Course code	Course Name	L-T-P - Credits	Year of Introduction
HS300	Principles of Management	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To develop ability to critically analyse and evaluate a variety of management practices in the contemporary context;
- To understand and apply a variety of management and organisational theories in practice;
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace;
- To be able to critically reflect on ethical theories and social responsibility ideologies to create sustainable organisations.

Syllabus

Definition, roles and functions of a manager, management and its science and art perspectives, management challenges and the concepts like, competitive advantage, entrepreneurship and innovation. Early contributors and their contributions to the field of management. Corporate Social Responsibility. Planning, Organizing, Staffing and HRD functions, Leading and Controlling. Decision making under certainty, uncertainty and risk, creative process and innovation involved in decision making.

Expected outcome.

A student who has undergone this course would be able to

i. manage people and organisations
ii. critically analyse and evaluate management theories and practices
iii. plan and make decisions for organisations
iv. do staffing and related HRD functions

Text Book:

Harold Koontz and Heinz Weihrich, *Essentials of Management*, McGraw Hill Companies, 10th Edition.

References:

1. Daft, *New era Management*, 11th Edition, Cengage Learning
2. Griffin, *Management Principles and Applications*, 10th Edition, Cengage Learning
3. Heinz Weirich, Mark V Cannice and Harold Koontz, *Management: a Global, Innovative and Entrepreneurial Perspective*, McGraw Hill Education, 14th Edition
4. Peter F Drucker, *The Practice of Management*, McGraw Hill, New York
5. Robbins and Coulter, *Management*, 13th Edition, 2016, Pearson Education

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment- global, innovative and entrepreneurial perspectives of Management (3 Hrs.)– Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management (3 Hrs.)	6	15%

II	**Early Contributions and Ethics in Management**: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z (3 Hrs.) Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics. (3 Hrs)	6	15%
FIRST INTERNAL EXAMINATION			
III	**Planning:** Nature and importance of planning, -types of plans (3 Hrs.)- Steps in planning, Levels of planning - The Planning Process. – MBO (3 Hrs.).	6	15%
IV	**Organising for decision making:** Nature of organizing, organization levels and span of control in management Organisational design and structure –departmentation, line and staff concepts (3 Hrs.) Limitations of decision making- Evaluation and selecting from alternatives- programmed and non programmed decisions - decision under certainty, uncertainty and risk-creative process and innovation (3 Hrs.)	6	15%
SECOND INTERNAL EXAMINATION			
V	**Staffing and related HRD Functions:** definition, Empowerment, staff – delegation, decentralization and recentralisation of authority – Effective Organizing and culture-responsive organizations –Global and entrepreneurial organizing (3 Hrs.) Manager inventory chart-matching person with the job-system approach to selection (3 Hrs.) Job design-skills and personal characteristics needed in managers-selection process, techniques and instruments (3 Hrs.)	9	20%
VI	**Leading and Controlling:** Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership (3 Hrs.) - Leadership Behavior and styles – Transactional and Transformational Leadership (3 Hrs.) Basic control process- control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling (3 Hrs.)	9	20%
END SEMESTER EXAM			

Question Paper Pattern

Max. marks: 100, Time: 3 hours .
The question paper shall consist of three parts

Part A: 4 questions uniformly covering modules I and II. Each question carries 10 marks Students will have to answer any three questions out of 4 (3X10 marks =30 marks)
Part B : 4 questions uniformly covering modules III and IV. Each question carries 10 marks Students will have to answer any three questions out of 4 (3X10 marks =30 marks)
Part C: 6 questions uniformly covering modules V and VI. Each question carries 10 marks Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE302	DESIGN OF HYDRAULIC STRUCTURES	4-0-0-4	2016

Prerequisite : CE309 Water Resources Engineering

Course objectives:

- To impart knowledge regarding the design of the various minor irrigation structures
- To convey the knowledge on the causes of failure, design criteria and stability analysis of different types of dams

Syllabus :

Diversion head works - layout and functions of components. Causes of failure of weirs on permeable soils, Bligh's theory and Khosla's theory. Irrigation canals- Design of unlined canals through alluvial soils-Kennedy's theory and Lacey's theory. Minor irrigation structures- Cross drainage works, Canal Regulation works : Falls and Regulators, Design of Hydraulic Structures: Aqueduct, siphon aqueduct, Canal falls-notch type, well type, Sarda type, and Cross regulator. Dams-Types, Gravity dam - forces acting - stability analysis and modes of failure - theoretical and practical profiles- Functions of shafts, galleries, keys and water stops. Arch dams-types, Thin cylinder theory. Earth dams-types, causes of failure and design criteria. Spillways-Types. Ogee type spillway-profile.

