methods of Drilling, Blasting and Tunneling Equipment : Definition of terms, bits, Jackhammers, Drifters, wagon drills, chisel drills, piston drills, blast hole drills, shot drills, diamond drills, tunneling equipment, selecting the drilling method/equipment; selecting drilling pattern. Safety and Environmental issues in mechanization			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES: <ol style="list-style-type: none"> 1. "Construction Equipment and its Planning and Applications", Mahesh Varma, Metropolitan Book Co.(P) Ltd., New Delhi. India. 2. "Construction Machinery and Equipment in India". (A compilation of articles Published in Civil Engineering and 3. "Construction Review" Published by Civil Engineering and Construction Review, New Delhi, 1991. 4. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, Delhi, 1988 5. Peurifoy R L, "Construction Planning, Equipment and Methods", Mc Graw Hill 6. James F Russell, "Construction Equipment", Prentice Hall 7. "Current Literature 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

9	16CCT12/ 16CEM22/ 16CTM23/16CIM23	Group-1	CONSTRUCTION PROJECT AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Construction Projects- Concept, Project Categories, Characteristic of projects, project life cycle phase. Project Management- Project Management Function, Role of Project Manager. Organizing For Construction - Principles of organization, type of organization structure			
Module -2 Project Feasibility Reports: Introduction, Significance infeasibility report- Technical analysis, Financial analysis, Economic analysis, Ecological analysis, Flow diagram for feasibility study of a project. Project planning Scope: Planning Process, Objectives, Types of Project plans, Resource Planning Process.			
Module -3 Bar Charts, Work Breakdown Structure, Time estimates, Applications of CPM and PERT-A-O-N Network- Logic and Precedence diagrams, advantages, Drawing A-O-N network from A-O-A network and related problems			
Module -4 Time Cost relationship: Direct and indirect cost, step in optimization of cost, related problem. Allocation of resources: Histogram, Resource smoothening, Resource leveling and related problem. Project updating using CPM network and related numerical problems.			
Module -5: Scheduling, Monitoring and Updating. Line of Balance Scheduling. Resource Planning-Leveling and Allocation. Introduction to Building Information Model (BIM).			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES:			
<ol style="list-style-type: none"> 1. Chitkara, K.K. “Construction Project Management: Planning, Scheduling and Control”, Tata McGraw-Hill Publishing Company, New Delhi, 1998. 2. Choudhury S , “Project Management”, McGraw-Hill Publishing Company, New Delhi, 1988. 3. Chris Hendrickson and Tung Au, “Project Management for Construction –Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000. 4. Srinath L.S, “PERT and CPM”, East West Press Pvt Ltd New Delhi. 5. Frank Harris and Roland McCaffer, “Modern Construction Management”- 4th Ed Blackwell Science Ltd. 6. Current Literature 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CGT12/ 16CCT152/ 16CGT154/16CTM153	GROUP-1	THEORETICAL SOIL MECHANICS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction – Elasticity and stability problems, concept of stress and strain – plane stress, plane strain and axisymmetric problems– equation of equilibrium and compatibility – stress functions.			
Module -2. Stresses in elastic half-space medium by external loads –fundamental solutions –Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – elastic displacement-layered soil-Burmister method			
Module -3 Limit equilibrium analysis – perfectly plastic material – stress –strain relationship –stress and displacement field calculations – slip line solutions for undrained and drained loading, arching of soils and theories of arching			
Module -4 . Limit analysis – principles of virtual work – theorems of plastic collapse – Mechanism for plane plastic collapse – Simple solutions for drained and undrained loading –stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations			
Module -5: Flow through porous media – Darcy’s law – General equation of flow– steady state condition – solution by flow net – fully saturated conditions; Yielding, Bounding Surfaces			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. Foundations of Theoretical Soil Mechanics, Harr, M.E (1966) McGraw Hill,			
2. Foundation Engineering Handbook, Winterkorn, H.F., and Fang, H.Y(2000)Galgotia, Booksource, 2000			
3. Theoretical Soil Mechanics- Karl Terzaghi (1943), John Wiley & Sons.			
4. Soil Mechanics and Foundations, MuniramBudhu(2007), John Wiley & Sons,Inc.			
Reference Books:			
1. Soil Mechanics, T.W. Lambe and R.V. Whitman (1969). John Wiley & Sons,.			
2. Foundations and slopes- Attikinson (1981), McGraw Hill, New Delhi			
3. Seepage, Drainage and Flownets – Cedergren H R(1997).-, John Wiely& Sons			
4. The Mechanics Basic concepts and Engineering Applications- Aysen A (2002),AA Balkema Publishers, 2002			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16CHT11/ 16CTM11/ 16CTE 252	Group-1	APPLIED STATISTICS IN TRANSPORTATION ENGINEERING
Exam Hours:03		Exam Marks:100	
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>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</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Martin Wohl, Brian V Martin, “Traffic System Analysis”- Mc Graw Hill Series 2. Johnson R and G Bhattacharya, “Statistics – Principles and methods”- John Wiley & sons, Newyork, 1985 3. Medhi, “Introduction to statistics”- New Age Pub, New Delhi 4. Benjamin Jack R and Cornell C Allin, “Probability Statistics & Decisions for Civil Engineers”-McGraw Hill Co. 5. Agarwal, B.L, “Basic Statistics”- 3rd edition, New Age Pub. New Delhi. 6. L.R Kadiyali, “Traffic Engineering”- Khanna Publishers New Delhi 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	16CHT12/ 16CTE 12	Group-1	HIGHWAY AND PAVEMENT MATERIALS
Exam Hours:03		Exam Marks:100	
<p>Module -1. Characterization: Properties of sub grade layers; different types of soils, Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in - situ procedures for evaluating the mechanical properties of soils viz. SPT, CPT, CBR, Plate Load test, Field compaction and control.</p>			
<p>Module -2..Origin, classification, requirements, properties and tests on road aggregates, mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; concepts of size and gradation – design gradation, maximum aggregate size, aggregate blending to meet specification, Fuller and Thompson’s Equation, 0.45 power maximum density graph, Sampling of aggregates.</p>			
<p>Module -3 Bitumen and Tar: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Bituminous Emulsions and Cutbacks, Preparation, characteristics, uses and tests, Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion.</p>			
<p>Module -4 Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties. Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV. Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall’s specifications, Hubbard Field method of mix design, Hveem’s method of mix design; Introduction to super pave mix design procedure, Modified binders, HMA, WMA, CMA</p>			
<p>Module -5:.. Types of cements and basic cement properties, Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties; Introduction to advanced concretes like self compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; Joint fillers and sealers for Jointed Plain Cement Concrete Pavements and their characterization.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>TEXT BOOKS</p> <ol style="list-style-type: none"> 1. RRL, D S I R , ` Bituminous Materials in Road Construction`, HMSO Publication 2. RRL, D S I R , ` Soil Mechanics for Road Engineers`, H M S O Publication <p>REFERENCES</p> <ol style="list-style-type: none"> 1. Khanna, S.K., Justo, C.E.G., and Veeraragavan,A., `Highway Engineering`, Nem Chand and Bros, Roorkee, 2014. 2. ParthaChakroborty and Animesh Das, `Principles of Transportation Engineering`, Prentice Hall (India), New Delhi, 2011. 3. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice – Hall 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. 4. Relevant IRC and MoRTH Publications. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16CSE12/ 16CCT151/ 16CIM152/ 16CSE151/ 16CCS24	Group-1	ADVANCED DESIGN OF REINFORCED CONCRETE STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Yield line method of design of slabs:Assumptions, Derivation and Examples for differentshapes of Slab.			
Module -2. Design of grid floors:Concept, Importance and Design Examples.			
Module -3 Design of continuous beamsConcept of Moment Redistribution, Design Examples.			
Module -4 Design of flat slabs, Importance of flat slabs, Flat slab withand without Column Head, Drops, Design Examples..			
Module -5: Art of detailing earthquake resistant construction –expansion and construction joints.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES:			
<ol style="list-style-type: none"> 1. P.C.Varghese, "Advanced Reinforced Concrete Design"- Prentice-Hall of India, NewDelhi, 2005. 2. 2.Dr.B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, " Comprehensive RCCDesign" 3. Advanced Reinforced Concrete Design - N. Krishnaraju, CBS Publishers 4. A Park and Paulay, "Reinforced and Prestressed Concrete"-John Wiley & Sons 5. Lin TY and Burns N H, "Reinforced Concrete Design". John Wiley & Sons 6. Kong KF and Evans T H "Design of Prestressed Concrete Structures" 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CSE153/ 16CCS421	Group-1	DESIGN OF PRECAST AND COMPOSITE STRUCTURES
Exam Hours:03		Exam Marks:100	
<p>Module -1 Concepts , components, Structural Systems and Design of precast concrete floors Need and types of precast construction, Modular coordination, Precast elements- Floor, Beams, Columns and walls. Structural Systems and connections.</p> <p>Design of precast Concrete Floors: Theoretical and Design Examples of Hollow core slabs,. Precast Concrete Planks, floor with composite toppings with and without props.</p>			
<p>Module -2..Design of precast reinforced and prestressed Concrete beams Theoretical and Design Examples of ITB – Full section precast,Semi Precast, propped and un propped conditions. Design of RC Nibs</p>			
<p>Module -3 Design of precast concrete columns and walls Design of braced and un braced columns with corbels subjected to pattern and full loading. Design of Corbels Design of RC walls subjected to Vertical, Horizontal loads and moments, Design of vertical ties and horizontal joints.</p>			
<p>Module -4 ..Design of Precast Connections and Structural Integrity Beam bearing, Beam half Joint, Steel Inserts, Socket Connection, Structural integrity, Avoidance of progressive collapse, Design of Structural Ties.</p>			
<p>Module -5:.Design of Steel Concrete Composite Floors and Beams Composite Floors: Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Design Example</p> <p>Composite Beams: Elastic Behaviour, Ultimate Load behavior of Composite beams, Stresses and deflection in service and vibration, Design Example of Simply Supported beams.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Hass A.M. – Precast Concrete – Design and applications AppliedScience, 1983. 2. David Sheppard – “Plant cast, Precast and Prestressed concrete –McGraw Hill; 1989 3. NBC – 2005 (Part I to Part VII) BIS Publications, New Delhi, IS 15916-2011,IS 11447,IS6061 – I and III 4. R.P.Johnson: Composite Structure of Steel and Concrete (Volume 1),Blackwell Scientific Publication (Second Edition), U.K., 1994. 5. IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel and Concrete. 6. INSDAG Teaching Resource Chapter 21 to 27: www.steel-insdag.org 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

15	16WLM11	Group-1	OPTIMIZATION TECHNIQUES
Exam Hours:03		Exam Marks:100	
<p>Module -1 INTRODUCTION Development of optimization techniques, nature and characteristics of operation research, methodology of optimization, applications of optimization techniques, classification of operation research model, uses and limitation of optimization techniques.</p>			
<p>Module -2.. LINEAR AND DYNAMIC PROGRAMMING Introduction to operations research - Linear programming, problem formulation, graphical solution, solution by simplex method - Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans – Case studies. Dynamic programming-Stage coach problem to resource allocation, distribution of efforts problem. Optimization by simulation, mathematical models for large scale Multipurpose projects, different case studies.</p>			
<p>Module -3 TRANSPORTATION PROBLEM Transportation problem, mathematical formulation of problem, steps in transportation method, methods for finding initial basic feasible solution, degeneracy in transportation problem. ASSIGNMENT PROBLEMS Mathematical formulation, assignment algorithm methods for solving assignment problems. Network problems.</p>			
<p>Module -4 . SIMULATION Basic principles and concepts - Random variant and random process - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models - Case studies.</p>			
<p>Module -5: ADVANCED OPTIMIZATION TECHNIQUES Integer and parametric linear programming - Goal programming models with applications. Discrete differential dynamic programming and incremental dynamic programming - Linear decision rule models with application - Stochastic dynamic programming models</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. H.A. Taha: “Operations Research” Macmilan Publishing Co. 2. S.D. Sharma: “Operations Research” KedarathRamnath& Co. Meerut. 3. Ravindran,D.T.,Philips and Solberg,J.J. “Operation Research- Principles and practice” 4. KantiSwarup, P.K. Gupta &Manmohan “Operations Research” Sultan chand& sons. 5. Hadly,G. “Linear programming” 6. Rao,S.S., “Engineering Optimization”, 7. Arora, J.S., Elsevier, 2nd Edition “Introduction to optimum Design”-(2004),. 8. Hiller,F.S., and Liberman,G.J., “Introduction to operation Research”-(1992), CBS publicationand Distributions, New Delhi. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

16	16WLM12	Group-1	SURFACE WATER HYDROLOGY
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction: Scope and importance of hydrology, Hydrologic cycle, Global and India's Water resources, Applications of hydrology. Watershed concept and modeling: Catchment-topographic and ground water divide, stream patterns, Description of the catchment, catchment processes, demarcating a catchment, water budgeting, Classification of models, model formulation, Lumped parameter conceptual models, Physically based models, Model performance testing. Precipitation:-Transitory systems favoring precipitation, Formation of precipitation, Climate and Weather seasons in India.</p>			
<p>Module -2. Location of rain-gauges and optimum number of rain-gauges, Analysis of rainfall data, Rainfall mass curve and hyetograph, Intensity-Duration analysis, Intensity-Frequency-Duration analysis, Depth-Area-Duration analysis, Double mass curve. Abstractions from precipitation: Evaporation-Process, measurement, empirical equations and Estimation by water budget method and Energy budget method.</p>			
<p>Module -3 Evapo-transpiration-AET & PET, Estimation by Penman's equation, Reference Crop Evapo-transpiration by Blaney Criddle formula, Infiltration-Process, Measurement, Horton's equation and Philip's equation. Infiltration indices, measurement factor affecting infiltration. Probability and Statistics-Introduction, Probability and Random variables, PDF and CDF, Distribution functions, Selection of distribution function and its parameter estimation. Correlation, Regression analysis-Simple linear and multiple linear regression, curvilinear regression. F test and t- tests. Runoff:-Process, Factors affecting runoff, API, Basin yield, Curve number method.</p>			
<p>Module -4 Hydrograph and its features, hydrograph separation methods, Unit hydrograph and its derivation, Unit hydrographs from complex storms and for various durations, Use of Scurve, Synthetic unit hydrograph.</p>			
<p>Module -5: Flood: Design flood and its estimation- Rational method, Frequency analysis Gumbel's and Log-Pearson's type III distribution, Risk and Reliability, Flood routing- Reservoir routing: Modified Pul's method, Goodrich method, Channel routing- Prism and Wedge storage, Muskingum method, Flood control- Structural and Non-structural measures</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Linsley R K, Kohler and Paulhus, "Hydrology for Engineers", McGraw Hill, NY, USA, 1958. 2. Mutreja, K. N., "Applied hydrology", Tata McGraw Hill Pub. Co., New Delhi, India-1986. 3. Chow, V.T., "Handbook of Applied hydrology", McGraw Hill, NY, 1964 4. Singh, V. P., "Elementary Hydrology", Prentice Hall, 1992 5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, 1998 6. Jaya Rami Reddy, P., "A text book of Hydrology", Laxmi publications, 2009 7. Putty, M. R. Y., "Principles of Hydrology", I.K. Int. Publishing House, New Delhi, 2010 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

17	16CEM11/ 16WLM152	Group-1	SPATIAL PLANNING AND REGIONAL ANALYSIS
Exam Hours:03		Exam Marks:100	
<p>Module -1. Introduction to Spatial Planning: Variants of Planning and Non-Planning, Planning as a Dialogue, Epistemic, Pragmatic an Planning Cycle, Planning Cycle with Internal Selection, Functions of Planning Agencies, Classical Planning Processes, Dimensions of Planning Process:-Organization, Location, Purpose, Openness, Time Horizon, Scope, Specificity, Flexibility</p>			
<p>Module -2... Introduction to Spatial Planning: Variants of Planning and Non-Planning, Planning as aDialogue, Epistemic, Pragmatic an Planning Cycle, Planning Cycle with Internal Selection, Functions of Planning Agencies, Classical Planning Processes, Dimensions of Planning Process:-Organization, Location, Purpose, Openness, Time Horizon, Scope, Specificity, Flexibility</p>			
<p>Module -3 Regional Planning: Workshop Task(Producers)- Motivation, Information, Organization, Installation, Platform Task(Moderator)- Communication, Concentration, Synchronization, Turntable Task(Mediator)- Articulation, Interpretation, Lookout Task(Observer)-Updating, Reviewing and Alerting, Creative use of Planning Process-Plural, Situational Rational and Involvement, Policy Maker and Citizen Input into the Classical Planning Process:- Ideal Sequence, Shortcut and Recycling within Planning Process.</p>			
<p>Module -4 . Regional Analysis: Fields of Regional Analysis, Spatial Units and Dimensions, Analysis of Population Change, Economic Analysis, Carrying Capacity, Measures of Concentration and Accessibility, Spatial Interaction, Analysis of Settlement Pattern, Simulation /Gaming:-Frame Games, Empathy Games, Resource Allocation Game, Process Game. Decision Making; Tools and Techniques, Factors- Risk, Turbulence, Uncertainty,Change, Planning Management, Forecasting, Equity, Growth and Development, Analysisof Settlement System.</p>			
<p>Module -5:.. Regional Analysis In Developing Countries: Basic Principles Functional Complexity, Levels of Settlements, Spatial Linkages Analysis, Analytical Mapping Accessibility Analysis, Functional Gap Analysis, Formulation of Spatial Development Strategies, Identification of Investment, Projects, Projects and Program, Monitoring an Evaluation. Institutionalizing Spatial Analysis in the Regional Planning Process, Role of Towns and Cities in the Development of Rural Regions: Physical Input, Economic, Organization and Knowledge Factors, Problems of Rural Regions, Benefits of Physical Linkages, Development of Employment Structure by Sectors: Primary, Secondary and Tertiary.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference books:</p> <ol style="list-style-type: none"> 1. Kenny Lynch, Rural-Urban Interaction in the Developing World, Taylor & Francis, 2004. 2. Gopal B, Development Of Indian Urban Rural And Regional Planning W. Neha Publishers &Distributors, 2000 3. Harmit Singh Bedi, Smart Urban and Rural Planning Techniques, COPAL Publication, 2015. 4. Kang-Tsung Chang, 'Introduction to Geographic Information Systems', McGraw-Hill BookCompany 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16CCS13/ 16CSE14	GROUP-2	STRUCTURAL DYNAMICS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Single Degree of Freedom System: Degrees of freedom, undamped system, springs in parallel, in series. Newton's laws of motion, free body diagrams. D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, critically damped system, over damped system, under damped system, and logarithmic decrement. Response of single degree of freedom system to harmonic loading – undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments.</p>			
<p>Module -2 Response to General Dynamic Loading Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, un-damped system, numerical evaluation of Duhamel's integral, damped system. Fourier analysis and response in frequency domain – Fourier analysis, Fourier co-efficient for piece-wise linear functions, exponential form of Fourier series, discrete Fourier analysis, fast Fourier transform.</p>			
<p>Module -3 Generalised Co-ordinates and Rayleigh's method Principle of virtual work, generalized single degree of freedom system (rigid body and distributed elasticity), Rayleigh's method. Multistorey Shear Building. <i>Free vibration</i> – natural frequencies and normal modes, Zero modes of vibration. <i>Forced motion</i> – modal superposition method – response of a shear building to base motion. Damped motion of shear building – equations of motions – uncoupled damped equation – conditions for uncoupling. Damping.</p>			
<p>Module -4 Discretization of Continuous Systems Longitudinal Vibration of a uniform rod. Transverse vibration of a pre-tensioned cable. Free transverse vibration of uniform beams –Rotary inertia and shear effects – The effect of axial loading. Orthogonality of normal modes. Undamped forced vibration of beams by mode superposition.</p>			
<p>Module -5 Dynamic Analysis of Beams Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretised beam in matrix form and its solutions.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Mario Paz, "Structural dynamics, Theory and computation", 2 nd Edition, CBS Publisher and Distributors, New Delhi. 2. Mukhopadhyaya, "Vibration, Dynamics and structural problems," OxfordIBH Publishers 3. Clough, Ray W and Penzien J, "Dynamics of Structure s", 2nd Edition McGraw-Hill, New Delhi. 4. Roy R. Craig, Andrew J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley & Sons 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