Course Outcomes:

The students will be able to

i. Perform the stability analysis of gravity dams
ii. Explain the causes of failure of different types of dams and their design criteria
iii. Design minor irrigation structures such as regulators, cross drainage works and canal falls

Text Books :

1. Garg S.K, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2006.
2. Modi. P. N., Irrigation Water Resources and Water Power Engineering, Standard Book House, 2009.
3. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd. 2010.

References:

1. Arora, K.R., "Irrigation, Water Power and Water Resources Engineering", Standard Publishers Distributors, 2010.
2. Asawa. G.L. Irrigation and Water Resources Engineering, New Age International, 2000
3. Sahasrabudhe S.R., Irrigation Engineering & Hydraulic Structures, S.K. Kataria & Sons, 2013
4. Sathyanarayana M. C. Water Resources Engineering-Principles and Practice, New Age International Publishers. 2009
5. Varshney, R.S. Theory & Design of Irrigation Structures - Vol III, Nem Chand & Bros., Roorkee.

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Diversion head works- layout and functions of components, Weir and barrage- Causes of failure of weirs on permeable soils - Bligh's theory. Design of vertical drop weir. Khosla's theory of independent variables- Khosla's corrections-Use of Khosla's charts.	6	15

II	Irrigation canals, canal alignment- cross section of unlined canals- Design of canals through alluvial soils-Kennedy's theory and Lacey's theory. Cross drainage works-Types, selection of suitable type, Type of aqueducts. Regulation Works - Canal falls-necessity, classification. Canal regulators- Regulator cum road bridge- Head regulators and cross regulators.	8	15
FIRST INTERNAL EXAMINATION			
III	Design and Drawing of the following hydraulic structures: 1. Aqueduct (Type III) 2. Syphon Aqueduct (Type III) 3. Canal Fall (Trapezoidal Notch type) 4. Siphon Well Drop 5. Sarda Type Fall (High Discharge only) 6. Cross Regulator (Using Khoslas Theory)	30	50
SECOND INTERNAL EXAMINATION			
IV	Dams-Types, Gravity dam – selection of site- forces acting - stability analysis and modes of failure – Principal and shear stresses- Problems - Elementary profile –limiting height of gravity dams- high and low dams- Practical profiles, Functions of various components shafts, keys, water stops, and different types of gallery, Grouting. Instrumentation in dams (Concept only).	6	10
V	Arch dams-types, methods for design (list only)-Thin cylinder theory. Earth dams-types, causes for failure and design criteria. Spillways-Types. Effective length of spillway- Ogee type spillway- profile. Energy dissipation below spillways - Stilling basins- Indian standard Type I and Type II (design not necessary).	6	10
END SEMESTER EXAMINATION			

Note: In Internal Evaluation the marks for assignment shall be awarded based on the submission of drawings.

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks : 100 **Exam Duration: 4 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III : One question out of 2 questions carrying 50 marks ; with weightage for design as 25 marks and sketching of two views of design specified in question : 25 marks

Part C - Module IV & V : 2 questions out of 3 questions carrying 10 marks each.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE304	DESIGN OF CONCRETE STRUCTURES - II	3-0-0-3	2016

Pre-requisites : CE301 Design of Concrete Structures - I

Course objectives:

- To provide knowledge in the structural design of selected advanced structures of concrete and enable them to design reinforced concrete structures for real-world applications.

Syllabus :

Columns subjected to compression , uniaxial bending and biaxial bending- design using SP16 charts for limit state-design of slender columns- design of wall/strip footing- design of rectangular footings-eccentrically loaded rectangular footing- circular footings-detailing-combined footings-rectangular and trapezoidal (design principles only)- design of cantilever retaining wall without surcharge-detailing - design principles of counter fort retaining wall and detailing- Circular slabs-simply supported, fixed and partially fixed subjected to udl- design of water tanks-design philosophy and requirements-joints-IS code recommendations- design of rectangular and circular water tanks using IS code coefficients (IS 3370)- Pre-stressed concrete-concept of prestressing- materials-methods of prestressing – prestressing systems- losses of prestress. analysis of prestressed beams (rectangular and I-sections) at stages of transfer and service

Expected Outcomes:

The students will be able to

i. Design eccentrically loaded and slender columns using SP 16 design charts and different
ii. types of foundations
iii. Design and detail cantilever retaining wall and understand the design principles of Counter fort retaining wall
iv. Design and detail circular slabs and domes
v. Design rectangular and circular water tanks using IS code coefficients (IS 3370).
vi. Gain knowledge of prestressed concrete fundamentals and analyse pre and post tensioned beams.

Text Books / References:

1. N. Krishnaraju, Prestressed Concrete , Tata McGraw- Hill, 5e, 2012
2. Pillai S.U & Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009
3. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015
4. Relevant IS codes (IS 456, IS 875IS 1343, IS 3370, SP 16, SP 34)

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Analysis and design of short columns under eccentric loading- Columns subjected to compression and uniaxial bending- design using SP16 charts for limit state Columns subjected to combined axial load and biaxial bending moments-code procedure for design- design using SP16 charts for	8	15

	limit state Slender columns- behavior of slender columns-braced and unbraced columns-design procedure- design using SP16 charts for limit state		
II	Foundations- classification-IS code provisions for design of isolated footings- design principles of rectangular footings- Design of rectangular footings-uniform thickness and sloped- eccentrically loaded rectangular footing of uniform thickness-detailing. Combined footings (design principles only)- analysis of combined footings-rectangular and trapezoidal.	8	15
FIRST INTERNAL EXAMINATION			
III	Retaining walls-Types- Cantilever retaining wall- earth pressure and forces acting-stability-proportioning-structural behavior of components -design example of cantilever retaining wall without surcharge-detailing Counterfort retaining wall- design principles of components and detailing (design not required)	6	15
IV	Circular slabs- stresses- reinforcements- simply supported, fixed and partially fixed subjected to uniformly distributed loads Design and detailing of spherical and conical domes	6	15
SECOND INTERNAL EXAMINATION			
V	Introduction to design of water tanks-design philosophy and requirements-joints- IS code recommendations Design of rectangular water tanks using IS code coefficients (IS 3370). Design of circular water tanks using- IS code coefficients (IS 3370)	7	20
VI	Introduction to Pre-stressed concrete: Concept of pre-stressing-Materials-High strength concrete and high tensile steel. Analysis of pre-stressed beams (Rectangular and I-sections) at stages of transfer and service. Losses in Prestress	7	20
END SEMESTER EXAMINATION			

Note:
1. All designs shall be done as per current IS specifications
2. Special importance shall be given to detailing in designs
3. SI units shall be followed.
4. Students shall submit a term project on design and detailing of any structure of real- world application at the end of the semester.

QUESTION PAPER PATTERN (End semester examination) :

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each
Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each
Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1. Each part should have at least one question from each module
2. Each question can have a maximum of 4 subdivisions (a,

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE306	COMPUTER PROGRAMMING AND COMPUTATIONAL TECHNIQUES	3-0-0-3	2016

Pre-requisites : Nil

Course Objectives:

- To provide adequate knowledge for coding in C++ language
- To give awareness about the different computational methods and their implementation to analyze basic Engineering problems

Syllabus

Computer programming - Elements of C++ programming language - control statements - Basic concepts of object oriented programming

Computational Techniques – Roots of transcendental equation- Interpolation -Functional approximation- Numerical Integration, Solution of simultaneous linear equations.

Expected Outcome:

- The students will be able to develop computer programs and implement numerical techniques for solving basic engineering problems using C++ language.