02	16CEE13/ 16WLM252	Group-2	ADVANCED WATER TREATMENT TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Sources of water, necessity of treatment, Critical Water quality parameters, water quality guidelines and standards for various water uses. Unit operations: Principles and design of aeration systems – twofilm theory, water in air system, air in water system. Intake structures: Different types, design criteria			
Module -2 Principles of sedimentation: Types of settling and settling equations, design criteria and design of settling tanks. Principle of Coagulation and Flocculation: types of coagulants, coagulant aids, coagulation theory, optimum dose of coagulant, design criteria and numerical examples.			
Module -3 Filtration: Theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operational problems and trouble shooting.			
Module -4 Adsorption Process: Types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations and their applications			
Module -5 Unit processes: disinfection – different types, disinfectants, factors affecting disinfection, methods of disinfection, chemistry of chlorination. Water Softening – Ions causing hardness, Langelier index, various methods. Fluoridation and defluoridation – Principles and design. Trace organic contaminants in water supplies and their removal. Bench Scale and Pilot Plant studies in water treatment. Rural Water Supply Systems.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Fair, G.M., Geyer J.C and Okun, "Water and Waste water Engineering" Vol II, John Wiley Publications. 2. Weber W.J., "Physico - Chemical Processes for Water Quality Control". 3. APHA, AWWA, AAWF, "Water Quality and Treatment" McGraw Hill. 4. CPHEEO Manual on "Water Supply and Treatment", available at Jain Book agency, C-9, Connaught place, New Delhi 5. Peavy, H.S., Rowe and Tchobonoglous, G., "Environmental Engineering", McGraw Hill 6. Raju, B.S.N., "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt Ltd., New Delhi. 7. World Health Organization, Geneva, Guidelines for Drinking Water Quality, Third Edition, Volumes 1-3. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

03	16CEE14/ 16WLM21 /WLM22	Group-2	SOLID AND HAZARDOUS WASTE MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Municipal Solid Waste Management: Legal and Organizational foundation: Definition of solid waste – waste generation technology – major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW – storage and handling of solid waste – Future changes in waste composition.			
Module -2 Collection and Transport of Solid Waste: Collection of Solid Waste: Type of waste collection systems, analysis of collection system – alternative techniques for collection system. Separation and Processing and Transformation of Solid Waste: unit operations used for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators Transfer and Transport: Need for transfer operation, transport means and methods, transfer station types and design requirements.			
Module -3 Landfills : Site selection, design and operation, drainage and leachate collection systems – requirements and technical solution, designated waste landfill remediation – Integrated waste management facilities.			
Module -4 Hazardous Waste Management: Definition and identification of hazardous wastes – sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste – compatibility, handling and storage of hazardous waste – collection and transport, e-waste - sources, collection, treatment and reuse management.			
Module -5 Hazardous waste treatment and Design: Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites. Biomedical Waste management: Biomedical (Handling and Management) Rules 2008, sources, treatment and disposal			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Tchobanoglous G., Theissen H., and Eliassen R., “Solid Waste Engineering – Principles and Management Issues”, McGraw Hill, New York. 2. Pavoni J.L., “Handbook of Solid Waste Disposal”. 3. Mantell C.L., “Solid Waste Management”, John Wiley. 4. CPHEEO, Manual on Municipal Solid waste management, Jain Book Agency, c-9, Connaught place, New Delhi 5. Sasikumar and Krishna S. G, Solid waste Management, PHI Learning Pvt Ltd, New Delhi 6. WHO Manual on Solid Waste Management. 7. Hazardous waste (management and handling) Rules, 2001 8. Biomedical (Handling and Management) Rules 2008 9. Charles A. Wentz; “Hazardous Waste Management”, McGraw Hill Publication, 1995. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

04	16CEE153/ 16CWM21 /16CHT423 /16CEM41	Group-2	OCCUPATIONAL SAFETY AND HEALTH
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws. Indian Acts – Labour Act, Factories Act, OSHA.			
Module -2 Ergonomics: need, Task Analysis, Preventing Ergonomic Hazards, Ergonomics Programme. Accident – Causation, investigation methods and different models.			
Module -3 Occupational Hazard and Control: Hazard Analysis, Human Error and Fault Tree Analysis, Emergency Response. Hazards and their control in different manufacturing and processing industries			
Module -4 Fire Prevention and Protection: Types of Fire, Fire Development and its Severity, Effect, Extinguishing Fire, Electrical Safety, Product Safety			
Module -5 Occupational Health: Health and Safety Considerations, Personal Protective Equipment. Health problems in different types of industries – construction, textile, steel and food processing, pharmaceutical, occupational Health and Safety considerations in Wastewater Treatment Plants.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Goetsch D.L., “Occupational Safety and Health for Technologists”, Engineers and Managers”, Prentice Hall. 2. Heinrich H.W., “Industrial Accident Prevention”, McGraw Hill Publication, New York. 3. Colling D.A., “Industrial Safety Management and Technology”, Prentice Hall, New Jersey. 4. Della D.E., and Giustina, “Safety and Environmental Management”, Van Nostrand Reinhold International Thomson Publishing Inc. 5. CPHEEO, Manual on Sewerage and Sewage Treatment, M/s. Jain Book Agency, c-9, Connaught place, New Delhi. 6. National Safety Council and Associate (Data) Publishers Pvt. Ltd., “Industrial Safety and Pollution Control Handbook” 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

5	16CGI153	Group-2	ADVANCED GEOGRAPHIC INFORMATION SYSTEMS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Geodatabase: Basic geodatabase and structure, Types of geodatabase, Advantages of geodatabase, Basic geodatabase structure, Topology, relational classes, geometric networks, raster data – Creating geodatabase, organizing data, defining database structure -Understanding spatial reference in geodatabase – Modifying spatial domain, Simple feature creation in geodatabase, Creating and editing map topology, - Types of geodatabase annotation - Adding behaviour to a geodatabase.</p>			
<p>Module -2 Surface Analysis: Slope and aspect - Hydrologic functions – Viewsheds- Shaded relief maps Spatial analysis - Surface analysis - 3-D analysis – Map algebra - Cell statistics DEM, DTM and TIN Model Building and Spatial Modeling: Why build models – Anatomy of a model - Model elements - Introduction to scripting. The object model in GIS. Vector and raster data extraction for modeling, Land use classification, Temporal land use analysis, Spatial modeling procedure, Cellular automata modeling, Methods of spatial interpolation. Data Accuracy, Error Assessment and Propagation: Spatial data standards, Positional accuracy, Accuracy measurement techniques, Error in linear and area feature, Land use classification accuracy, Attribute accuracy, Error propagation in spatial attribute Advanced Cartography: Annotations, labels, and metadata; Mapmaking with advance tricks Working with labels and annotations – Managing (organizing and modifying) labels and annotations – Metadata file creation and management with new tools.</p>			
<p>Module -3 Multi-Criteria Decision Analysis and Spatial Decision support System (SDSS): Elements of multi-criteria decision analysis, classification of decision problems, criteria evaluation, hierarchical decision alternatives and constraints, alternatives and decision variables, deterministic variables, criteria weighting, estimation weights, ranking methods, decision rules, multi-attribute decision rules, sensitivity analysis, SDSS, what is SDSS, requirements multi-criteria spatial decision support systems (SDSS). SDSS for location planning, application-specific capabilities.</p>			
<p>Module -4 Expert GIS : Introduction to concepts of Expert GIS, Data formats, Proprietary file formats, translator and transfer formats, open formats, standards, metadata, standards gazetteer, XML and GML, GIS and databases Spatial databases, relational databases, object databases, advanced database technology, derived mapping – generalization, text placement, automated cartography, data from imagery, Web GIS, simple maps in web pages, web software, Mobile GIS – positioning, location based services, personal and vehicle navigation, LBS for mass market, telematics. – Applications</p>			
<p>Module -5 Enterprise GIS : User need assessment; old and new spatial database models, SDE layers, Geodatabase, architecture design, capacity planning (Hardware), security planning, RDBMS, RDBMS software selection, GIS software selection, planning for migration. Enterprise GIS management. Case Studies: GIS analysis in transportation, GIS analysis in water management, urban development, environmental analysis, hydrological modeling, Habitat suitability modeling, virtual cities 3D modeling and visual simulation, Automata based models of Urban system</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> 1. GIS and Multi-criteria decision analysis by Jacek Malczewski, John Wiley and sons. 2. Expert Systems by Peter Jackson, third edition, 1999, Pearson Education. 3. Concepts and Techniques of Geographic Information Systems, CP Lo, Albert K WYeung, 2005 Prantice Hall of India 4. Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002. 5. Remote sensing and Image interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994. 6. Geographical Information Systems – Principles and Applications, Volume I & II, edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

06	16CCT13	Group-2	ADVANCED TECHNIQUES IN CONCRETE CONSTRUCTION
Exam Hours:03		Exam Marks:100	
Module -1 Features of Recent Advances in Concrete, Types of Concrete to be dealt; Terminologies, Ingredients, Properties of Fresh & Hardened concrete, related tests, Production and use of concrete.			
Module -2 High Performance Concretes: Definition & Introduction, Classification, general properties, Advantages, Disadvantages, Applications, Description of types. Guidelines for Mix design and use of following concretes: Light weight concrete, High strength concrete, Ultra-high strength concrete (reactive powder concrete), High workability concrete/Self compacting concrete, Fiber reinforced concrete, Polymer-concrete composites			
Module -3 Special Concretes: Definition & Introduction, General properties, Advantages, Disadvantages, Applications, Concreting practices, Guidelines for Mix design and use of following concretes: High density concrete, Shrinkage compensating concrete, Mass concrete, Roller compacted concrete.			
Module -4 Durability of Concrete: Definitions, Deterioration processes– Physical, Chemical, Environmental & Biological; Measures for ensuring durability, Corrosion of reinforcing steel, protective measures.			
Module -5 Testing and Quality Control of Concrete: Classification of test methods, In-situ, Non-Destructive & Partially-Destructive tests for fresh concrete, hardened concrete and durability of concrete. Problems on the in-situ testing results and compared with Laboratory results			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES:			
<ol style="list-style-type: none"> 1. Gambhir.M.L., “Concrete Technology”, McGraw Hill Education, 2006. 2. Gupta.B.L., Amit Gupta, “Concrete Technology”, Jain Book Agency, 2010. 3. Neville, A.M., “Properties of Concrete”, Prentice Hall, 1995, London. 4. Santhakumar.A.R. ; “Concrete Technology”, Oxford University Press, 2007. 5. Shetty M.S., “Concrete Technology”, S.Chand and Company Ltd. Delhi, 2003. 6. Mehta .P.K., and Paulo J.M. Monteiro, “Concrete- Microstructure, Properties and Materials”-(Indian Ed., Indian Concrete institute), McGraw Hill. 7. “Current Literature”. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

07	16CCT154, 16CWM422, 16CCT424	Group-2	SUSTAINABLE MATERIALS AND GREEN BUILDING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction and definition of Sustainability. Carbon cycle and role of construction material such as concrete and steel, etc. CO2 contribution from cement and other construction materials.			
Module -2 Construction materials and indoor air quality. No/Low cement concrete. Recycled and manufactured aggregate. Role of QC and durability. Life cycle and sustainability.			
Module -3 Components of embodied energy, calculation of embodied energy for construction materials. Energy concept and primary energy. Embodied energy via-a-vis operational energy in conditioned building. Life Cycle energy use.			
Module -4 Control of energy use in building, ECBC code, codes in neighboring tropical countries, OTTV concepts and calculations, features of LEED and TERI Griha ratings. Role of insulation and thermal properties of construction materials, influence of moisture content and modeling. Performance ratings of green buildings. Zero energy building			
Module -5 Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas, Nuclear energy, Global temperature, Green house effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES:			
<ol style="list-style-type: none"> 1. “Construction Materials, Methods & Techniques”(3e) by William P Spence, Yesdee Publication 2012, Pvt. Ltd., Chennai, India 2. “Concrete Structure properties & Materials” by Mehta P.K & Manteio P.J.M, Prentice hall. 3. “Building Materials” by M L Gambhir, Neha Jamwal, Tata McGraw Hill Publ. 4. New Building Materials and Construction World magazine 5. C.J.Kibert(2008)“Sustainable Construction: Green Building Design and delivery”, 3rd Ed., John Wiley, Hoboken, New Jersey 6. Energy Conservation Building Code (ECBC) 7. Sustainable Engineering Practice ASCE Publication 2010. 8. Hagger Sustainable Industrial Design and Waste Management, Techniz Book 2010. 9. Willan T. Mayer Energy economics and building design. 10. National Building Code 2005, Part 0-10, Bureau of Indian Standards 11. G.T. Miller Jr. (2004) “Living in the Environment: Principles, Connections, and Solutions”, 14th Ed., Brooks Cole, Pacific Grove, California, Washington 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

08	16CGT13/16CTE13/ 16CIM253/16WLM253 / 16CHT253	GROUP-2	SUBSURFACE INVESTIGATION AND GROUND IMPROVEMENT TECHNIQUES
Exam Hours:03		Exam Marks:100	
Module -1 SITE INVESTIGATION:Planning of Exploration and experimental programme, investigations,exploration for preliminary design, exploration for detailed designGeo-physical explorations (soundings, probings, boring, boring methods), excavation methods for explorations, ground waterinvestigations, rock boring, miscellaneous exploratory techniques			
Module -2 SAMPLING AND IN-SITU FIELD TESTS: Types of samples, samplers,preservation, shipment and storage of samples, bore log, pore pressuremeasurements, core recovery, rock strength, rock quality designationIn-situ field testing and laboratory investigation of soils and rock(including advanced equipment), instrumentation, data acquisition andmeasurement techniques: SPT, SCPT, DCPT, pressuremeter, dilatometer,permeability, plate load test, lateral pressure test. Numerical problems			
Module -3 DATA INTERPRETATION: Data interpretation for determination ofengineering properties of soils and their application to geotechnicaldesign, preparation of site investigation reports			
Module -4 SITE IMPROVEMENT: General methods of stabilization – shallow anddeep, factors governing suitable method, compaction,Drainage: soil and filter permeability, filter criteria, drainage layout andpumping system, Pre-compression and consolidation: principles, sand drains, porepressure distribution, electro-osmotic and chemical osmoticconsolidation. Numerical problems			
Module -5 STABILIZATION: Mechanical stabilization, lime, cement, bitumen, chemical etc.Grouting: Injection and principles, grouting pressure criteria, groutingequipment, injection chemicals,Thermal methods: heating and cooling effects on soils, equipment,Miscellaneous: moisture barriers and preventing techniques			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Engineering Principles of Ground Modifications – Hausmann, McGraw Hill. 2. Foundation Analysis and Design – J E Bowles, Tata McGraw Hill. 3. Subsurface Exploration and Sampling of Soils for Civil Engg. Purposes –Hvorslev M J, 			
Reference Books: <ol style="list-style-type: none"> 1. Soil Mechanics, T.W. Lambe and R.V. Whitman. John Wiley & Sons, 1969. 2. Geotechnical Engineering- Donald P Coduto Phi Learning Private Limited,New Delhi 3. Geotechnical Engineering- Shashi K. Gulathi&ManojDatta. (2009), “Tata McGraw Hill. 4. Soil Mechanics and Foundation Engg.- Muni Budhu (2010), 3rd Edition, JohnWiely& Sons 5. Soil Mechanics for Road Engineers - HMSO 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

09	16CHT153/ 16CTM421	Group-2	PLANNING AND DESIGN OF LOW VOLUME ROADS
Exam Hours:03		Exam Marks:100	
Module -1 Planning of Low volume roads: Introduction to planning of low volume roads, concepts of network planning, selection of roadway alignment, factors affecting routeselection, engineering surveys for new road location.			
Module -2 Geometric design parameters: basic principles of geometric design, design of horizontal alignment, curves, super elevation, design of vertical alignment, summit curve, and valley curve standard of design of low volume road.			
Module -3. Materials: Road materials for pavement construction, soil-subgrade, road aggregate, binder, test on soil, test on aggregates and test on bitumen, bituminous mix design, Marshall stability method for mix design.			
Module -4 Design of pavement: Factors affecting pavement design function of pavement components, design of flexible pavement by GI method, CBR method, Burmeister layer. Design of rigid pavement by using IRC method.			
Module -5 Road construction: Specifications of material and construction of sub grade, subbase, base and surface layer, construction of non bituminous road, construction of bituminous roads, equipment required for construction, maintenance of low volume roads			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. A. Veeraragavan, S.K Khanna and C.E.G. Justo, Highway Engineering, Nem Chand & Brothers, 2014. 2. Bruton, M. J., Introduction to Transportation Planning, UCL press, London, UK, 1992. 3. Ethiopian Roads Authority, Design Manual for Low Volume Roads, Parts A-G: http://www.icafrica.org/knowledge-publications/article/design-manual-for-low-volume-roadsparts-a-g-116/ 4. Gordon Keller & James Sherar, Low-Volume Roads Engineering: Best Management Practices – FieldGuide, USDA Forest Service/USAID, 2003. http://www4.worldbank.org/afr/ssatp/Resources/HTML/LVSR/English/Added-2007/2003-LVREngineering-FieldGuide-USA-by-GKeller.pdf 5. IRC SP 20: Rural road manual, Indian road congress, New Delhi, 2002 6. Yan H. Huang, Pavement Analysis and design, Second Edition, prentice hall inc, 2004 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CHT154	Group-2	URBAN PUBLIC TRANSPORT
Exam Hours:03		Exam Marks:100	
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.			
Module -2 Comparing Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit, Problems.			
Module -3. Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing.			
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.			
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.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 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. 3. Horst R. Weigel, Rainer E. Gotz, Helmut H. Weiss, 'City Traffic - A Systems Digest', VanNostrand Reinhold Company, New York 4. John W. Dickey, 'Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co., New Delhi 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16CSE13/ 16CCS14/ 16CGT153	Group-2	MECHANICS OF DEFORMABLE BODIES
Exam Hours:03		Exam Marks:100	
Module -1 . Theory of Elasticity: Introduction: Definition of stress and strain at a point, components of stress and strain at a point of Cartesian and polar coordinates. Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.			
Module -2 Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress, spherical and deviatoric strains, max. shear strain.			
Module -3. Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentration due to the presence of a circular hole in plates.			
Module -4 Elementary problems of elasticity in three dimensions, stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media. Applications of finite difference equations in elasticity.			
Module -5 Theory of Plasticity: Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, yield conditions, stress – space representation of yield criteria through Westergaard stress space, Tresca and Von-Mises criteria of yielding			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill 2. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994 3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers 4. Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd 5. Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag 6. Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co Ltd. 7. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers 8. Xi Lu, "Theory of Elasticity", John Wiley. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	16CSE154/16CCS251	Group-2	RELIABILITY ANALYSIS OF STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 . Preliminary Data Analysis: Graphical representation-Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = abx$, and parabola, Coefficient of correlation.			
Module -2 Probability Concepts: Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem			
Module -3. Random variables: Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poisson distributions, Continuous distributions-Normal, Log normal distributions.			
Module -4 Reliability Analysis: Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method)			
Module -5 System reliability: Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers random numbers with standard uniform distribution, continuous random variables, discrete random variables			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Ranganathan, R. (1999). "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India.			
2. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –I, John Wiley and sons, Inc, New York.			
3. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –II, John Wiley and sons, Inc, New York.			
4. Milton, E. Harr (1987). "Reliability based design in civil engineering"- McGraw Hill book Co.			
5. Nathabndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, "Probability and reliability for Civil and Environmental Engineers"- Mc Graw Hill international edition, Singapore.			
6. Achintya Haldar and Sankaran Mahadevan (2000). "Probability, Reliability and Statistical methods in Engineering design"- John Wiley and Sons. Inc.			
7. Thoft-christensen, P., and Baker, M., J., (1982), "Structural reliability theory and its applications"- Springer-Verlag, Berlin, New York.			
8. Thoft-christensen, P., and Murotsu, Y. (1986). "Application of structural systems reliability theory"- Springer-Verlag, Berlin, New York			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16CSE151/16CIM11/16CCT 423/ 16CCS423	Group-2	ADVANCED DESIGN OF PRE-STRESSED CONCRETE STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 . Losses of Prestress: Loss of prestress in pre-tensioned and posttensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis of sections for flexure.			
Module -2 Design of Section for Flexure: Allowable stresses, Elastic design of simple beams having rectangular and I-section for flexure, kernlines, cable profile and cable layout. Design of Sections for Shear: Shear and Principal stresses, Improving shear resistance by different prestressing techniques horizontal, sloping and vertical prestressing, Analysis of rectangular and I-beam, Design of shear reinforcement, Indian code provisions.			
Module -3. Deflections of Prestressed Concrete Beams: Short term deflections of uncracked members, Prediction of long-term deflections, load–deflection curve for a PSC beam, IS code requirements for maximum deflections.			
Module -4 Transfer of Prestress in Pretensioned Members : Transmission of prestressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in posttensioned members, stress distribution in End block, Anchorage zone reinforcements.			
Module -5 Statically Indeterminate Structures: Advantages and disadvantages of continuous PSC beams, Primary and secondary moments, P and C lines, Linear transformation, concordant and non-concordant cable profiles, Analysis of continuous beams.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: Srinath. L.S., Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Delhi Co ltd., New 1. Krishna Raju, “Prestressed concrete”, Tata Mc Graw Hill Book – Co ., New Delhi. 2. T.Y. Lin and Burn, “Design of prestress concrete structures”, John Wiley, New York. 3. S. Ramamrutham, “Prestressed concrete”, Dhanpat Rai & Sons, Delhi.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CTE14/ 16CTM13	Group-2	URBAN TRANSPORT PLANNING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction –Introduction to transportation planning, scope and objective of UTP, various modes of transportation and comparisons, urban transportation system planning process, transportation demand and forecast.			
Module -2 Transportation Planning Process & Surveys System approach to urban planning, Stages in transportation planning, Basic Movements-Study Area-Zones- Surveys- Planning of different types of surveys-Inventory of transportation facilities			
Module -3.Trip generation & Trip distribution Trip generation: Trip purpose- Factors governing trip generation and attraction- Category analysis-Problems on above Trip distribution: Methods- Growth factors methods- Synthetic methods- Fratar and Furness method and problems on the above			
Module -4.Model Split & Trip Assignment Model Split: Factors affecting- characteristics of split- Model split in urban transport planning- problems on above Trip Assignment: Assignment techniques- problems on all techniques, minimum path tree problems.			
Module -5 Interdependency of Land Use & transport, characteristics of land use Models–Lowry Model- Hansen’s Accessibility Model-Density- Saturation Gradient Model-Problems(Exception Lowry Model & DSGM)- Difficulties in planning small & medium cities- Recent case studies			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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 2. C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI. 3. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ			
REFERENCES			
1. B.G.Hutchinson, Principles of urban transportation system planning- McGraw-Hill, New York, 1974 2. S.C. Saxena, Traffic Planning and Design, DhanpatRai Pub., New Delhi.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

15	16CEM13	Group-2	CONSTRUCTION EQUIPMENTS AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Plants and Equipment for production of materials- Crushers, mixers, bituminous mixing plants, concrete mixing plants, transit mixers, advantages, choice, production rate calculation.			
Module -2 Construction Equipment – Operations, applications and performance of dozers, excavators, graders, compactors, pavers, haulers, crawler, wheel tractors, power shovels, pile driving equipments, hauling equipments, and drilling, blasting and tunneling equipment.			
Module -3. Miscellaneous Equipments - Equipment for: Dredging, tunneling, dewatering. Equipment for flooring- dewatering and floors finishing. Sprayers, kerb casting equipment, screening equipment.			
Module -4. Selection of Construction Equipment- Task considerations, cost considerations, engineering considerations, equipment acquisition options.			
Module -5 Management Of Construction Equipment: Need for mechanization of construction – planning and financing construction plant and equipment – Owning and operating equipment versus hiring– planning for infrastructure mechanization equipment management – equipment maintenance and repair, log maintenance, safety during operation, economical life of equipment.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References:			
<ol style="list-style-type: none"> 1. Peurifoy, R.L., Ledbette. W.B., Construction Planning, Equipment and Methods, McGrawHill Co., 2. Antil J.M., Civil Engineering Construction, McGraw Hill Book Co. 3. Smith, R.C, Andres, C.K., Principles and Practice of Heavy Construction, Prentice Hall 4. SC Sharma ‘Construction equipment’ 5. Chitkara, K. K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw Hill Publishing Company, New Delhi, 1998. 6. Frank harris, “Modern Construction Equipment & methods”, John Wiley & Sons 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

16	16CEM14/16CIM422/ 16CCT41/16CSE252	Group-2	REPAIR AND REHABILITATION OF STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking.			
Module -2 Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.			
Module -3. Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration -testing techniques			
Module -4. Materials for Repair: Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete. Techniques for Repair: Rust eliminators and polymer coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning.			
Module -5 Examples of Repair to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure. Demolition-Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References:			
<ol style="list-style-type: none"> 1. Sidney, M. Johnson “Deterioration, Maintenance and Repair of Structures”. 2. Denison Campbell, Allen & Harold Roper, “Concrete Structures – Materials, Maintenance and Repair”- Longman Scientific and Technical 3. R.T.Allen and S.C. Edwards, “Repair of Concrete Structures”-Blakie and Sons 4. Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service”-R&D Center (SDCPL) 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16CCS252	GROUP-3	AI AND EXPERT SYSTEMS IN STRUCTURAL ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 Artificial Intelligence:Introduction: AI – Applications fields, defining the problems – statespace representation – problem characteristics – production system– production system characteristics. Knowledge Representation:Formal logic – predicate logic – logic programming – forward v/backward reasoning – matching control knowledge.			
Module -2 Search and Control:Concepts – uninformed / blind search: depth first search –breadth first search - bi-directional search – informed search –heuristic graph search – generate and test - hill climbing – best–first search – AND OR graph search. Non-formal KnowledgeRepresentation – semantic networks – frames – scripts – productionsystems. Programming in LISP.			
Module -3 Expert Systems:Their superiority over conventional software – components of anexpert system – expert system life cycle– expert system development process – nature of expert knowledge– techniques of soliciting and encoding expert knowledge.Inference: Forward chaining – backward chaining – rule valueapproach.			
Module -4 Uncertaintysymbolic reasoning under uncertainty: logic for non-monotonicreasoning. Statistical reasoning: Probability and Bayes’ theorem –certainty factor and rule based systems – Bayesian network -Dempster– Shafer theory.			
Module -5 Fuzzy reasoning and Neural Networks:Features of rule-based, network- based and frame -based expertsystems – examples of expert systems in Construction Managementand Structural Engg. Expert system shells. Neural Networks: Anintroduction– their possible applications in Civil Engineering.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Adeli, H., “Expert Systems in Constructions and Structural Engg”,Chapman &Hall, New York 2. Patterson D W, “Artificial Intelligence and Expert Systems”, Prentice-Hall,India, New Delhi. 3. Rich, E. and Knight K. “Artificial Intelligence”, T MH, New Delhi. 4. Rolston ,D.W., “Artificial Intelligence and Expert Systems” McGraw Hill,New York. 5. Nilsson, N.J., “Principals of Artificial Intelligence”, Narosa., New Delhi.SDCPL –R&D Center – New Mumbai 73. 5. Jaikrishna et al. “Elements of Earthquake Engineering”, South AsiaPublishers, New Delhi 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

02	16CEE21/ 16CWM41	Group-3	ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: sources, effects on – ecosystems, characterization of atmospheric pollutants, air pollution episodes of environmental importance			
Module -2 Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Windrose diagram			
Module -3 General characteristics of stack emissions, plume behaviour, heat island effect. Pollutants dispersion models – description and application of point, line and areal sources. Monitoring of particulate matter and gaseous pollutants – respirable, non-respirable and nano - particulate matter. CO, CO ₂ , Hydrocarbons (HC), SOX and NOX, photochemical oxidants.			
Module -4 Air Pollution Control equipment for particulate matter & gaseous pollutants – gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – adsorption, absorption, scrubbers, condensation and combustion			
Module -5 Indoor Air Pollution – sources, effects and control. Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Wark K., Warner C.F., and Davis W.T., “Air Pollution - Its Origin and Control”, Harper & Row Publishers, New York. 2. Lee C.C., and Lin S.D., “Handbook of Environmental Engineering Calculations”, McGraw Hill, New York. 3. Perkins H.C., “Air Pollution”, McGraw Hill. 4. Crawford M., “Air Pollution Control Theory”, TATA McGraw Hill. 5. Stern A.C., “Air Pollution”, Vol I, II, III. 6. Seinfeld N.J., “Air Pollution”, McGraw Hill. 7. Stern A.C., Vol. V, “Air Quality Management”. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

03	16CGI21	Group-3	SATELLITE DATA IMAGE PROCESSING
Exam Hours:03		Exam Marks:100	
Module -1 Digital Data: Introduction- Satellite data acquisition –Storage and retrieval – Data Formats – Compression – Satellite System – Dataproducts – Image processing hardware and software. Image Rectification and Restoration: Geometric correction- Radiometric correction – Noise removal.			
Module -2 Image Enhancement: Contrast Manipulation –Gray-Level Thresholding- Level Slicing Contrast Stretching – Convolution – Edge Enhancement – Spatial feature manipulation –Fourier Analysis. Multi Image Manipulation: Spectral Ratioing –Principal and Canonical Components– Vegetative Components – Intensity – Hue – Saturation –Colour Space Transformation. Rectifying a Camera Image: Perform Image to Image Rectification –Check Map Models – Ortho-rectification- Area correlation –Resampling-Multi-image fusion- Spatial and spectral domain fusion.			
Module -3 Information Extraction: Principal Component Analysis (PCA), Ratio Images, Multispectral Classification – Supervised and Un-supervised Classification methods, Graphical representation of the spectral response patterns, Quantitative expression of category separation, Selfclassification of training set data, interactive preliminary classification representative and subsene classification, Hybrid –Classification –Classification of Mixed Pixels. Output generation: Graphic Products – tabular data, Digital Information files – Post Classification Smoothing – Classification Accuracy Assessment. Classification error matrix, sampling consideration, evaluating classification error matrix.			
Module -4 Data Merging and GIS Integration: Multi-temporal Data merging, Multi-sensor image merging – Merging of image data with Ancillary data- Incorporating GIS Data in automated land cover classification. Change detection: Binary change detection, multi-date composite image change detection.			
Module -5 Hyper-spectral Image Analysis and Radar image analysis: Atmospheric correction – Hyper-spectral image analysis techniques. SAR data processing and analysis. Image Analysis and Understanding: Pattern recognition – Shape analysis- Textural and contextual analysis – Decision concepts – Fuzzy sets and evidential reasoning. Advanced Concepts: Artificial intelligence and expert systems –Artificial Neural Network concepts, genetic algorithms and programming.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: 1. John R Jenson ‘Introducing Digital Image Processing’ Prantice Hall. New Jersey 1986. 2. R. A. Schowengert, ‘Techniques for Image Processing and Classification in Remote Sensing’; 1983 3. Robert A Schowengert, ‘Remote Sensing – Models and Methods for Image Processing’ Academic Press 1997 4. Hord R M, Academic Press, 1982.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

04	16CGI22/ 16CGI253	Group-3	APPLICATIONS OF GEOINFORMATICS IN NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT
Exam Hours:03		Exam Marks:100	
<p>Module -1 Concepts of natural resources management: Types of natural resources, renewable, non-renewable, Linkages of natural resources with the economy, impact of natural resources utilization on Earth system functioning, National Natural Resources Management Systems (NNRMS), Natural Resources Census, Natural Resources Information Systems.</p> <p>Geological Resources Exploration: Geomorphological Mapping: Mapping geological structures-folds, faults, joints and lineaments, Lithological mapping, Mineral resources mapping and Mineral Resources Information System; Encroachment mapping, GIS in mine remediation and mine reclamation</p> <p>Land Resources Management: Soil survey, soil classification, soil series establishment, profile studies, Land Use Land Cover Mapping, Wetland Mapping, Wasteland Mapping, Land Degradation and Desertification Mapping, Soil Conservation Measures, Soil Erosion Modeling, Land capability Maps, land/ soil Irrigability maps and Land Resources Information Systems (LRIS).</p>			
<p>Module -2 Agro-ecosystem management: Agro-climatic zonation, Crop Acreage Production Estimation (CAPE), Forecasting Agriculture output through Satellite and Land-based observations (FASAL), Crop norm violation, Cropping systems analysis, RS basis for crop insurance claim. Satellite agro-meteorology; Thermal RS application for crop stress detection, & Microwave application in agriculture, Space inputs for precision agriculture, Agro-climatic planning and information Bank (APIB), Site suitability studies for agricultural crops, horticultural crops. Horticulture, Sericulture, inputs management.</p> <p>Forest Resources management: Mapping and inventorying of forest resources, Forest biomass estimation, carbon sequestration, forest fire mapping and monitoring, forest fire risk zonation, Biodiversity conservation planning, eco-restoration and eco-development; encroachment mapping and monitoring, Forest Management Plans, and Working Plans. Inputs for preparation of working plan/management plan. Environmental Impact assessment of mining and Industrial activities, Microwave application in Forestry, Wildlife ecology applications-Habitat management- wildlife habitat selection, habitat fragmentation, protected areas, Catchments area treatment plans, waste land development, forest plantations and its monitoring, joint forest management, forest resource information system</p>			
<p>Module -3 Water Resources Management: Hydrological cycle, Surface water resources mapping and management; Integrated river basin management, Inter river basin connectivity mapping, river diversion studies, Site suitability for surface storages and hydro-electric power plants, Digital elevation models and their applications, storage yield analysis and reservoir sizing, Floodplain mapping and flood plain zoning, flood mitigation measures, flood water diversion for irrigation. Ground water modeling, preparation of ground water prospecting and recharging maps</p>			
<p>Module -4 Introduction to Environment: Components of environment, biotic and abiotic components, laws of conservation of mass and energy, the basics of thermodynamics, concepts of ecosystem, bio-geo-chemical cycles, ecological pyramids, food webs, energy flow and ecosystem functioning.</p> <p>Sustainable Development: Concept of sustainability, Integrated Mission for Sustainable Development, Watershed characterization, Action Plans for Sustainable development, watershed prioritization, developmental impact assessment, Action plans for Sustainable Agriculture and Space based Information System for Decentralized Planning (SIS-DP), Sujala Watershed Project in Karnataka.</p>			
<p>Module -5 Water Pollution Applications: Siltation estimation and storage loss estimation, water quality index mapping, point source pollution mapping, non-point source pollution modeling, eutrophication and water vegetation mapping, methane production area mapping and modeling, Modeling of dams and reservoirs for estimation of damage to natural resources, oil slicks tracing and monitoring, sea turbidity and sedimentation mapping, coastal erosion mapping, coastal habitat degradation mapping, ground water contamination studies, Groundwater pollution hazard assessment and protection planning using GIS techniques; groundwater quality index mapping.</p> <p>Air and Atmospheric Pollution Applications: Aerosol remote sensing, air quality indexing and mapping, dynamic air pollution modeling, mapping and measuring troposphere pollutants, environmental sensitivity index mapping; spread and dispersion of smoke plumes from industries and power plants, forest fires, oil wells, etc.</p> <p>Miscellaneous Applications: RS and GIS Applications in noise pollution and light pollution monitoring. GIS modeling for bioterrorism, ecology of vectors of epidemics, mapping epidemic vulnerable zones.</p>			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 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:

1. Introduction to Environmental Remote Sensing by Barrett E.C., Curtis, I.F., Chapman and Hall, New York, 1982
2. Remote Sensing principles and Interpretations- Sabins, F.F., (Ed) W.H. Freeman and Co., New York, 1986
3. Remote sensing and Image interpretation - Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

05	16CCT22	Group-3	CONSTRUCTION ECONOMICS AND FINANCE
Exam Hours:03		Exam Marks:100	
Module -1 Financial Management; Meaning and Scope, Economics and Scope, Supply and Demand Mechanism, analysis and forecasting. Balance sheet, profit & loss account, fund flow statement.			
Module -2 Production and Cost theory, analysis. Pricing; objectives, determinants, absorption, marginal costing. Financial analysis, Decisions. Capital Budgeting, budgetary control, standard costing and variance, investment appraisal. Practical problems and case studies			
Module -3 Engineering economics, Time value of money, discounted cash flow, NPV, ROR, Bases of comparison, Incremental analysis, Benefit-Cost analysis, Replacement analysis, Breakeven analysis, Capital budgeting, Taxation and Inflation, Working capital management, Construction accounting, Income statement, Financial statements.			
Module -4 Construction Finance: Accounting information and application, Financial versus economic evaluation, financial statements and project appraisal. Project yield, taxation and inflation, risk and uncertainty, Turnkey activities; finance and working capital, depreciation and amortization; cost control, performance budgeting, equipment rentals.			
Module -5 Bidding and awards, work pricing, cost elements of contracts, letters of credit, financing plans, multiple sources of finance. Qualifying, bidding, bidders, comparing the bids, under-writing. unforeseen revisions, costs and rates escalation, cost progress reporting. Legal aspects			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES: <ol style="list-style-type: none"> 1. Peterson, H.C., Lewis, W.C. "Managerial Economics", Prentice Hall of India Pvt. Ltd., 2001 2. Parkin, M. & Bade R., "Modern Macroeconomics" 4th Edition, Prentice Hall, 1996 3. Werther & Davis, "Human Resources & Personnel Management", McGraw Hill, 1996 4. Edwards, John et.al., 1983 "Manpower planning, John Wiley": New York 5. Anthony, R.N. Govindrajana, V., Irwin, "Management control systems", McGraw Hill 10th Edition, 2000 6. Baumel, W.J., A.S. Blinder and W.M. Scarth, "Economics: Principles and policy", Academic Press Canada, Toronto, 1985 7. Anthony & Reece, "Accounting Principles-AITBS", Sixth Edition, 1998 8. Koontz O'Donnel : "Essentials of Management"; Tata McGraw Hill, 1982 9. Monappa A. "Personnel Management", Tata McGraw Hill, 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