Text Books:

1. Balaguruswamy, Object Oriented programming with C++. Tata Mcgraw Hill., 2008
2. Gerald C. F. and P. O. Wheatley, Applied Numerical Analysis, Pearson Edu., 2004
3. Robert Lafore ., C++ Programming., Sams publishers.,4th Edition, 2001

Reference Books:

1. Barkakati N., Object Oriented Programming in C++, SAMS, 1991.
2. Kamthane A. M., Object Oriented Programming with ANSI & Turbo C++, Pearson Education, 2009.
3. Lippman S. B. and J. Lajoie, C++ Primer, Pearson Education, 2005.
4. Maria Litvin.and Gary Litvin, C++ for You++, Skylight Publishing, 1998.
5. Ravichandran D., Programming with C++, Tata McGraw Hill, 2007.

COURSE PLAN

Modules	Contents	Hours	Sem. Exam Marks %
I	Introduction to C++: Structure of C++ program; Character set; Keywords; Identifiers; Data types – integer, real, character, string, Boolean, Enumerated data types, Constants and Variables; Operators – assignment, arithmetic, relational, logical, increment, decrement and conditional operators; Statements – simple & compound, declaration statements. Input and output streams. Selection statements: if, if-else, switch statements	7	15
II	Looping statements - for, while, do-while statements, Jump statements – break, continue, goto, exit (). Arrays - single and multi-dimensional arrays, initializing array elements, pointers & arrays, Character arrays, string functions, Unformatted console I/O functions, Unformatted Stream I/O	6	15

	functions. Preparation of programs for evaluation of factorial of a number, Infinite series, Sorting, Searching and Matrix manipulations.		
FIRST INTERNAL TEST			
III	User defined functions – Arguments, return values, call by value, call by reference, functions calling functions, functions and arrays - Global variables, automatic, static and register variables, recursive functions.	6	15
IV	Structures - functions and structures - Arrays of structures - structures within structures, Structures containing arrays. Files - Input & Output, sequential & random access. Basic concepts of object oriented programming - class, objects, constructors and destructors, inheritance (Programs not required)	7	15
SECOND INTERNAL TEST			
V	Roots of Transcendental equations - Successive approximations, Regula - Falsi, Newton Raphson Methods, Interpolation-Lagrange interpolation method.	8	20
VI	Functional approximation - Fitting straight line & parabola, Numerical Integration - Trapezoidal, Simpson's rule & Gauss quadrature Method. Solution of simultaneous linear algebraic equations – Gauss elimination method. Solution of Partial differential Equation - Finite Difference Method	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a,b,c,d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE308	TRANSPORTATION ENGINEERING - I	3-0-0-3	2016

Pre-requisite : NIL

Course objectives:

- To introduce the principles and practice of Highway Engineering and Airport Engineering.
- To enable students to have a strong analytical and practical knowledge of geometric design of highways.
- To introduce pavement design concepts, material properties, construction methods and to design highway pavements.
- To understand the principles of traffic engineering and apply this for efficient management of transportation facilities.

Syllabus:

Classification and alignment of highways- Geometric design of highways- Properties and testing of pavement materials- CBR method of flexible pavement design- Construction and maintenance of pavements- Design of runways, taxiways and aprons.

Traffic characteristics- Traffic studies and analysis- Traffic control devices

Airport characteristics- Aircraft component parts- Site selection-Design of runways, taxiways and aprons- Terminal area planning- Airport marking and lighting

Expected Outcomes:

The students will be able to

i. Design various geometric elements of a highway
ii. Determine the characteristics of pavement materials and design flexible pavements
iii. Conduct traffic engineering studies and analyze data for efficient management of roadway facilities, Plan and design basic airport facilities

Text Books :

1. Khanna, S.K. & Justo E.G., Highway Engineering, Nem Chand & Bros., 2000
2. Kadiyali, L. R., Principles of Highway Engineering, Khanna Publishers, 2001
3. Khanna, S. K. & Arora. M. G., Airport Planning and Design, Nemchand& Bros.