06	16CGT21/16CCS424	GROUP-3	SOIL DYNAMICS
Exam Hours:03		Exam Marks:100	
Module -1. Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, transmissibility , Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.			
Module -2 Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, transmissibility , Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.			
Module -3 Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elastodynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation			
Module -4 Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques			
Module -5 Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Soil Dynamics and Machine Foundation (2010), Swami Saran, Galgotia Publications Pvt. Ltd. 2. Soil Dynamics (1981)- Prakash, S. McGraw Hill Book Company 			
Reference Books: <ol style="list-style-type: none"> 1. Foundation for Machines (1998) Prakash, S. and Puri, V. K.: Analysis and Design, John Wiley & Sons, 2. Vibration Analysis and Foundation Dynamics (1998)-Kameswara Rao, N. S. V., Wheeler Publication Ltd., 3. Vibrations of Soils and Foundations (1970) Richart, F. E. Hall J. R and Woods R.D., Prentice Hall Inc., 4. Principles of Soil Dynamics (2002) Das, B. M., PWS KENT publishing Company, Boston. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

07	16CGT252	GROUP-3	SOIL STRUCTURE INTERACTION
Exam Hours:03		Exam Marks:100	
Module -1. Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior			
Module -2 Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions			
Module -3 Plates on Elastic Continuum: Thin and thick rafts, Analysis of finite plates, Numerical analysis of finite plates			
Module -4 Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap			
Module -5 Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Foundation analysis and design - J E Bowles, McGraw Hill, NY 2. Soil Mechanics in Engineering Practice – Karl Terzaghi and R B Peck (1967), John Wiley and Sons, NY 3. Analysis and Design of Foundations and Retaining Structures – S Prakash (1979), Sarita Prakashana, Meerut 			
Reference Books: <ol style="list-style-type: none"> 1. Soil Mechanics and Foundation Engineering – S K Garg, Khanna Publications 2. Geotechnical Engineering – C Venkataramaiah, New Age International Publishers 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

08	16CHT21/ 16CTE422	GROUP-3	PAVEMENT EVALUATION AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
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.			
Module -2 Structural and functional evaluation of pavements- 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.			
Module -3 Evaluation of new pavement materials- Model studies, pavement testing Under controlled conditions, accelerated testing and evaluation methods. Test track studies. Instrumentation for pavement testing. Introduction to pavement management: components & principals of pavement management systems, pavement maintenance measures, planning investment, research management			
Module -4 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.			
Module -5 Ranking and Optimization Methodologies: Recent developments, sample size selection, economic optimization of pavement maintenance and rehabilitation. Design alternatives and Selection: Design objectives and constraints, alternate pavement design strategies and Expert systems and Pavement Management			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
Reference Books:			
<ol style="list-style-type: none"> 1. 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. 2. E.J. Yoder & Witzczak M.W. "Principles of Pavement Design"- 2nd Edition – John Wiley and Sons Inc., New York, 1975. 3. Hass R., Hudson. W. R., Zaniewisti .J. "Modern Pavement Management" – Krieger Publishing Company, Florida, 1994. 4. Per Ulitz "Pavement Analysis" - Elsevier Amsterdam. 5. David and Paul Croney, "Design and performance of road pavements"- third edition, Mc Grawhill, 1998. 6. Ralph Hass, Ronald Hudson and Zanieswki, "Modern Pavement management"- Krieger Publications. 7. W. Ronald Hudson, Ralph Haas and Waheed Uddin, 'Infrastructure Management' - Mc Graw Hill 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

09	16CHT22	Group-3	TRAFFIC ENGINEERING
Exam Hours:03		Exam Marks:100	
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. Accident characteristics, causes, studies, investigations and analysis of individual accidents, statistical analysis, measures to improve road safety. Problems on above.			
Module -2 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			
Module -3 Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators.			
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.			
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			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Kadiyali L.R. “Traffic Engineering and Transportation Planning”-Khanna Publication, New Delhi 2. Salter RJ and Hounsell NB, “Highway, Traffic Analysis and Design”- Macmillan Press Ltd., London. 3. Matson T M, Smith W S , Hurd F W, “ Traffic Engineering, Mc graw Hill Book Co, NY , USA. 4. Drew D R ,” Traffic Flow Theory and Control”, McGraw Hill Book Co, NY, USA. 5. Wohl and Martin, “Traffic System Analysis of Engineers and Planners”-Mcgraw Hill Book Co, New York, USA. 6. Pignataro , “ Traffic Engineering”, John wiley & sons. Nicholas J Garber, Lester A Hoel, 7. “Traffic & Highway Engineering”- Third edition, Bill Stenquist. 8. IRC: SP:41-1994, IRC SP:31-1992, IRC 43-1994, Indian Roads Congress 9. MoRTH “Type Designs for Intersections on National Highways”-Indian Roads Congress 10. MORTH “Manual for Road Safety in Road Design”-Indian Roads Congress 11. 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 12. Khanna and Justo, “Highway Engineering”- Nem Chand and Bros., Roorkee 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CIM21/16CSE152/ 16CEM21/16CTE 153	Group-3	ADVANCED CONCRETE TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1. Basic Design Theory: Comparison of mix design by IS and ACI method, Design of HSC Using Erintroy Shaklok Method- Ultra High Strength Concrete. Ferro cement: Introduction, cracking moment and design of Ferro cement elements under tension, construction technique.			
Module -2 Self-compacting concrete: Introduction, Materials, Mix design of SCC, Fresh and Hardened Properties of SCC, Production and transportation, Formwork, Applications.			
Module -3 Geo-polymer concrete: Constituents of Geo-polymer Concrete, Mixing, Casting, and Compaction of Geo-polymer Concrete, Curing of Geo-polymer concrete, Design of geo-polymer, short and long term properties of Geo-polymer concrete.			
Module -4. Recycled concrete: Introduction, properties of recycled aggregate, Methods of recycling and quality, Applications. Pumped concrete: Introduction, Types of concrete pump, Requirements of a concrete for pumping, Effects of aggregates, cement and admixtures on the pumpability of concrete.			
Module -5 Properties of lightweight concrete: Introduction, Production and properties of No-fines concrete, Production and properties of Aerated and foamed concrete and Production and properties of Lightweight aggregate concrete. Waste Materials in Concrete: Introduction, waste material, waste glass, waste plastic and waste rubber.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 2. Advanced Concrete Technology –Process by John Newman and Ban Seng Choo, ISBN 0 7506 5105 9, Elsevier Ltd. 3. Concrete Construction Engineering Handbook by Dr. Edward G. Nawy, CPC Press, 2nd Edition, ISBN 978-0-84937492-0. 4. “Self-Compacted Concrete by-Applying what we know” By Joseph A. Daczko, CPC Press, ISBN-13:978-0-203-84422-9 References : <ol style="list-style-type: none"> 1. Shetty, M.S.’ Concrete Technology, M/S S. Chand & Co. Ltd. New Delhi. 2. Concrete Technology by Dr. Aminul Islam Laskar, University Science Press. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16CIM22/16CCT254	GROUP-3	CONSTRUCTION COSTING AND MATERIAL MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1. Management Accounting: Nature and scope of management accounting, cost accounting, financial accounting and its limitation, Break even analysis			
Module -2 Meaning of fund and fund flow analysis, advantages of fund flow statements, limitation and preparation of fund flow statement and cash flow statement			
Module -3 Material Management: importance, Integrated material Management, classification of Material, ABC analysis, standardization, purchase management, codification types and its uses			
Module -4. Price forecasting benefits and its methods: Average method, moving average method, weighted average method, exponential smoothening.			
Module -5 Inventory Management, Store Accounting: LIFO, FIFO, Average cost and market cost, relevant cost of inventory.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References <ol style="list-style-type: none"> 1. M. N. Arora: "Management accounting", Himalaya Publishing House. 2. Mueller, F.W. Integrated cost and schedule control for construction projects. 3. Gobourne: Cost control in the construction industry. 4. Schedule of rates, specification manuals etc. from PWD 5. Chris Hendrickson and Tung Au: Project Management for Construction15 6. Datta : Material Management Procedures, Text and Cases, 2e Prentice Hall 7. Gopalakrishnan ,P,Sundaresan , M: Material Management - an IntegratedApproach, Prentice Hall. 8. Dobbler and Bart: Purchasing and Supplies Management, Text and Cases, 6e 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	16CSE21/ 16CCT251	Group-3	ADVANCED DESIGN OF STEEL STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1. Laterally Unrestrained Beams:Lateral Buckling of Beams, Factors affecting lateral stability, IS800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion.			
Module -2 Beam- Columns in Frames:Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 - Examples			
Module -3 Steel Beams with Web Openings:Shape of the web openings, practical guide lines, and Forced distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)			
Module -4.Cold formed steel sections:Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions- numerical examples, beam design, column design.			
Module -5 Fire resistance:Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance ratings- Numerical Examples.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. N. Subramanian, “Design of Steel Structures”, Oxford, IBH			
2. Duggal.S.K., Design of Steel Structures . , Tata McGraw-Hill			
3. IS 1641, 1642, 1643			
4. IS 800: 2007, IS 811			
5. INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16CSE22/1616CCS22/ 16CCT253	Group-3	EARTHQUAKE RESISTANT STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1. Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devices, base isolation systems.			
Module -2 The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893.			
Module -3 Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – code provisions.			
Module -4. Design of Reinforced concrete buildings for earthquake resistance- Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS-1893. Structural behavior, design and ductile detailing of shear walls.			
Module -5 Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Dynamics of Structures – Theory and Application to Earthquake Engineering- 2nded. – Anil K. Chopra, Pearson Education. 2. Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (india) 3. Earthquake Resistant Design of Structures, Duggal, Oxford University Press 4. Earthquake resistant design of structures - Pankaj Agarwal, Manish Shrikande - PHI India 5. IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993 6. Design of Earthquake Resistant Buildings, Minoru Wakabayashi, McGraw Hill Pub. 7. Seismic Design of Reinforced Concrete and Masonry Buildings, T Paulay and M J N Priestley, John Wiley and Sons 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CSE251	Group-3	DESIGN OF TALL STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1. Design Criteria: Design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of liveload reduction, Impact, Gravity loading, Construction loads			
Module -2.Wind loading: static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modalanalysis, combinations of loading, working stress design, Limit state design, Plastic design.			
Module -3 Behavior of Various Structural Systems: Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Futigger – braced and hybrid megasystem.			
Module -4.Analysis and Design: Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three dimensional analyses.			
Module -5 Stability of Tall Buildings: Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis,simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Taranath B.S, “Structural Analysis and Design of Tall Buildings”- McGraw Hill 2. Wilf gang Schuller, “High rise building structures”- John Wiley 3. Bryan Stafford Smith &Alexcoull, “Tall building structures Analysis and Design”- John Wiley 4. T.Y Lin &D.Stotes Burry, “Structural concepts and system for Architects and Engineers”- John Wiley 5. Lynn S.Beedle, “Advances in Tall Buildings”- CBS Publishers and Distributors. 6. Dr. Y.P. Gupta – Editor, “Proceedings National Seminar on High Rise Structures- Design and Construction practices for middle level cities”- New Age International Limited 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

15	16CTE22/16CTM21/ 16CCT252	Group-3	PAVEMENT DESIGN AND ANALYSIS
Exam Hours:03		Exam Marks:100	
<p>Module -1. Introduction Factors Affecting Pavement Design, Variables Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types, Tire Pressure, Contact Pressure, EAL and ESWL Concept, Lane Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads</p>			
<p>Module -2.Stresses And Deflections In Flexible Pavements Stresses and deflections in homogenous masses. Burmister's two-layer theory, three layer and multilayer theories, Problems on above.</p>			
<p>Module -3 Flexible Pavement Design Methods Principle, design steps, advantages and applications of different pavement design methods – Group Index, CBR, McLeod, Kansas Triaxial test, IRC, AASHTO and Asphalt Institutemethods</p>			
<p>Module -4.Stresses In Rigid Pavements Factors affecting design and performance of pavements. Types of stresses and causes, factors influencing the stresses, general considerations in rigid pavement analysis, EWL, wheel load stresses, warping stresses, frictional stresses, combined stresses. Problems on above.</p>			
<p>Module -5.Rigid Pavement Design Types of joints in cement concrete pavements and their functions, joint spacing, design of CC pavement for roads and runways, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements. Problems on above</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>TEXT BOOKS 1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering`, Nem Chand and Bros, Roorkee. 2. Yoder, E.J., and Witzack, `Principles of Pavement Design`, 2 nd Edition, John Wiley and Sons</p> <p>REFERENCES 1. Yang, `Design of Functional Pavements`, McGraw Hill Book Co. 2. Yang. H. Huang, `Pavement Analysis and Design`, Prentice Hall Inc</p>			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

16	16CTE251/16CTM251	Group-3	ROAD SAFETY MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1. Road accidents, Causes, Scientific Investigations and Data Collection Analysis of Individual accidents to arrive at Real Causes, Statistical Methods of Analysis of Accident Data, Application of Computer Analysis of Accident Data.			
Module -2. Ensuring Traffic Safety in Designing New Roads Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section & Objects on the Right-of-Way.			
Module -3 Ensuring Traffic Safety in Road Reconstruction Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads, Examples of Reconstruction of Selected Road Sections for Improving Traffic Safety, Improving Traffic Conditions on Grades, Sharp Curves, Redesign of Intersections, Channelized At-Grade Intersections, Bus Stops, Parking & Rest Areas and Effectiveness of Minor Road Improvements.			
Module -4. Ensuring Traffic Safety in Road Operation Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.			
Module -5. Road Safety Audit and Traffic Management Techniques Principles- Procedures and Practice, Code of Good Practice and Checklists. Road safety issues and engineering, education, enforcement measures for improving road safety. Local area management, Various types of long term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. Babkov, V.F. 'Road conditions and Traffic Safety', MIR publications, Moscow - 1975. 2. K.W. Ogden, 'Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.			
REFERENCES 1. Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009. 2. Jotin Kishty and B. Kent Lall, 'Transportation Engineering-An Introduction', Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006 3. Latest Editions of Relevant Indian Roads Congress (IRC) Publications for Design of Roads and Road Safety.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

17	16CEM151	Group-3	ADVANCE FOUNDATION ENGINEERING
Exam Hours:03		Exam Marks:100	
<p>Module -1. Bearing Capacity & Settlement: Presumptive bearing capacity according to BIS, Factors affecting bearing capacity, Factors influencing selection of depth of foundation, types of shallow foundations, Settlement of Shallow Foundations: Immediate, consolidation, & differential settlements, Factors influencing settlement, Safe Bearing Capacity and Allowable Bearing Pressure.</p>			
<p>Module -2... Shallow Foundations: Principles of Design of foundation, Definition for Shallow and Deep foundation, Requirements for geotechnical and structural aspects of design, Proportioning of isolated footing, combined footing, Strap footing, Strip footing and Raft foundation.</p>			
<p>Module -3 Pile Foundations – Single Pile: Historical Development, Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests, Laterally Loaded Pile.</p> <p>Pile Foundations – Group Effect: Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, Under reamed piles.</p>			
<p>Module -4 . Well Foundations: Historical Development, Different shapes and characteristics of wells, Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies for tilts and shifts.</p> <p>Drilled Piers & Caissons: Construction, advantages and disadvantages of drilled piers. Design concepts and Advantages and disadvantages of open, pneumatic and floating caissons.</p>			
<p>Module -5:... Foundations On Expansive Soils: Definition, Identification, Mineral Structure, Index properties of expansive soils, Swell potential and Swell pressure, Free swell, Tests on expansive soils, foundation treatment for structures in expansive soil, CNS layer.</p> <p>Machine Foundations: Basic definitions in vibration, free and forced vibrations, determination of natural frequency, types of Machine foundations, general criteria for design of machine foundation., vibration analysis of a machine foundation, degrees of freedom of a block foundation, vibration isolation and control.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. <p>The students will have to answer 5 full questions, selecting one full question from each module.</p>			
<p>References:</p> <ol style="list-style-type: none"> 1. Soil Mechanics & Foundation Engineering – V.N.S. Murthy – Pub: Sai Tech. 2. Foundation Engineering – Braja M. Das – Cengage Learning. 3. Soil Mechanics Foundations – Dr. B.C. Punmia – Pub :Laxmi publications, pvt.Ltd. 4. Foundation Analysis and Design – Bowles J.E. (1996) – 5th Ed, McGraw Hill Pub. Co., New York. 5. Advanced Foundation Engineering – V.N.S. Murthy – Pub :Sai Tech. 6. Pile Foundation.-Chellies 7. Geotechnical Engineering.- P. Purushotham Raj 8. Geotechnical Engineering – Dr. C. Venkataramaiah – Pub : New age Publications. 9. Foundation Engineering – Dr. P.C. Varghese :- Pub : Prentice Hall of India. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16 CCS254/16CHT252/ 16CEM423	Group-4	DESIGN OF STRUCTURAL SYSTEMS FOR BRIDGES
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to bridge engineering Historical background of bridges and types. Bridge aesthetics and proportioning. Bridge geometry. Conceptual design of various structural forms. Foundations with or without piles; abutments, retaining walls and wing walls; columns and cap beams; bearings.			
Module -2 Loads on bridges (IRC6-2010) Class 70 R, Class AA, Class A, Class B, Tracked Vehicle, Wheeled Vehicle, Load Combinations, Impact, Wind, Water Currents, Longitudinal Forces: acceleration, braking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads. Load Combinations			
Module -3 Design of Elevated Bridges: Solid slab bridges, Simple Girder bridges, PSC Girder Bridges			
Module -4 Design of Underpass and Box culverts			
Module -5 FE Concepts: Discrete and Continuum models of Bridge Deck – Spin e, Grillage, Surface models, Bridge Piers, Support and Loading conditions, Soil- Structure Interaction			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Krishna Raju N “ Design of Bridges,” Oxford, IBH Publications New Delhi. 2. Johnson Victor, “ Essential of Bridge Engineering,” Oxford, IBH Publications, New Delhi 3. Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, 2008. I. Stridin, a. N. Tehw. LD. Se. I, h Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Co 4. IRC112 - 2011 Code of Practice for Concrete Road Bridges and Railway Board Codes 5. Jagadeesh. T.R. and Jayaram. M.A., “Design of Bridge Structures”, Prentice Hall of India, 2004. 6. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, New Delhi, 1991. 7. IITK-RDSO GUIDELINES ON SEISMIC DESIGN OF RAILWAY BRIDGES Provisions with Commentary and Explanatory Examples, 2010 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

02	16 CEE23/ 16CWM13	Group-4	ADVANCED WASTE WATER TREATMENT ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 Objectives of wastewater treatment: Characteristics, flowvariations, types of reactors and reactors analysis.Wastewater Treatment Flow Diagrams and Hydraulic Profile.Kinetics of biological treatment systems: Biokinetic constantsand their determination, batch and continuous systems.			
Module -2 Theoretical principles and design: screens, equalization basin,grit chamber, primary and secondary settling tanks			
Module -3 Theoretical principles and design:Suspended growth system -conventional activated sludge process and itsmodifications. Attached growth system – trickling filter, biotowersand rotating biological contactors. Principles and design ofstabilization ponds			
Module -4 Advanced Wastewater Treatment: Need and technologies used.Nitrification and Denitrification Processes,Phosphorous removal. Wastewater disinfection			
Module -5 Sludge Processing: Separation - sludge thickeners, volumereduction, conditioning and digestion – aerobic and anaerobic.Rural wastewater systems: Septic tanks, two-pit latrines, ecotoilet,soak pits			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Benefield R.D., and Randal C.W., , “Biological Process Design for Wastewater Treatment”,Prentice Hall, Englewood Chiffs, New Jersey. 2. Metcalf and Eddy Inc., , “Wastewater Engineering - Treatment and Reuse”, 4th Edition,TataMcGraw Hill Publishing Co. Ltd., New Delhi. 3. Karia G.L., and Christian R.A., “Wastewater Treatment Concepts and Design Approach”,Prentice Hall of India Pvt. Ltd., New Delhi. 4. Ronand L., and Droste, ,”Theory and Practice of Water and Wastewater Treatment”, John 5. Wiley and Sons Inc. 6. Fair G.M., Geyer J.G and Okun, “Water-wastewater Engineering”. 7. Lee C.C., and Lin S.D., “Handbook of Environmental Engineering Calculations”, McGrawHill, New York 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

03	16CGI252	Group-4	APPLICATIONS OF GEOINFORMATICS IN URBAN PLANNING AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
<p>Module -1 Large Scale Mapping and Cadastral Information System: Technologies for Large Scale Mapping (LSM) of urban areas – Aerial Photography - High- Resolution Satellite Remote Sensing – Electronic Distance Measurement (EDM) -Total Station - Differential Global Positioning System (DGPS) – Issues in Large Scale Mapping (LSM), Integrated approach to LSM, Concept of Cadastre, History of cadastral survey, Cadastral survey methods and survey maintenance, cadastral mapreproduction, development of cadastral information system.</p>			
<p>Module -2 Urban Mapping and Spatial Analysis: Urban process, the physical structure and composition of urban areas, Urbanisation process, growth trend, problems of urbanisation, information requirements for perspective planning, Scale and resolution concepts and interpretation techniques for urban and regional analysis, urban GIS, spatial analytical techniques, statistics and visualization, conceptual modelling of urban processes; Urban Sprawl: Change detection in Land Use Land Cover monitoring physical growth of urban area, trends in urban sprawl and associated problems. Urban Planning: Plans – planning needs, types of plans, urban and regional planning; LU/LC mapping Urban Planning: Zoning of Land Use, Zonal Land Use Plan, Object oriented GIS data modeling for urban design, landscape architecture, urban infrastructure, Site selection for urban development, site suitability analysis for utilities and civic amenities, interim master plan, Master Plan. AM/FM Applications: GIS/GPS applications in Automated mapping (AM) and Facility management (FM), Urban infrastructure planning and management</p>			
<p>Module -3 Demographic and Business Applications: Geo-Demographics- Population distribution maps by age, gender, education, occupation, socioeconomic grouping, health criteria index, crime rates and types. Business GIS - Market analysis, retail site selection, retail planning, health care planning, financial services planning, educational institutions planning, water demand modeling and planning distribution network, household analysis, real estate inventory, mapping and GIS. Crime Analysis, Electoral Redistricting. Network Applications: Transportation demand modeling and analysis, transportation planning, Vehicle Routing and Scheduling, Vehicle Tracking and Navigation: Integration of GPS and GIS data, intelligent transportation systems, streets network analysis; pavement management system (PMS) Water and sewage related- GIS based urban water demand analysis, pipeline planning and alignment</p>			
<p>Module -4 Urban Ecology Applications: Air quality indexing and mapping, monitoring atmospheric haze, smoke, toxic gas movement and prediction of vulnerable zones. Noise pollution zonation, Natural resources inventory and management- conservation of water bodies, vegetation, storm water system GIS; soil and groundwater conservation, site suitability for ground water recharging and rain water harvesting, urban area heat budgeting, Logistic management and spatial planning for solidwaste management. Urban Disaster and Emergencies Management: Mapping vulnerable zones with respect to earthquake, flood, fire, terrorist attacks, and finding optimum routes for ambulances, and emergency services, GIS modeling for Hazard risk and emergencies management</p>			
<p>Module -5 Cultural GIS: Mapping heritage buildings, monuments, places of worship, tourism spots, recreation facilities, sports facilities and serving on web GIS. Urban Governance: Governance of urban regions: mapping administrative boundaries, city base map generation, property enumeration and property GIS, tax revenue rationalization, egovernance, Metropolitan Spatial Data Infrastructure, metropolitan information management system, Urban GIS and Smart Cities.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> 1. “GIS and GPS based asset management for Road and Railway Transportation Systems “- GPS based vehicle tracking system. 2. www.gisdevelopment.net, www.esri.com www.aboutgis.com 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

04	16CGT23	Group-4	DESIGN OF DEEP FOUNDATIONS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Single Pile: Vertically loaded piles, Static capacity- α, β and λ Methods, Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Mini and Micro Piles.</p>			
<p>Module -2 Buckling of Fully and Partially Embedded Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups</p>			
<p>Module -3 Pile Raft foundation: design criteria Design of Sheet pile foundations: Analysis of anchored sheet piles and cantilever sheet piles Lateral supports in open cuts Numerical problems</p>			
<p>Module -4 Well Foundation: Design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts. Drilled Shaft: Construction procedures, Design Considerations, Load Carrying Capacity and settlement analysis</p>			
<p>Module -5 Special Topics of Foundation Engineering Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing, Preventive and Remedial measures. Foundations on Expansive Soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design & construction measures.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Analysis and design of Substructures (2009), Swami Saran, Oxford & IBH Publications Pvt. Ltd. 2. Foundation design in practices (2010)- Karna Moy Ghosh. PHI 3. Foundation engineering (2012)- J E Bowles, McGraw Hill 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Pile Foundation Analysis and Design H.G. Poulos, and E.H. Davis, John Wiley and Sons, New York. 2. Design of Foundation Systems (1992) N.P. Kurien: Principles & Practices, Narosa, New Delhi 3. Foundation Engineering Hand Book (1990), H. F. Winterkorn and H Y Fang Galgotia Booksource 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

05	16CGT253	GROUP-4	OFFSHORE GEOTECHNICAL ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 DESIGN OF OFFSHORE PLATFORMS: Introduction, fixed and floating platforms, case studies and general features, elements of hydrodynamics and wave theory, fluid structure interaction, steel concrete and hybrid Platforms Consolidation and shear strength characteristics of marine sediments			
Module -2 Design Criteria: Environmental loading, wind, wave and current loads after installation, stability during towing Foundations: Site investigations, piled foundation, foundations for gravity structures, pile-supported structures			
Module -3 Behaviour under dynamic loading, static and dynamic analysis of platforms and components			
Module -4 Dynamic response in deterministic and indetermistic environment, codes of practice, analysis of fixed platform and semisubmersible related topics			
Module -5 Anchor design, breakout resistance analysis and geotechnical aspects of offshore pipeline and cable design			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Offshore Geotechnical Engineering – Mark Radolph and Susan Gourvenec, CRC Press. 2. Construction of Marine and Offshore Structures – Ben C Gerwick, CRC Press. 3. Offshore Geotechnical Engineering – ETR Dean 			
Reference Books: <ol style="list-style-type: none"> 1. Frontiers in Offshore Geotechnics II – Susan Gourvenec and David White, CRC Press. 2. Frontiers in Offshore Geotechnics II – Vaughan Meyer, CRC Press 3. Geotechnical Aspects of Coastal and Offshore Structures: Proceedings of the Symposium, Bangkok – A S Balasubramaniam, CRC Press 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

06	16CHT23/ 16CTE24/ 16CTM24	Group-4	HIGHWAY PLANNING AND ECONOMIC ANALYSIS
Exam Hours:03		Exam Marks:100	
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,			
Module -2 20 year road development plan including 1st and 2nd 20 year plan in brief and 3 rd and 4th 20 year plan in detail, Land use planning, Land use development – models, problems on the above topics, Highway Planning in India			
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			
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.			
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.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 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. 3. Prasanna Chandra “Financial Management”-Tata McGraw, New Delhi. 4. Oods K.B, Berry, D.S. and Goetz W.H, “Highway Engineering”-McGraw Hill Book Co. 5. Hewes C.I. and Oglesby, C.H., “Highway Engineering”-Asia Publishing House. 6. Ian G. Heggie, “Transportation Engineering Economics”-McGraw Hill Book Co. 7. “Road User Cost Study in India”- Final Report, Central Road Research Institute, New Delhi, 1982. 8. Kadiyali, L.R., et al, “Value of Travel Time Savings” - Traffic Engineering, HRB 9. 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.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

07	16CIM254	GROUP-4	BUILDING SERVICES & MAINTENANCE
Exam Hours:03		Exam Marks:100	
Module -1 Standard fire, fire resistance, classification of buildings, means of escape, alarms, etc.,provisions of NBC. Engineering services in a building as a system, Lifts, escalators, cold andhot water systems, waste water systems and electrical systems			
Module -2 Building Maintenance: Preventive and protective maintenance, Scheduled and contingencymaintenance planning, M.I.S. for building maintenance. Maintenance standards. Economicmaintenance decisions.			
Module -3 Quality policy in construction industry: Consumer satisfaction, Ergonomics-Time ofCompletion-Statistical Tolerance-Taguchi's concept of quality.			
Module -4 Contract and construction programming-Inspectional procedures. Total QA/QC Program andcost implication.			
Module -5.Different aspects of quality - Appraisals - failure mode analysis, Stability methods and tools,activity, Environmental safety, Social and environmental factors			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw Hill,2000. 2. James, J.O Brian, Construction Inspection Handbook - Quality Assurance and QualityControl, Van Nostrand, New York,1989. 3. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, TataMcGraw Hill, 1982 			
Reference Books: <ol style="list-style-type: none"> 1. NBC," Relevant Parts: BIS New Delhi 2. Jain V K," Services in Building Complex and High Rise Buildings",Khanna Pub. 3. Pchelinstev V. A., Fire Resistance of Buildings 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

08	16CSE23/16CGT11	Group-4	FINITE ELEMENT METHOD OF ANALYSIS
Exam Hours:03		Exam Marks:100	
Module -1 Basic concepts of elasticity – Kinematic and Static variables for various types of structural problems – approximate method of structural analysis – Rayleigh– Ritz method – Finite difference method – Finite element method. Variation method and minimization of Energy approach of element formulation. Principles of finite element method – advantages & disadvantages – Finite element procedure. Finite elements used for one, two & three dimensional problems – Element aspect ratio – mesh refinement vs. higher order elements – Numbering of nodes to minimize band width.			
Module -2 Nodal displacement parameters – Convergence criterion – Compatibility requirements – Geometric invariance – Shape function – Polynomial form of displacement function. Generalized and Natural coordinates – Lagrangian interpolation function – shape functions for one, two & three dimensional elements.			
Module -3 Isoparametric elements, Internal nodes and higher order elements, Serendipity and Lagrangian family of Finite Elements, Sub-parametric and Superparametric elements, Condensation of internal nodes, Jacobian transformation Matrix. Development of strain-displacement matrix and stiffness matrix, consistent load vector, numerical integration.			
Module -4 Application of Finite Element Method for the analysis of one & two dimensional problems, Analysis of simple beams and plane trusses, Application to plane stress/ strain / axisymmetric problems using CST & Quadrilateral Elements			
Module -5. Application to Plates & Shells, Choice of displacement function (C0, C1 and C2 type), Techniques for Non – linear Analysis.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Krishnamoorthy C S, “Finite Element Analysis”- Tata McGraw Hill 2. Desai C and Abel J F, “Introduction to the Finite Element Method”- EastWest Press Pvt. Ltd., 1972 3. Bathe K J, “Finite Element Procedures in Engineering Analysis”- Prentice Hall 4. Rajasekaran. S, “Finite Element Analysis in Engineering Design”- Wheeler Publishing 5. Cook R D, Malkan D S & Plesta M.E, “Concepts and Application of Finite Element Analysis” - 3rd Edition, John Wiley and Sons Inc., 1989 6. Shames I H and Dym C J, “Energy and Finite Element Methods in Structural Mechanics”- McGraw Hill, New York, 1985 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

09	16CSE253/ 16CCS23	Group-4	STABILITY ANALYSIS OF STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Beam – column – Differential equation. Beamcolumn subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii) continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pinned – pinned, fixed – fixed, fixed – free and fixed – pinned column.			
Module -2 Buckling of frames and continuous beams. Elastic Energy method: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Column subjected to non – conservative follower and pulsating forces.			
Module -3 Stability analysis by finite element approach – deviation of shape function for a two noded Bernoulli – Euler beam element (lateral and translation of) – element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretised column with different boundary condition – calculation of critical loads for a discretised (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active DOF) – symmetrical single bay portal frame.			
Module -4 Lateral buckling of beams – differential equation – pure bending – cantilever beam with tip load – simply supported beam of I section subjected to central concentrated load. Pure Torsion of thin – walled bars of open cross section. Non – uniform Torsion of thin – walled bars of open cross section.			
Module -5. Expression for strain energy in plate bending with in plate forces (linear and non – linear). Buckling of simply supported rectangular plate – uniaxial load and biaxial load. Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Stephen P. Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw – Hill, New Delhi.			
2. Robert D Cook et.al, "Concepts and Applications of Finite Element Analysis"-3 rd Edition, John Wiley and Sons, New York.			
3. S. Rajashekar, "Computations and Structural Mechanics"-Prentice – Hall, India.			
4. Ray W Clough and J Penzien, "Dynamics of Structures" - 2nd Edition, McGrawHill, New Delhi			
5. H. Zeiglar, "Principles of Structural Stability"-Blaisdall Publications			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CSE254/ 16CCS21	Group-4	THEORY OF PLATES AND SHELLS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions (No derivation), Numerical examples.			
Module -2 Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.			
Module -3 Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids.			
Module -4 Axially symmetric bending of shells of revolution, Closed cylindrical shells, water tanks, spherical shells and Geckler's approximation. Bending theory of doubly curved shallow shells.			
Module -5. Design and detailing of folded plates with numerical examples Design and Detailing of simple shell problems – spherical domes, water tanks, barrel vaults and hyperbolic paraboloid roofs			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Timoshenko, S. and Woinowsky-Krieger, W., "Theory of Plates and Shells" 2 nd Edition, McGraw-Hill Co., New York, 1959			
2. Ramaswamy G.S. – "Design and Constructions of Concrete Shell Roofs" – CBS Publishers and Distributors – New Delhi – 1986.			
3. Ugural, A. C. "Stresses in Plates and Shells", 2nd edition, McGraw-Hill, 1999.			
4. R. Szilard, "Theory and analysis of plates - classical and numerical methods", Prentice Hall, 1994			
5. Chatterjee. B.K. – "Theory and Design of Concrete Shell", – Chapman & Hall, New York-third edition, 1988			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16WLM23	Group-4	ADVANCED IRRIGATION ENGINEERING
Exam Hours:03		Exam Marks:100	
<p>Module -1 General: Irrigation Development in India: Historical review modern trances-interdisciplinary approach. Agricultural Hydrology: Subsurface water, storage zones, Soil physics-mechanics offlow, Soil water, measurement, metric potential, models of soil water movement. Infiltration and groundwater recharge. Return flow analysis</p>			
<p>Module -2 Soil and Land Management in Agriculture: Soil Management in relation to water usesoilhorizons, classification and surveys-land capability farm development: size of farmunit, land development in relation to solid characteristics and irrigation practicesconservationvillage-land shopping and grading-equipment.</p>			
<p>Module -3 Crop requirements and irrigation scheduling : Major Indian crops times of sowingand harvesting –critical periods of growth moisture stress, nutritional disorders-rootingdepths-consumptive use of crop blanney-criddle, Thornthwait penman, Christiansenmethods-crop selection crop water requirements, duty period depth and frequency of application protective irrigation –irrigation schedules in relation to crop requirements andmaximum water-use efficiency scope of computerization-cropping patterns-soil water,fertilizer and plant interactions.</p>			
<p>Module -4 Water conveyance and application lined and unlined channels-seepage losses-watercontrol and diversion structure structures in field channels and drain: their design andlocation- underground pipe system application methods: border, check, basin, furrow andsprinkler irrigation, sub irrigation and drip irrigation –relative merits. Glances of water logging-design of surface and subsurface drains-saline and alkaline lands reclamationand management of Salt affected lands.</p>			
<p>Module -5.Economics of Irrigation: Objectives of resources development. Costs and benefits,Efficiency-objective-economic growth, income redistribution-net benefit-function andoptimality conditions. Optimization techniques and command area planning-systemtechnique, linear and dynamic programming methods.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Modi. P. N., Irrigation, Water Resources & Water Power Engineering- Standard Publishers, New Delhi 2. Linsley, R. K. and Frazinini, J. B.,-“Water Resources Engineering”2nd Ed. McGraw Hill, NY 3. Chaturvedi. M.C, “Water Resources Systems Planning and Management” Tata McGraw Hill. NY 4. James L.D and Lee R.R“Economics of Water Resources Systems Planning” McGraw Hill. NY 5. B. C. Punmia, Pande, Ashok kumar and Arunkumar Jain “Irrigation and water power engineering” Laxmi Publications (P) LTD. 6. Santhosh Kumar Garag “Irrigation Engineering” Khanna Publishers, Delhi 7. Mays, Handbook of Resources 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	16CTE154	Group-4	INTELLIGENT TRANSPORTATION SYSTEMS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction to Intelligent Transportation Systems (ITS) Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques –Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.</p>			
<p>Module -2 Telecommunications in ITS Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts</p>			
<p>Module -3 ITS functional areas, User Needs and Services – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.</p>			
<p>Module -4 ITS Operations Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning</p>			
<p>Module -5. ITS applications Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations ; public transportation applications; Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>TEXT BOOKS</p> <ol style="list-style-type: none"> 1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House. 2. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2000. <p>REFERENCES</p> <ol style="list-style-type: none"> 1. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005. 2. US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CD-ROM). 3. Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”, Prentice Hall 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16CEM23/ 16CCT421	Group-4	DISASTER MITIGATION AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
<p>Module -1 Environmental Hazards & Disasters- Environmental disasters and environmental stress. Types of environmental hazards & Disasters, Earthquake Hazards- Causes of earthquakes, distribution of earthquakes, effects of earthquakes, earthquake hazards in India, human adjustment, perception & mitigation of earthquake. Cyclones -- Tropical cyclones & local storms, destruction by cyclones, causes, distribution, human adjustment, perception & mitigation. Cumulative atmospheric hazards/ disasters- floods, droughts, cold waves, heat waves. Conventional earthquake resistant design, Seismic base isolation method, retrofitting, Training, demonstrations and exhibitions, Information management (Safety, emergencies, management and planning, design, response, user experience problems and case studies, Proper land use practices, long term disaster preparedness measures. Precautions after a major earthquake, Preparedness for medical supply Emergency care (First aid, Home remedies), Disposal of dead bodies (Human and Cattle), Care for old and orphans.</p>			
<p>Module -2 Physical hazards/ Disasters- Soil erosion and sedimentation-- mechanics & forms of soil erosion and sedimentation, factors & causes of soil erosion and sedimentation, conservation measures of soil erosion. Chemical hazards/ disasters- release of toxic chemicals, nuclear explosion.</p>			
<p>Module -3 Approaches in Disaster reduction / Management- Pre- disaster stage (preparedness) - Preparing hazard zonation maps, predictability/ forecasting & warning, preparing disaster preparedness plan, Land use zoning, preparedness through (IEC) Information, education & communication pre-disaster stage (mitigation), Disaster resistant house construction, population reduction in vulnerable areas, awareness Emergency Stage - Rescue training for search & operation, immediate relief, assessment surveys Post disaster stage- Rehabilitation, Political administrative aspect, social Aspects, economic, environmental aspects.</p>			
<p>Module -4 Disaster Management- An integrated approach for disaster preparedness, mitigation & awareness. Meteorological observatory, Seismological observatory, Hydrology Laboratory, Industrial Safety inspectorate, Institution of urban & regional planners, Chambers of Architects, Engineering Council, preparedness of various govt departments, Education on disasters, Community involvement Management cell, Central crisis management core group, damage reconnaissance, Management of relief and rehabilitation (Infrastructure rehabilitation, Housing rehabilitation, Social rehabilitation), Role of volunteers, Emergency operation centres, Information system, Danger zone restrictions, Cooperation with local authority, Coordination for international relief, Role of government, NGO's, Business and donors, Role of remote sensing in relief operations, Information management and related technologies in engineering and disaster management. The design and management of Disaster Information Resource Network, Asian Disaster Preparedness Centre, Regional data base, Contacts and Sources, CD – ROM Library for Natural Disaster Management, Regional Disaster Documentation Centre, Non Governmental Organizations.</p>			
<p>Module -5. India Specific Land Subsidence, Coastal Erosion, Cyclone, failure of hill slopes, Ecological planning for sustainability & sustainable development in India, sustainable rural development, Role of Panchayats in disaster mitigations Environmental policies & programmes - Institutions & National Centres for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>References:</p> <ol style="list-style-type: none"> 1 .R.B.Singh (Ed) Environmental Geography, Heritage Publishers New Delhi 2 Savinder Singh Environmental Geography, Prayag Pustak Bhawan 3 Kates, B.I. & White, G.F The Environment as Hazards, Oxford, New York 4 R.B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi 5 H.K. Gupta (Ed) Disaster Management, Universities Press, India 6 Dr. Satender, Disaster Management in Hills, Concept Publishing Co., New Delhi 7 A.S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi 8 R.K. Bhandani An overview on Natural & Manmade Disaster & their Reduction CSIR, New Delhi 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CEM253	Group-4	REUSE & RECYCLE TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Waste as a Resource- Resource Economics, Disposable Materials, Recovery, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse. Waste Analysis: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fineness Analysis, Energy Content.			
Module -2 System Design: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems.			
Module -3 Energy Recovery: Combustion, Energy Losses, Energy Recovery Analysis, Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel-cogeneration and tri generation concepts.			
Module -4 Water Reuse: Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Case studies of Water Reuse, Close Cycle and Open Cycle Reuse, Recreational Reuse. Reuse of Industrial Effluents: Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones, Uses of in Pisciculture, Groundwater Recharge using treated Domestic wastewater.			
Module -5. Metals Recovery: Ferrous Metals, Properties, Principles of Magnetic Field-ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous Metal Separation, Eddy-Current Separation – Theory and Types, Extraction of Material from a Bed. Reuse of construction waste, Demolished concrete, RAP material, Recycled aggregates. Health Aspects of Water Reuse: Guidelines for Evaluating Recreational Water Reuse, Resource Conservation and Recovery Act.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References: <ol style="list-style-type: none"> 1 Takashi Asano, Water Reuse: Issues, Technologies, and Applications, , McGraw-Hill Prof Med/Tech, 2007 2 Mackenzie Davis, and Susan Masten, "Principles of Environmental Engineering & Science", McGraw Hill , 2 nd edition, 2008. 3 Henry, J. G. and G. W. Heinke, "Environmental Science and Engineering", 2nd edition, Prentice Hall, Inc., Upper Saddle River, NJ, 1996. 4 Kiely, G, "Environmental Engineering", Irwin/McGraw-Hill Book Co., Singapore, 1999 5 Vogler, Jon, Work from Waste – Recycling Wastes to Create Employment, Intermediate Technology Publications, 1981 6 McHarry, Jan, Reuse Repair Recycle, Gaia Books Ltd. 1993. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