References:

1. Horonjeff R. & McKelvy, F., Planning and Design of Airports, McGraw Hill, 5e, 2010
2. IRC: 37-2001, Guidelines for the Design of Flexible Pavements, IRC 2001, New Delhi
3. IRC:37-2012, Tentative Guidelines for the Design of Flexible Pavements
4. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier, 1997
5. Rangwala, S. C. , Airport Engg. Charotar Publishing Co., 16e, 2016
6. Yoder, E. J & Witezak, M. W, Principles of Pavement Design, John Wiley & Sons, 1991

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %

I	Introduction to Transportation Engineering, Classification of roads, Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads, Engineering surveys for highway location- Introduction to geometric design of highways, Design controls and criteria, Design of highway cross section elements.	6	15
II	Sight distance, Stopping sight distance, Overtaking sight distance, Design of horizontal alignment and Vertical alignment	7	15
FIRST INTERNAL EXAMINATION			
III	Introduction to highway materials, design and construction, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil. Flexible and rigid pavements, Factors influencing the design of pavements, CBR method and IRC guidelines for flexible pavements	7	15
IV	Introduction to performance grading and superpave, Construction of bituminous pavements, Types and causes of failures in flexible and rigid pavements, Highway drainage. Introduction to Traffic Engineering, Traffic characteristics, Traffic studies and their applications.	6	15
SECOND INTERNAL EXAMINATION			
V	Types of road intersections, Traffic control devices, Traffic signs, Road markings and Traffic signals, Design of isolated signals by Webster's method. Introduction to Airport Engineering, Aircraft characteristics and their influence on planning of airports, Components of airport, Selection of site for airport	8	20
VI	Runway orientation, basic runway length and corrections required, Geometric design of runways, Design of taxiways and aprons, Terminal area planning, Airport markings, Lighting of runway approaches, taxiways and aprons, Air traffic control	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a, b, c, d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE332	TRANSPORTATION ENGINEERING LAB	0-0-3-1	2016

Pre-requisite : CE308 Transportation Engineering - I

Course objectives:

- To enable the students to conduct different tests to find various properties of aggregates, bitumen and soil subgrade and hence to assess their suitability in pavement construction.

List of Experiments (All experiments shall be conducted as per BIS/ASTM/AASHTO procedures)

I. Tests on aggregates

1. Aggregate crushing value
2. Aggregate impact value
3. Los Angeles abrasion value
4. Shape tests-Flakiness index and Elongation index
5. Angularity of course aggregates and fine aggregates
6. Specific gravity and water absorption of course aggregate
7. Stripping value of road aggregates
8. *Dry Packing characteristics of aggregates (ASTM C29/ C29 M – 97)*

II. Test on soil

1. California Bearing Ratio test (*Soaked and Un-soaked CBR*)
2. *Dynamic cone penetration test (ASTM D6951 (2015) procedure)*

III. Tests on bitumen

1. Penetration value of bitumen
2. Softening point of bitumen
3. Ductility of bitumen
4. Flash and Fire point of bitumen
5. *Measurement of mixing and compaction temperature of bitumen (Brookfield viscometer) (The test was previously written in the draft syllabus as Viscosity test on bitumen, but we have specified it)*

IV.Test on bituminous mixes

1. *Determination of theoretical specific gravity of loose mix and bulk specific gravity of*

compacted mix (ASTM D2041, ASTM D1188)

2. *Moisture sensitivity test of bituminous mixes (AASHTO T283 procedure)*

V. Functional evaluation of pavements

1. *Use of MERLIN apparatus to determine road roughness*

Expected outcome:

- The students will be able to assess the quality of various pavement materials and their suitability in highway construction.

Reference books :

1. L .R. Kadiyali, Principles and Practices of Highway Engineering, Khanna Publishers, 2009
2. MoRTH (2013) Specification for Road and bridge works (5^{th} revision)
3. MS-2 manual (2015) Seventh edition, Asphalt Institute.
4. S. K. Khanna, C. E. G. Justo, A Veeraragavan, Highway Engineering, Khanna Publishers, 10e.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE334	COMPUTER AIDED CIVIL ENGINEERING LAB	0-0-3-1	2016

Prerequisite : CE231 Civil Engineering Drafting Lab

Course objectives:

1. To introduce the fundamentals of Civil Engineering drafting and drawing.
2. To familiarize with the FEA software packages for analysis and Design of structures
3. To understand the Total Station data transfer and interpretation.
4. To enable the usage of Project Management Software