15	16CEM254/ 16WML251	Group-4	URBAN HYDROLOGY, STORM DRAINAGE AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Urban Hydrologic Process :Process of urbanization – Water in Urban ecosystem – Urban water subsystems – Urban hydrologic cycle.Impact of urbanization on urban runoff and stream flow quantity – Impact of urbanization on quality of runoff and stream flow – Erosion due to urban runoff.			
Module -2 StormwaterModeling:Analysis of hydrologic changes due to urbanization- Approaches tostudy – Data collection and analysis – Probabilistic and statistical approaches. Modelling of urban water quantity – Types of models – Rainfall, Runoff modeling ; urban watershed modeling(quantity) – Rational Method (or coefficient method), Runoff hydrograph, unit hydrographs – 10min synthetic unit hydrograph – Linear reservoir model (Viessman) – Chen and Shubinski model– QUURM Model – TVA model. Urban watershed modellingfor water quality of runoff andstream water quality.			
Module -3 Urban Drainage Systems :Sanitary and combined sewer systems – components – Designconsiderations for fixing sewer capacity – Infiltration into and exfiltration from sewers –causesInfiltration inflow analysis – Field investigations – Control measures. Design consideration of the components of the sewer systems – Performance of the sewer systemboth under dry weather flow condition and under storm water impact - Sewer sediment.			
Module -4 Storm Water Management: Urban storm runoff quantity and quality management – Mitigationof damaging effects of urban storm runoffStructural and non-structural control measures – Storm water management models.			
Module -5. Urban Drainage Systems Maintenance: Maintenance management of UDS and its subsystems– Drainage system – Storm drain conveyance system – Pump stations – Open channel – Illicitconnections and discharges – Spill response – Other considerations (limitations and regulations).			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References:			
1 Takashi Asano, Water Reuse: Issues, Technologies, and Applications, , McGraw-Hill Prof Med/Tech, 2007			
2 Mackenzie Davis, and Susan Masten, "Principles of Environmental Engineering &Science",McGraw Hill ,2 nd edition, 2008.			
3 Henry, J. G. and G. W. Heinke, “Environmental Science and Engineering”, 2nd edition, Prentice Hall, Inc., Upper Saddle River, NJ, 1996.			
4 Kiely, G, “Environmental Engineering”, Irwin/McGraw-Hill Book Co., Singapore, 1999			
5 Vogler, Jon, Work from Waste – Recycling Wastes to Create Employment, Intermediate Technology Publications, 1981			
6 McHarry, Jan, Reuse Repair Recycle, Gaia Books Ltd. 1993.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16 CEE24	Group-5	ENVIRONMENTAL GEO-TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Soil- Pollutant Interaction:Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction- Physicochemical behavior and modelling -failures of foundations due to pollutants			
Module -2 Characterization, Stabilization and Disposal Safe disposal of waste – site selection for land fills – characterization of land fill sites – waste characterization –stability of land fills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system– mechanism of stabilization - solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation detoxification — organic and inorganic stabilization			
Module -3 Transport of Contaminants:Contaminant transport in sub surface – advection – diffusion –dispersion – governing equations – contaminant transformation –sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers.			
Module -4 Detection and Testing Methods Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes			
Module -5 Remediation of Contaminated Soils:Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation –solidification, bio – remediation, incineration, soil washing, electrokinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well application of geo synthetics in solid waste management – rigid or flexible liners.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.			
2. Daniel, B.E., Geotechnical practice for waste disposal, Chapman and Hall, London, 1993.			
3. Fang, H.Y. Introduction to environmental Geotechnology, CRC press New York, 1997.			
4. Lagrega, M.d., Bukingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

02	16 CEE422	Group-5	TOXICOLOGY & ENVIRONMENTAL RISK ASSESSMENT
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to toxicology:Significance, Applications, & Importance			
Module -2 Introduction to risk assessment:Assessment methods, Human exposure assessment,characterization of health risks. LD50 & LC50 concentrations			
Module -3 Toxicology:Exposure, toxic effects, dose response relationships,carcinogens and non-carcinogens.			
Module -4 Toxicology & Epidemiology:Public health & Risk assessment, Epidemiology & its importance			
Module -5 Hazard identification, exposure and toxicity assessment, Riskcharacterization, risk communication, Ecological risk assessment – Monte Carlo methods, case studies.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. LaGrega M.D., Buckingham P.L. and Evans J.C., “Hazardous WasteManagement”- McGraw Hill, New York			
2. David G.M, and Haner N.B., “An Applied Approach to Epidemiology andToxicology for Engineers” – Instructor’s Resource Guide, US Department ofHealth Education and Welfare.			
3. World Health Organization Report,” Recommended Health Based Limits inOccupational Exposure to Heavy Metals”			
4. Kamrin S. E., “A text book on Primer on Toxicology Principles & Applications”Lewis Publishers.			
5. Kalos M.H., and Whitloc P.A, Monte Carlo Methods, Vol. 1, Basics, WileyPublications.			
6. Fan A.M & Chang L.W, , ”Toxilogy& Risk Assessment- Principles, Methods &Applications”, Informa Health Care pubs.			
7. Price F.T, Nancy Lane, Briq K.V, , “Environmental Toxiology& Risks Assessment– Recent Advancement in Environmental Fate & Transport “, ASTM International			
8. Landis W.G., Ming-Ho Yu, “Introduction to Environmental Toxicology – Impactsof Chemicals upon Ecological Systems”, CRC Press			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

03	16CGI24	Group-5	WEB APPLICATIONS IN GEOINFORMATICS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction to Web GIS: Definition, concept of Web GIS, History of web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Fundamentals of computer networking – network environment – network communication models – protocols – TCP/IP. Applications of web GIS, users and stakeholders of web GIS, advantages and limitations of web GIS, overview of Web GIS.</p> <p>Client/server Computing: Client – server – glue – client/server system partition – layered architecture – advantages and disadvantages of client/server architecture. Distributed component framework – web mapping – static and interactive web mapping – open GIS web map server.</p>			
<p>Module -2 Distributed geographic information services: Principle – components – logic and data components. Geographic Markup Language: Principles – characteristics – commercial web mapping programs - mobile GIS. Distributed GIS in data warehousing and data sharing.</p>			
<p>Module -3 Functions of Web GIS: Display of general information for the public, display of planning information, interactive display of spatial information sharing and distribution of spatial data as well as management of spatial data. Design of User Graphic Interface User friendly interface, characteristics, menus and icons, common terms. Graphic Appearance – colours, sizes, fonts, scales and arrangement.</p>			
<p>Module -4 Web GIS Software. Brands of software used to develop web GIS at the server and client sides. Evaluation of different brands, ArcIMS, MapObjects, Mapguide, Map Server, Geomedia web map, Fulcrum, Vectoreyes. Web GIS Data. Classification of WEB GIS data, Geospatial data, type, characteristics, distribution, GIS interactive maps, - general maps at regional level, very detailed maps down to lot level. Level of Service (LOS) Level of Contents (LOC) Level of GIS Functions or Level of Functions (LOF). A Cross Tabular Matrix (CTM) approach. Stake-holders, users, owners and organizations of web GIS, policies and laws pertaining to web GIS, Watermarking Geo-Spatial Data.</p>			
<p>Module -5 Applications of WEB GIS: Participatory GIS -Web-based GIS For Collaborative Planning And Public Participation, Digital Democracy for planning, web GIS An Aid To Local Environmental Decision-making, web GIS for regional and local level planning. Community GIS, Internet GIS Applications in intelligent transportation systems, planning and resource management. E-Governance, Bhoomi project, Bangalore-1, Electronic Government Proposals.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> 1. Zhong- Ren Peng, Ming-Hsiang Tsou, (2003) Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks, Wiley. 2. Korte, G. B., (2001) "The GIS book": 5th Edition, Onward press, Australia. 3. Cartwright, W., M.P. Peterson, G. Gartner (Eds) "Multimedia Cartography", Berlin: Springer. 4. Kraak, M., and A. Brown (2001) "Web Cartography: Development and Prospects, London": Taylor and Francis. 5. Kraak, M. and F. Ormeling (2003) "Cartography: Visualization of Geospatial Data", Delhi: Pearson Education. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

04	16CGI421	Group-5	APPLICATIONS OF GEOINFORMATICS IN DISASTER MANAGEMENT
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction: Definition, classification of disasters, types of Disaster, importance of RS and GIS in Disaster Management- Reconnaissance, forecast, forewarning systems, Disaster preparedness with respect to different disasters. SDI to facilitate Disaster Management. GIS based DSS for disaster management. Satellite surveillance for disaster mitigation.</p>			
<p>Module -2 Drought: Drought types, causes, mitigation measures, delineation of drought vulnerable areas using RS and GIS; Drought Information System; Drought monitoring; GIS based drought analysis; Desertification factors, Assessment of drought impact using RS and GIS. Monitoring vegetative biomass, Drought management- prediction, preparedness, monitoring of drought., . El-Nino damage assessment using RS and GIS.</p> <p>Earthquakes and Tsunami: Causes of earthquake, prediction of earthquake, Geomatics in earthquake mitigation, seismic damage evaluation and loss estimation, RS and GIS application for post-quake rehabilitation, GIS database for previous earthquakes, space technology and earthquake prediction, geospatial information system for earthquake disaster management, Tsunami- types, causes, RS and GIS applications for post Tsunami damage assessment and rehabilitation</p> <p>Forest Fire: Forest fire causes, forest fire management using geospatial information system, forest fire risk zonation mapping, forest fire monitoring, forest fire, forecasting system using internet GIS and Satellite Remote Sensing, delineation of coal fire risk zonation.</p>			
<p>Module -3 Cyclones and Floods: Floods types- flash and riverine floods, snowmelt floods, ice jams, and mud flows; causes and mitigation measures, flooding potential zonation mapping, flood hazard assessment, flood risk analysis using RS and GIS, tropical cyclone monitoring using INSAT, ERS-1, NOAA, and DMSP satellites, RS and GIS in Hurricane mapping and mitigation, flood disaster monitoring and reporting system, terrain modeling for flood plain zoning, digital surface modeling and flood hazard simulation, ice cover monitoring and its role in flooding. Flood damage impact minimization, damage assessment in hurricane / tornado affected areas. Cyclone tracking, Cyclone warning, cyclone management.</p>			
<p>Module -4 Landslide: Landslides, causes, types, and mitigation measures, landslide zonation, land slide susceptibility mapping, land slide monitoring, landslide analysis in GIS, geospatial technology for landslide management, sand drift in Indian desert, topographic and morphometric features affecting in landslide.</p> <p>Soil Erosion: Types, causes, and mitigation measures, application of RS and GIS for soil erosion and sediment estimation, RS and GIS application for desertification studies, desertification studies, estimation of soil erosion, soil erosion mapping universal soil loss equation and GIS, land degradation studies, sodic soil mapping</p>			
<p>Module -5 Volcano: Volcanoes, types causes of volcanoes, hazards of volcanoes, remote sensing of geothermal field, mapping lava flows, ash falls and lahars, mapping damage, volcano hazard management.</p> <p>Disaster Management in Human Settlements: Mapping disaster vulnerable zones, fire hazards, flood and storm water inundations, earthquake impact assessment</p> <p>Recent Trends: The role of Mobile GIS and SDI as an integrated framework in Emergency Management</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> 1. Amdahl G (2002) Disaster Response: GIS for Public Safety, Published by ESRI, Redlands California. 2. http://www.esri.com/news/arcnews/winter0102/articles/gishomeland.html - visited on October 2002. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

05	16CGI422	Group-5	EMERGING TRENDS IN GEOINFORMATICS
Exam Hours:03		Exam Marks:100	
<p>Module -1 Global and Indian Scenario of Geo-informatics - Current status and Recent Advances in the field of RS, GIS, Photogrammetry, GPS, products and process, software and hardware.</p> <p>Global and Indian R&D Organizations: Global Institutions- NASA, ESRI, ERDAS, Canadian Institute of Remote Sensing, International Institute of Photogrammetry and Remote Sensing, Google, India- ISRO and its subunits, NRSA, SAC, Antrix, IIRS, RRSSCs; State Remote Sensing Centres; Funding Sources for R&D projects; Global and National Spatial Data Centres, Satellite data sources and procurement procedures.</p>			
<p>Module -2 World and Indian Space Programmes: Satellites and sensors and their products and applications; Geoinformatics usage by Government and Private Sectors - User Departments of Central Govt. and State Govt. and their major projects: Central - SOI, MOEF, MOUD, MOD, few Case studies.</p> <p>Global and Indian Geoinformatics Market: Present trends and future prospects and problems, GIS BPO in private sector in India, GIS companies in India.</p>			
<p>Module -3 Global and National Major Initiatives in RS and GIS: Digital Earth, GSDI, 3D Cities, NSDI</p>			
<p>Module -4 Education and Training facilities in Geoinformatics: Global Geoinformatics Courses, scholarships; Web Resources for e-learning; eBooks; open sources of free softwares; International Journals, Review magazines, News Letters, e-journals.</p>			
<p>Module -5 Laws and Policy Perspectives and International Co-operations: Laws and policy matters at international and national level with respect to Space, Sea, photogrammetry, data sharing and data security, interoperability; Global and national Geoinformatics survey reports, case-studies, show cases of best practices.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
<p>REFERENCE BOOKS:</p> <p>1. "GIS Development".net, ESRI web site, NCGIA, UCGIA, GoogleEarth, Yahoo Maps, NASA web site, ISRO website.</p>			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

06	16CCT24	Group-5	CONSTRUCTION CONTRACTS AND SPECIFICATIONS
Exam Hours:03		Exam Marks:100	
Module -1 Agreement, Contract, essential conditions, Indian Contract Act 1872, types of contract, terminology of contract. Construction Specifications: standard specifications, general specification, development, interpretation.			
Module -2 Tender and tender documents: types of bidding, tender notice, tendering procedure. Construction claims: extra item, excess quantity, deficit quantity, price escalation.			
Module -3 Dispute resolution mechanism: litigation, arbitration, conciliation, mediation, dispute resolution board. Contractual Problems: possible contractual problems, creation of claims, development of disputes. Contract document: drafting of clauses, development, and interpretation, CPWD conditions of contract, FIDIC conditions of contract			
Module -4 BOT contract: types of contract, PPP framework, types of risk, concession agreement, drafting of clauses, development, and interpretation.			
Module -5 Laws affecting Engineers: Labour Law, Sales Tax, VAT, Service Tax, Excise Duty. Relational Contract: partnering, alliancing, key elements, processes.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES:			
<ol style="list-style-type: none"> 1. Collier, Kieth, "Managing Construction Contracts" 2. S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India January 2008. 3. C. J. Schexnayder and R. E. Mayo, Construction Management Fundamentals, McGraw Hill, New Delhi. 2003 4. General Conditions of Contract, Central Public Works Department, New Delhi, 2010 5. D.S. Berrie and B.c. Paulson, Professional construction management including C.M., Design construct and general contracting, McGraw Hill International, Third Edition 1992.. 6. V. K. Raina, Construction & Contract Management Practices, SPD, New Delhi 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

07	16CGT24/ 16CCS154	GROUP-5	EARTH AND EARTH RETAINING STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Geostatic Stresses: Total, neutral and effective stress inhomogeneous soils, stress diagrams, stresses effected by Capillarywater and direction of flow of water. Numerical problems			
Shear Strength of Soils: Introduction, concept of stresses,Principal stresses, principal planes, Mohr's construction, location of pole, basic concept of shearing resistance, Coulomb's theory, Mohr-Coulomb's theory. Numerical problems			
Module -2 Determination of Shear strength parameters, stress controlled and strain controlled tests, classification of shear tests based on drainage conditions, stress-strain relationship of clays and sands, concept of critical void ratio, determination and uses of Skempton's pore pressure coefficients A and B experimentally. Numerical problems			
Module -3 Earth Pressure: Introduction, active and passive earth pressures, earth pressure at rest, Rankine's theory for determination of active and passive earth pressure, coefficient of earth pressure at rest, earth pressure distribution, total earth pressure and its point of application, determination of tension cracks and critical height for unsupported excavation, effect of water table on earth pressure, Coulomb's theory of active and passive earth pressure, Culmann's and Rebhann's graphical methods for determination of active and passive earth pressures, earth pressure calculations for line load and/or uniform strip load acting on the ground surface			
Module -4 Stability of Slopes: Introduction, Factor of Safety, slope failure, toe and base failure of finite slopes, analysis of stability by method of slices, Taylor's stability number, effect of water table on slopes, tension cracks			
Module -5. Seepage Analysis: Laplace's equation for two dimensional flow of water through soils, flownets, properties and uses of flownets, phreatic line, graphical and analytical procedures for determination of quantity of seepage, prevailing hydraulic head and exit gradient in homogeneous earth dam, uplift pressure, sketching of flownets for typical hydraulic structures – weirs, dams, sheet pile walls			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. Foundation analysis and design - J E Bowles, McGraw Hill, NY			
2. Soil Mechanics in Engineering Practice – Karl Terzaghi and R B Peck (1967), John Wiley and Sons, NY			
3. Analysis and Design of Foundations and Retaining Structures – S Prakash (1979), Sarita Prakashana, Meerut			
Reference Books:			
1. Soil Mechanics and Foundation Engineering – S K Garg, Khanna Publications			
2. Geotechnical Engineering – C Venkataramaiah, New Age International Publishers			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

08	16CGT422	GROUP-5	REINFORCED SOIL STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Historical background: Introduction to reinforced soil structures, comparison with reinforced cement concrete structures. Reinforced Earth: Principles, concepts and Mechanisms of reinforced earth			
Module -2 Materials used, properties, laboratory testing and constructional details, metallic strips, metallic grids, geotextiles, geogrids, geomembranes and geocomposites, their functions and design principles			
Module -3 Geotextiles: Introduction, design methods, function and mechanism, geotextile properties and test methods – physical, mechanical and hydraulic properties, construction methods and techniques using geotextiles			
Module -4 Design applications of reinforced soil structures in pavements, embankments, slopes, retaining walls and foundations, reinforced soil structures for soil erosion control problems, geosynthetic clay liners			
Module -5. Case studies of reinforced soil structures, discussion on current literature and design problems			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Designing with Geosynthetics – Koerner R H (1994), Prentice Hall Inc. 2. Reinforcements and Soil Structures – Jones, CJEP (1996), Butterworth Publications 3. Membranes in ground engineering – Rankilior, P R (1985), John Wiley & Sons. 			
Reference Books: <ol style="list-style-type: none"> 1. Soil Reinforcement with Geotextiles – Jewel R A (1996), CIRIA 2. Geotextiles hand book – Ingold J S and Miller K S (1988), Thomas Telford Ltd. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

09	16CHT24	Group-5	ROAD CONSTRUCTION PLANNING AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
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 upgradation of existing roads. Planning of Road Projects – project management framework, scope, project objectives, project environment, causes of project failure, project development process			
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			
Module -3 Construction equipment and choice-type, capacity and number, task considerations, cost considerations, engineering considerations, equipment acquisition options, optimum location of crushing and mixing plants, problems.			
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.			
Module -5. Planning Control System – resource production, project cost, project time, codification and project management, information system, use of software			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 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 3. Peurifoy / Schexnayder “Construction Planning, Equipment and Methods”- Tata McGraw Hill Publications 4. IRC “A Manual for the Application of Critical Path Method to Highway Projects in India” 5. Nhai.org, pmsgy.nic.in websites 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CIM24/16CCT23	GROUP-5	PRE-ENGINEERED STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Types of RC Prefabricated Structures: Long wall and cross wall large panel buildings- One way and two way prefabricated slabs - Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells - Crane – Gantry systems.			
Module -2 Functional Design Principles: Modular coordination – Standardization - Disuniting, Diversity of prefabricates – Production – Transportation – Erection - Stages of loading and codal provisions-Safety factors - Material properties - Deflection control - Lateral load resistance - Location and types of shear walls.			
Module -3 Floors, Stairs and Roofs: Types of floor slabs – Methods of Analysis and design example of cored and panel types and two-way systems - Staircase slab design - Types of roof slabs and insulation requirements - Description of joints, behavior and requirements - Deflection control for short term and long term loads - Ultimate strength calculations in shear and flexure.			
Module -4 Walls: Types of wall panels - Blocks of large panels – Curtain partition and load bearing walls Load transfer from floor to wall panels – Vertical loads Eccentricity and stability of wall panels –Use of Design curves -Types of wall joints, their behavior and design – Leak prevention, Joint sealants, sandwich wall panels.			
Module -5. Industrial Buildings: Components of single storey industrial sheds with crane gantry systems -Design aspects of R.C. Roof Trusses - Roof panels R.C. Crane - Gantry Girders - Corbels and columns and Wind bracing.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References:			
<ol style="list-style-type: none"> 1. Marashev, V.I.Sigalov, E.Y.Baikov, U.N., “Design of RC Structures”, Mir Publishers, Moscow. 2. “SERC, Design & Construction of Prefabricated Residential & Industrial Buildings”, Organized by SERC, Chennai. 3. B.Leweicki, “Building with Large Prefabrication”, Elsevier Publishing Co. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16CSE24/16CCT21	GROUP-5	DESIGN CONCEPTS OF SUBSTRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts.			
Module -2 Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C- Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.			
Module -3 Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft –super structure interaction effects & general concepts of structural design, Basement slabs			
Module -4 Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.			
Module -5. Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations – general concepts.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Swami Saran – “Analysis & Design of Substructures”- Oxford & IBH Pub.Co. Pvt. Ltd., 1998.			
2. Nainan P Kurian – “Design of Foundation Systems”- Narosa Publishing House, 1992.			
3. R.B. Peck, W.E. Hanson & T.H. Thornburn – “Foundation Engineering”- Wiley Eastern Ltd., Second Edition, 1984.			
4. J.E. Bowles – “Foundation Analysis and Design”- McGraw-Hill Int. Editions, Fifth Ed., 1996.			
5. W.C. Teng – “Foundation Design”- Prentice Hall of India Pvt. Ltd., 1983.			
6. Bureau of Indian Standards: IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS-2950, IS-11089, IS-11233, IS-2911 and all other relevant codes			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	16CSE421/16CGT421/ 16CTE254/16CCS11	Group-5	OPTIMIZATION TECHNIQUES
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multiplier techniques and feasibility techniques.			
Module -2 Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simplex methods, duality in linear programming.			
Module -3 Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods			
Module -4 Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different techniques			
Module -5. Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. Dynamic programming: Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: 1. Spunt, "Optimum Structural Design"- Prentice Hall 2. S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd. 3. Uri Krisch, "Optimum Structural Design"- McGraw Hill 4. Richard Bronson, "Operation Research"- Schaum's Outline Series 5. Bhavikatti S.S.- "Structural optimization using sequential linear programming"- Vikas publishing house			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16CSE422	GROUP-5	DESIGN OF INDUSTRIAL STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Analysis of industrial building for Gravity and Windload. Analysis and design of framing components namely, girders, trusses, gable frames			
Module -2 Analysis and design of gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections.			
Module -3 Analysis of transmission line towers for wind load and design of towers including all connections.			
Module -4 Forms of light gauge sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements of cold formed light gauge sections. Concept of local buckling of thin elements. Limiting width to thickness ratio. Postbuckling strength.			
Module -5. Concept of Pre-engineered buildings, Design of compression and tension members of cold formed light gauge sections, Design of flexural members (Laterally restrained / laterally unrestrained).			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Bureau of Indian Standards, IS800-2007, IS875-1987, IS-801-1975. Steel Tables, SP 6 (1) – 1984			
2. N Subramanian- “Design of Steel Structure” oxford University Press			
3. B.C. Punmia, A.K. Jain “Design of Steel Structures”, Laxmi Publications, New Delhi.			
4. Ramchandra and Virendra Gehlot “ Design of Steel Structures “ Vol 1 and Vol.2, Scientific Publishers, Jodhpur			
5. Duggal “Limit State Design of Steel Structures” TMH			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CEM421/16CWM253/ 16CEE22/16WLM41/ 16CWM151	GROUP-5	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Introduction – Environment and its interaction with human activities. Environmental imbalances, basic concepts of E.I.A., Element of E.I.A. Environmental attributes, Indicators – Screening and Scoping Environmental Impact Statement (E.I.S).			
Module -2 Environmental Setting – Environmental Inventory, environmental indicators – Parameters, Indicators for terrestrial subsystems, Indicators for aquatic subsystems, socio-economic indicators, indicators for health and nutrition.			
Module -3 Environmental Impact Assessment methodologies – Important consideration for choosing a methodology ; categorization of methodologies. Review criteria, Environmental Management Plan(EMP). Step by step procedure for preparing on E.I.A. Prediction and Assessment of Impacts on the Air Environment, on the surface water environment, on vegetation & wild life.			
Module -4 Public participation in Environmental Decision making, practical consideration in preparing EIA and Statements, salient features of project activity. Prediction and Assessment of impacts on soil and ground water environment; On the biological environment, on the socio –economic environment. Prediction and Assessment of impacts on the cultural environment. Decision methods for evaluation of alternatives, public participation.			
Module -5. Environmental Audit – Environmental legislation, objectives Environmental Audit, types, audit protocol, evaluation of audit data and preparation of audit report. Preparation of Impact Assessment for some industries and case studies – standard and mandatory requirements.EIA for various civil engineering projects.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References: <ol style="list-style-type: none"> 1. Canter L.W. Mc. Graw Hill Publication Publication Co., 1st Edition 1996 2. Jain, R.K. , Urban, L.V. Stray, G.S. “Environmental Impact Analysis” Van Nastrand Reinhold Company, 2nd Edition, 2004 3. Anjaneyulu, VallManickam., Environmental Impact Assessment Methodologies, B.S.Publications, 1st Edition, 2000 4. Ran J.G. & Wooten, D.C., Environmental Impact Assessment” McGraw Hill Publication Company, 2nd Edition, 1999 5. Methodologies, Guidelines for the integrated Environmental evaluation of water Resources Development, UNESCO/UNEP, Paris, 1990. 6. Betty Bowers Mariott, “A Practical Guide on Environment Impact Assessment” 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

15	16CEM422	GROUP-5	STEEL AND COMPOSITE CONSTRUCTION TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Materials, classification and properties Structural steel sections and data Behavior of steel structures: Steel water tanks, Chimneys and Stacks, Bridge Structures, Building Frames, Steel Space grids.			
Module -2 Structural Steel Detailing: Symbols, layout drawings, shop detail drawings, assembly marking. Structural steel fabrication: Methods - tools, equipment and practices, Punching, Reaming and drilling, cutting Operations, fittings, fasteners, bolting, riveting and welding, Assembly, inspection, cleaning, sand blasting and painting: Transportation of fabricated components, Storage and handling.			
Module -3 Erection of steel structures : Erection equipment, erection tools, methods of erection, section sequence field connections, detailing to facilitate erection. Specifications, Estimating and costing steel work. Fire protection of steel construction Maintenance and repair of steel structures			
Module -4 Composite Constructions Introduction to composite construction, basic concepts, types of composite, Constructions Steel concrete composite, Analysis and of composite beams Composite floors.			
Module -5. Shear connectors: functions & types Steel concrete composite columns, columns subjected to axial loads and moments. Encased composite construction of beams and columns, concepts and design.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
References: <ol style="list-style-type: none"> 1. Ramachandra, 'Design of steel structures', Standard Book House, New Delhi 2. Bryan E.R., 'The stressed skin design of steel buildings' 3. Malhotra M.M. 'Design of Steel Structures' 4. Bresker Boro, 'Design of steel Structures' 5. Dayaratnam, 'Design of Steel Structures'. 6. IS:11384, IRC-22 7. Composite Structures, G M Sabnis 8. "Composite Construction, Design for Buildings", Viest et al., 1997, ASCE/McGraw-Hill, Inc. 9. "Handbook of Structural Steel Connection Design and Details" Edited by Akbar Tamboli, McGraw Hill 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

16	16WLM24/16WLM422	GROUP-5	GROUND WATER HYDROLOGY
Exam Hours:03		Exam Marks:100	
Module -1 General Water Balance, Regional Ground Water Balance, Distribution of Subsurface Water, Different Types of Aquifers, Heterogeneity and Anisotropy, Occurrence of Ground Water in Hydro Geological Formations, Structure and Types of Wells. –Problems on estimation of basic parameters.			
Module -2 Governing Equation of Groundwater Flow in Aquifers. Derivation of General Differential Equations for Ground Water Flow, Regional Ground Water Problems, Governing Equations for Transient Flow Conditions.			
Module -3 Models for Ground Water Analysis: Introduction, Major Applications of Ground water Models, Numerical Modelling of Groundwater Systems, Groundwater Modelling by the Finite Difference (FD). –Problems. Pollution of Groundwater: Hydrodynamic Dispersion of Pollutants in Groundwater Environment (Advection dispersion, Molecular diffusion)Optimization models for management of groundwater quantity and quality.			
Module -4 Well Hydraulics: Analysis of Steady Radial Flow Towards a Well in a confined Aquifer, Dupuit Forcheimmer (DF) Theory of free Surface Flow For Steady Flow in Unconfined Aquifers, Analysis of Steady Radial Flow in Laterally Stratified Phreatic Aquifers. Problems on well Hydraulics			
Module -5. Artificial Recharge: Spreading methods, Induced-recharge method, Recharge-well method, Subsurface dams, Wastewater discharge, Recharge by urban storm runoff, Case history. Geophysical Methods in Groundwater Exploration, Introduction, Electrical Resistivity Method, Analytical Derivation for Resistivity in Vertical Electrical Sounding, Seismic Retraction Method, Determination of Aquifer Thickness, Geologic and Hydrologic methods, Hydrogeologic well logging, Tracer techniques.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. A. K. Rastogi., Numerical Groundwater Hydrology, Penram International Publishing (India)Pvt.Ltd.2007. 2. Todd D.K. & Mays, L.W., “Ground Water Hydrology”, 3 Ed, Wiley. 3. Raghunath H.M., “Ground Water”, New Age Publishers, 2007. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

01	16CEE41/ 16CWM24/ 16WLM423/16CWM252	Group-6	INDUSTRIAL WASTEWATER TREATMENT
Exam Hours:03		Exam Marks:100	
Module -1 Effects of Industrial Wastes on sewerage system and sewage treatment plants and receiving water bodies. Effects of waste additions on physical and chemical properties of soil. Effluent standards and receiving water quality standards. Different aspects and choices of various disposal alternatives			
Module -2 Industrial Waste survey-Process flow charts, condition of wastestream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Biomonitoring			
Module -3 Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids. Wastewater Treatment in specific industries: Distillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical			
Module -4 Design of complete treatment system & disposal for industries: Distillery, Dairy, Textile, paper and pulp mill to meet P.C.B. norms. Radio Active Wastes treatment- Low activity and high activity radiation, application of radio active techniques for wastewater treatment. Bio-Remediation of contaminated soils			
Module -5 Environmental Auditing: Introduction, Cost of Pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Nemerow N.N., “Liquid Waste of industry theories, “Practices and Treatment. Addison Willey New York.			
2. Azad N. S.,– “Industrial Wastewater Management Hand Book” McGraw Hill book Co., New York.			
3. Ross R.D. “Industrial Waste Disposal”, Reinhold Environmental Series – New York.			
4. Dickinson” Practical Waste Treatment and Disposal Applied Science publication, London.			
5. Mahajan,” Pollution control in Process industries”. TMH, New Delhi.			
6. Eckenfelder, “Industrial Water pollution Control”- McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA			
7. Bioremediation books			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

02	16CEE424	GROUP-6	ENVIRONMENTAL LEGAL ASPECTS AND POLICY GUIDELINES
Exam Hours:03		Exam Marks:100	
Module -1 MODULE 1: Environment Definitions and Acts Environment definition in Indian law- Different environmental protection legislations- History of Environmental protection in India- Provisions in Indian Penal Code for Environmental protection-The constitutions of India – Union list- State list – Concurrent list -Panchayats and Municipalities role.			
Module -2 Water (prevention & control of Pollution) Act & Air(prevention & control of Pollution) Act Water pollution – definition – Water (Conservation and protection) Act 1974 – Objectives of Water Act – Legislation to control water pollution – Functions of CPCB and SPCB - Local bodies role – Water(prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention and control of pollution) Rules 1975 - Water (prevention & control of Pollution) Cess Act 1977 as amended by Amendment Act 1987 and relevant notifications -Tolerance limits for effluents discharge and drinking water -Constitution and Resources management and pollution control – Air(prevention & control of Pollution) Act 1981-Sections of Air(prevention & control of Pollution) Act 19, 20, 21, 22-Penalties - Ambient air quality standards-Noise and the Laws			
Module -3 Environmental (Protection) Act 1986 Environment and pollution - definition as per Environmental law- General powers of Central and state Government under EPA Important Notification in EPA 1986- The Indian Forest Act 1927-Forest Conservation Act 1980 - Wild Life (Protection) Act -Constitution of Pollution Control Boards - Powers, functions, Accounts, Audit etc. – Equitable remedies for pollution control			
Module -4 Municipal Solid Waste Management Rules Solid waste management – Hazardous Wastes (Handling and Management) Rules 1998-Bio-medical Wastes (Handling and Management) Rules 1998-Recycled plastics (Manufacture and Usage) Rules, 1999-Municipal Solid Waste Management Act 2003-Rules - E.I.A and Public Hearing- Eco-labeling-Eco Mark			
Module -5 Coastal Regulation Zone Notification and Green Benches Coastal Regulation Zone - definition-Importance of coral reef-Regulation activities in CRZ - The Biological Diversity Act 2002-Biodiversity Rules 2004-The Intellectual Property Rights (IPR)-National Environment Appellate Authority –Environmental Tribunal and Green Benches - Some Important cases on Environment -International Conventions - Protocols for protection of the Environment			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Constitutional Law of India – J.N. Pandey 1997 (31st Edn.) Central Law Agency Allahabad. 2. Administrative Law U.P.D. Kesari 1998. Universal Book Trade Delhi. 3. Environmental Law H.N. Tiwari, Allahabad Law. Agency 1997. 4. Environmental, A., Divan and Noble M. Environmental Law and Policy in India (cases, Materials and Statutes) 1991 Tripathi Bombay. 5. Environmental Policy. Forest Policy. Bare Acts – Government Gazette Notification. 6. Environmental Laws of India-C.P.R. Environmental Education Centre. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

03	16CCT422/ 16CIM423	GROUP-6	CONSTRUCTION DEMOLITION AND WASTE MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1 Environmental Impact of Building Materials Embodiedenergy of materials; impact on the local environment; toxicity of the material; life cycle assessment.Nature and Source Direct and indirect waste; site types andorigins; composition; quantity; current recycling/reusepotential of building materials.			
Module -2 Construction and Demolition Waste Management PlansInternational good practice; planning requirements; DoEHLG guidance document; company policy; demolitionplans; site implementation; supplier agreements sub-contractor management; role of waste managementcontractor; training; auditing; skip management; current markets; current disposal options; health and safety;reporting to local authorities. Treatment of Constructionand Demolition Waste, waste permits; waste licenses; wastetransfer facilities; landfills; treatment technologies;hazardous waste facilities; reporting to EPA			
Module -3 Designing for Waste Prevention and Minimisation Waste prevention and minimization; client, contractor and designer attitudes; proper maintenance of existingbuildings; reuse of existing building structure; designflexibility; design for reuse and recycling; dimensionalso-ordination and standardization; modular design;material selection and control.			
Module -4 Waste Forecasting Tools Application of WRAP's designingout waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker			
Module -5 Future developments Potential future markets; 'smart'materials; use of eco-materials.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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. 			
REFERENCES: <ol style="list-style-type: none"> 1. Springer, "Recycling and Resource Recovery Engineering", Springer-Verlag Berlin Heidelberg (1996) 2. Greg Winkler, "Recycling Construction and Demolition waste: A LEED-BasedToolkit (Green Source) (Google ebook), Mc Graw Hill Professional 3. V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste inHousing Development", Nova Science Publishers, 2008 4. "Current Literature" 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

04	16CGT41	GROUP-6	FORENSIC GEOTECHNICAL ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 INTRODUCTION:Historical failures of geotechnical structures (finite and infinite slopes,high embankments such as earthen dams, tunnels, excavations,foundations-shallow and deep, retaining structures etc.), characterization of failures, Inadequateness of Limit state design, principles and advantages of Mobilizeable strength design. Numerical problems			
Module -2 TECHNICAL FORENSIC INVESTIGATION: Collection of data, problem characterization, development of failure hypotheses, a realistic back analysis, field observations and performance monitoring, modelling of failure hypothesis and quality control of formal and technical aspects of the work. Numerical Problems.			
Module -3 GUIDELINES FOR FORENSIC INVESTIGATION OF GEOTECHNICAL CASES: Scope of the work, types of distress, diagnostic tests: field and laboratory tests, analysis, legal issues such as facts, interpretations, opinions, negligence TECHNICAL ISSUES RELATED TO GEOTECHNICAL FAILURES:Primary shortcomings causing failures, shortcomings in design,inadequate site investigations, unforeseen occurrences and phenomena,shortcomings in construction; recommendations to limit future occurrence of failures.			
Module -4 CASE HISTORIES:Construction of historic monuments, destruction due to environmental changes and survival of monuments among them, such as leaning tower of Pisa, Egyptian pyramids, tall structural foundations in Mexico city, prehistoric caves in India etc.,Consideration of geotechnical aspects such as settlement, shear strength, permeability, slope stability, etc., in construction of survived historic monuments as well as for the structures which have collapsed due to the new adjacent constructions or disturbances due to human activities etc.,Numerical problems			
Module -5 . GEOTECHNICAL ENGINEERING AND LEGAL SYSTEM:Legal conflict of geotechnical failures, sanctions in the legal code of construction, geotechnical work for documentation of forensic cases; case studies of legal conflict of prominent structures (such as landslides, deep excavations, unexpected settlements of oil tanks, distress in soil walls,failure due to slow creep of hills etc.)			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Forensic Geotechnical and Foundation Engineering – Robert W Day (2011) 2. Forensic Geotechnical Engineering – V V S Rao and G L Sivakumar Babu(2013), Springer India 			
Reference Books: <ol style="list-style-type: none"> 1. Indo-US Forensic Practices: Investigation Techniques and Technology – Shen En Chen, R Janardhanan, C Natarajan, Ryan Schmidt (2010), American Society of Civil Engineers 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

05	16CGT423	GROUP-6	ROCK MECHANICS
Exam Hours:03		Exam Marks:100	
Module -1 Classification of rocks, geological petro graphic and engineering.Index properties of rocks- porosity, density, permeability, durability and slake. Core recovery, RQD and its importance in engineering Stress-strain behaviour, factors influencing the strength of rock,temperature, confining pressure, strain rates, modes of failures of rocks.			
Module -2 Failure theories of rocks Mohr's hypothesis, Griffith's Criteria, Muller's extension of Griffith's theory, elementary theory of crack propagation, failure of rock by crack propagation, effects of cracks of elastic properties. Testing of rocks: Laboratory and field test, assessment of in-situ strength			
Module -3 Rock Foundation: Shallow and deep investigation for foundation design and construction aspect, slope stability analysis, mode of failures in rock. Design of slopes, excavation in rock and stabilization concepts			
Module -4 Strengthening of rocks: Foundation treatment for dams and heavy structures by grouting and rock reinforcement. Methods and principles of grouting, principles of design of rock bolts			
Module -5 .Tunnels – Basic terminology and application, site investigations, methods of excavation of tunnels supports and stabilization, construction control and maintenance, tunnel ventilation, control of ground water and gas Underground Mining; mining methods, planning and design, mining equipments and mining procedures, cause for subsidence and its remedial measures			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. Introduction to Rock Mechanics – Goodman (1976), John Wiley and Sons, NY 2. Fundamentals of Rock Mechanics – J C Jeager and N G W Cook (1976), Chapman and Hall, London 3. Geotechnology – Roberts , Pergamou Press Ltd., Oxford 			
Reference Books: <ol style="list-style-type: none"> 1. Principles of Engineering Geology and Geotechniques – Krynine and Judd 2. Rock Engineering – Jhon A Franklin and Maurice b Dusseault, McGraw Hill 3. Rock mechanics for Engineers: Varma, B.P, Khanna Publishers 4. Rock mechanics & Design of structures: Obert, L & Duvall, W.I., John Wiley & Sons 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

06	16CHT41	Group-6	SPECIAL PROBLEMS IN ROAD CONSTRUCTION
Exam Hours:03		Exam Marks:100	
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.			
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.			
Module -3 Problems in construction of high embankments, stability of foundation and embankment slopes. Stability of hill slopes, control of erosion.			
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.			
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, road construction on high altitudes, hilly and mountainous terrain.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. R.M. Koerner “Designing with Geosynthetics”- 4th Edition Prentice Hall, New Jersey, 1997. 2. IRC-75 “Guidelines for the design of High embankments”- IRC, 1979. 3. DSIR “Soil Mechanics for Road Engineers”– HMSO, London, 1954. 4. Leonards G.A. “Foundation engineering”- McGraw Hill Book Company, New York, 1962. 5. Cedgreen H.R. “Drainage of highway and airfield pavement”- John Willey and Sons.Inc., New York, 1974. 6. G. Kassiff M. Livnet. G. Wisemen “Pavements on Expansive clays”– Jerusalem Academy Press, Jerusalem. Israel, 1969. 7. R.D. Krebs & R.D. Walker “Highway Materials”- McGraw Hill Book House, New York, 1971. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

07	16CHT424	GROUP-6	AIRPORT PLANNING AND DESIGN
Exam Hours:03		Exam Marks:100	
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			
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.			
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			
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.			
Module -5 . Air Traffic Control and Aids: Runways and taxiways markings, day and night landing aids, airport lighting, ILS and other associated aids.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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: <ol style="list-style-type: none"> 1. "Planning and Design of Airports" - Robert Horenjeff, 2nd edition, McGraw Hill Book Co. 2. "Airport Engineering"- G. Glushkov, V. Babkov, Mir Publishers, Moscow. 3. "Airport Planning and Design"- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee 4. Harry.R.Cedergern. "Drainage of Airfield pavements"- John Wiley and Sons. 5. Virender Kumar and Satish Chandra, "Airport Planning and Design"- Galotia Publication press. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

08	16CSE41	GROUP-6	DESIGN OF CONCRETE BRIDGES
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges. Bridge substructures: Abutments, piers and wing walls Balanced Cantilever Bridge: Introduction and proportioning of components, Design of simply supported portion and design of cantilever portion, design of articulation			
Module -2. Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details.			
Module -3 T Beam Bridge Slab Design: Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of Beam, with Reinforcement Detail.			
Module -4 T Beam Bridge Main Girder Design: Analysis of Main Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading Using COURBON'S Method, Analysis of Main Girder Using HENDRY-JAEGER and MORICE-LITTLE Method for IRC Class AA Tracked vehicle only, BM & SF for different loads, Structural Design of Main Girder With Reinforcement Details			
Module -5 .PSC Bridges: Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force, cable profile and calculation of stresses, Design of End block and detailing of main girder			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. "Essentials of Bridge Engineering"- D Johnson Victor, Oxford & IBH Publishing Co New Delhi			
2. "Design of Bridges"- N Krishna Raju, Oxford & IBH Publishing Co New Delhi			
3. "Principles and Practice of Bridge Engineering"- S P Bindra Dhanpat Rai & Sons New Delhi			
4. IRC 6 – 1966 "Standard Specifications And Code Of Practice For Road Bridges"-Section II Loads and Stresses, The Indian Road Congress New Delhi			
5. IRC 21 – 1966 "Standard Specifications And Code Of Practice For Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi			
6. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi			
7. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi			
8. Raina V.K., "Concrete Bridge Practice"- Tata McGraw Hill			
9. Bakht B & Jaegggar, "Bridge Analysis Simplified"- McGraw Hill			
10. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill.			
11. Derrick Beckett, "An Introduction to Structural Design of Concrete Bridges"- Surrey University Press			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

09	16CSE423	GROUP-6	THEORY OF PLASTICITY AND FRACTURE MECHANICS
Exam Hours:03		Exam Marks:100	
Module -1 Plasticity General concept, yield criteria, flow rules for perfectly plastic and strain hardening materials - simple applications, Theories of failure. Plasticity models for concrete			
Module -2. Linear Elastic Fracture mechanics Basic modes of fracture, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing.			
Module -3 Elasto-plastic fracture mechanics Crack-tip plasticity and in metals. Mixed mode problems and evaluation of critical fracture parameters			
Module -4 Fatigue damage theories, Fatigue test, endurance limit, fatigue fracture under combined loading, fatigue controlling factors, cumulative fatigue damage concepts.			
Module -5 . Fracture of Concrete Review of concrete behaviour in tension and compression, Basic frameworks for modeling of quasi-brittle materials, discrete crack concept/Smearred crack concept. FE Concepts and applications.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, ND. New Delhi.			
2. Broek, D., "Elementary Engineering Fracture Mechanics", 4th edition, Martinus Nijhoff (1987).			
3. Venkataraman and Patel "Structural Mechanics with introduction to Elasticity and Plasticity" – Mcgraw Hill, 1990.			
4. T. L. Anderson, Fracture Mechanics- Fundamentals and Applications, inath. L.S., Advanced Mechanics of Solids, Tata McGraw-ltd., New Delhi Hill Publishing Co			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

10	16CSE424	GROUP-6	DESIGN OF MASONRY STRUCTURES
Exam Hours:03		Exam Marks:100	
Module -1 Introduction, Masonry units, materials and types:History of masonry Characteristics of Brick, stone, clay block, concrete block, stabilized mud blockmasonry units – strength, modulus of elasticity andwater absorption. Masonry materials – Classificationand properties of mortars, selection of mortars.			
Module -2..Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortarcharacteristics, effect of masonry unit height oncompressive strength, influence of masonry bondingpatterns on strength, prediction of strength ofmasonry in Indian context, Failure theories ofmasonry under compression. Effects of slendernessand eccentricity, effect of rate of absorption, effectof curing, effect of ageing, workmanship oncompressive strength			
Module -3 Flexural and shear bond, flexural strength andshear strength: Bond between masonry unit andmortar, tests for determining flexural and shear bondstrengths, factors affecting bond strength, effect ofbond strength on compressive strength, orthotropicstrength properties of masonry in flexure, shearstrength of masonry, test procedures for evaluatingflexural and shear strength			
Module -4 Design of load bearing masonry buildings:Permissible compressive stress, stress reduction andshape reduction factors, increase in permissiblestress for eccentric vertical and lateral loads,permissible tensile and shear stresses, Effectiveheight of walls and columns, opening in walls,effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels;Wall carrying axial load, eccentric load withdifferent eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry forbuildings up to 3 to 8 storeys using BIS codalprovisions			
Module -5 . Earthquake resistant masonry buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIScodal provisions. Masonry arches, domes and vaults:Components and classification of masonry arches, domes and vaults, historical buildings, constructionprocedure			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Hendry A.W., “Structural masonry”- Macmillan Education Ltd., 2nd edition			
2. Sinha B.P & Davis S.R., “Design of Masonry structures”- E & FN Spon			
3. Dayaratnam P, “Brick and Reinforced Brick Structures”- Oxford & IBH			
4. Curtin, “Design of Reinforced and Prestressed Masonry”- Thomas Telford			
5. Sven Sahlin, “Structural Masonry”-Prentice Hall			
6. Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, “AlternativeBuilding Materials and Technologies”- New Age International, New Delhi &Bangalore			
7. IS 1905, BIS, New Delhi.			
8. SP20(S&T),New Delhi			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

11	16CTM41	GROUP-6	TRANSPORTATION INFRASTRUCTURE DESIGN
Exam Hours:03		Exam Marks:100	
Module -1.Functional Classification of Highway System; Design Controls – Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed.Objectives of Geometric Design, Cross Section Elements: Design specifications; Pavement Surface characteristics – Skid Resistance, Road Roughness; Camber, Objectives, design standards. Specifications for hill roads.			
Module -2. Horizontal Alignment of Roads: Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance ; Objectives of horizontal curves; Super elevation;Extra- widening on Curves; Transition Curves – Objectives and Design. Transition Curve setting methods, Introduction to MX Roads software.			
Module -3. Vertical Alignment of Roads: Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Importance of Sight Distances for Horizontal and Vertical Curves ; Combination of Vertical and Horizontal Curves – Grade Compensation.			
Module -4. Geometric Design of Intersections : Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.			
Module -5 .Miscellaneous Elements: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays –Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design, Traffic Signs and Markings.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. AASHO, “A Policy on Geometric Design of Highways and Streets”, American Association of State Highway and Transportation Officials, Washington D.C.			
2. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna,2007.			
3. Khanna S.K. and Justo, C. E. G. `Highway Engineering`, Nem Chand and Bros.,2000.			
4. DSIR, `Roads in Urban Areas`, HMSO, London.			
5. Jack E Leish and Associates, `Planning and Design Guide: At-Grade Intersections`.Illinois.			
6. Relevant IRC Codes & Publications			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

12	14CTM424	GROUP-6	INTELLIGENT TRANSPORTATION SYSTEMS
Exam Hours:03		Exam Marks:100	
Module -1. Introduction to Intelligent Transportation Systems (ITS) – Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems(GIS), video data collection.			
Module -2. Telecommunications in ITS - Information Management, Traffic Management Centres (TMC).Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts.			
Module -3. ITS functional areas – Advanced Traffic Management Systems (ATMS) , Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management,Advanced Vehicle safety systems, Information Management.			
Module -4. ITS Operations – Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning			
Module -5 .ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations ; public transportation applications;Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries. [Case study]			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House. 2. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2000. 3. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005. 4. US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CDROM). 5. Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”, Prentice Hall Dept. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

13	16WLM424	GROUP-6	GLOBAL WARMING AND CLIMATE CHANGE
Exam Hours:03		Exam Marks:100	
Module -1. Introduction: Radiative forcing, Earth Albedo, Irradiance, Energy budget. Scientific principles- warming earth and Principle of thermodynamics			
Module -2. Green-House Effect as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources and sinks of CO ₂ , Methane, Nitrous oxides, carbon cycle disequilibrium, Global Warming Potential (GWP) of GHGs Characterization & Classification of atmospheric pollutants, –description and application of point, line and areal sources.			
Module -3. Climate change- Climate change trends. Components of climate change process, Ozone layer depletion and its control, Impacts of climate change: Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands and Estuaries loss Impact of ocean current on global climate, EL-NINO & LA-NINA effects			
Module -4. Kyoto Protocol: Importance, Significance and its role in Climate Change Carbon Trading - Mechanisms, Various Models (Indian) Global and Indian Scenario			
Module -5. Cleaner Development Mechanisms: Various Projects related to CO ₂ Emission Reduction. Alternatives of Carbon Sequestration: Conventional and non-conventional techniques, Role of Countries and Citizens in Containing Global Warming			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
<ol style="list-style-type: none"> 1. Barry R.G., and Chorley R.L., “Atmosphere, Weather and Climate”, 4th Edition, ELBS Publication. 2. Bolin B., “Carbon Cycle Modelling”, John Wiley and Sons Publications. 3. Corell R.W., and Anderson P.A., “Global Environmental Change”, Springer-Verlog Publishers. 4. Francis D., “Global Warming: The Science and Climate Change”, Oxford University Press. 5. Frame B., Medury Y., and Joshi Y., “Global Climate Change: Science, Impact and Responses”. 6. Linden E., “The Winds of Change: Climate, Weather and the Destruction of Civilizations”, Simon and Schuster Publications. 7. Mintzer I.M., “Confronting Climate Change, Risks, Implications and Responses”, Cambridge University Press. 8. Srivatsava A.K., “Global Warming”, APH Publications. 9. Wyman R.L., “Global Climate Change and Life on Earth”, Chapman and Hall Publications. 10. Yadav, Chander and Bhan, “Global Warming: India’s Response and Strategy”, RPH Publications 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Civil Engineering)
As per 2017 Regulation

14	16CTE423	Group-6	APPLICATIONS OF SOFT COMPUTING TECHNIQUES
Exam Hours:03		Exam Marks:100	
Module -1. Introduction, need for soft computing techniques, components of soft computing			
Module -2. Artificial Neural Networks (ANN), types of ANN and learning algorithms, tasks performed by ANN Basic concepts of feed forward neural networks, perceptron learning rule, back propagation learning algorithm, application of feed forward ANN for function approximation and prediction, limitations of feed forward neural networks, applications of feed forward neural networks in Hydrology, Water Resources and Environmental Engineering			
Module -3. Hebbian learning and Hopfield networks, pattern association, radial basis function networks, Kohonen networks and self organisation maps, applications of ANN in pattern classification.			
Module -4. Information and uncertainty, Chance versus ambiguity, Classical sets and fuzzy sets, Logic and reasoning, Fuzzy set operations and fuzzy relations, Membership Functions, fuzzy numbers and fuzzy arithmetic.			
Module -5 . Fuzzy Systems, fuzzy relations, fuzzy inference systems, Decision Making with Fuzzy Information, Fuzzy Classification and Pattern Recognition, Neuro-Fuzzy Systems Evolutionary computing, concepts of genetic algorithm, components of genetic algorithm, Hybrid soft computing techniques, Applications in Civil Engineering			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 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:			
1. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall India, New Delhi, 2008			
2. Jang, J.R, Sun Chuen-tsai, and Mizutani Eiji, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI Learning, 2009			
3. Rajasekaran, S., and Vijayalakshmi Pai, G.A., Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications, Prentice-Hall India, New Delhi, 2003			