List of Experiments :

1. Structural Drawings for
   a) Slabs and Beams
      i. One Way / Two way Slab/Continuous Slabs
      ii. Singly reinforced /Double reinforced Beams
      iii. Continuous / Flanged Beams
   b) Stair Case (Doglegged and Tread and Riser Type)
   c) Foundations (Isolated and Combined Rectangular)

II Analysis and design of steel and RCC elements using STAAD/SAP 2000/ ETABS/any FEM software package.

a) Continuous and Cantilever beams
b) Plane truss and Frames

III Use of Project Management Software (MS Project/Primavera)

a) Preparation of Bar Chart/Gantt Charts/CPM/PERT Charts and finding Critical Path
b) Practice on Resource allocation (and Project Monitoring(Cost and Time)

IV. Conduct of Survey camp using Total Station (minimum 3 days duration) and its plotting.

Expected Outcomes:

- The students are expected to accomplish the abilities/skills for the use of Civil Engineering Drafting/Analysis, Design and Project Management Software.

Text Books / References:

1. N Krishna Raju, Structural Design and Drawing, Second Edition, Universities Press (India), Private Limited, Hyderabad, 2009
2. Reference Manual of the Relevant Software
3. Satheesh Gopi, Dr. R Sathikumar, N Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2006
4. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, US, 2015

Note:

(1) Evaluation of drawing, along with a viva, to be done at the end of every class.

(2) A survey camp of minimum 3 days duration using total station is to be conducted in the semester, and is compulsory

(3) Evaluation Criteria :

Best 8 plate/Exercises - 40 marks
Survey Camp - 30 marks
.End semester examination - 30 marks
TOTAL - 100 marks

Course code	Course Name	L-T-P - Credits	Year of Introduction
**352	Comprehensive Examination	0-1-1-2	2016
Prerequisite : Nil			

Course Objectives

- To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- To comprehend the questions asked and answer them with confidence.

Assessment

Oral examination – To be conducted weekly during the slot allotted for the course in the curriculum (@ three students/hour) – 50 marks
Written examination - To be conducted by the Dept. immediately after the second internal examination– common to all students of the same branch – objective type (1 hour duration)– 50 multiple choice questions (4 choices) of 1 mark each covering all the courses up to and including semester V – no negative marks – 50 marks.

Note: Both oral and written examinations are mandatory. But separate minimum marks is not insisted for pass. If a students does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments.
The two hours allotted for the course may be used by the students for library reading and for oral assessment.

Expected outcome .

- The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE362	GROUND IMPROVEMENT TECHNIQUES	3-0-0-3	2016

Pre-requisite :CE305 Geotechnical Engineering - II

Course objectives:

- To impart fundamental knowledge of Ground Improvement Techniques
- To make capable of choosing and designing the appropriate method of Ground Improvement according to site conditions and requirement

Syllabus :

Classification of Ground Modification Techniques- Soil distribution in India- Reclaimed soils- Ground Improvement Potential- Grouting – Aspects – Groutability, Grouting materials, Suspension grouts and solution grouts, Compaction grouting. Procedure and applications of grouting- Chemical stabilization – Granular admixtures, Cement, Lime, Calcium Chloride, Fly Ash, Bitumen, Chemical admixtures. Construction Methods-Ground Anchors – Applications, types and components, Anchor tests. Rock bolts – Applications and types- Rock bolt action around an excavation. Soil Nailing – construction sequence – analysis of nailed soil-Compaction- Moisture Density relationship. Shallow surface compaction-Rollers – operational aspects. Deep Compaction – Explosion- heavy tamping- vibro compaction and vibro replacement. Properties of compacted soil, Compaction control tests- Hydraulic modification- Methods of dewatering- open sumps and ditches, Well point systems, deep well drainage, Vacuum dewatering, Electro osmosis. Design of dewatering for excavations

Expected Outcomes:

i. An understanding about types of ground improvement techniques and soil distribution in India
ii. Knowledge about various types of grouts and their applications
iii. Knowledge about types of chemical stabilization and their construction method
iv. Understanding about Ground Anchors, Rock Bolts and Soil Nailing
v. Knowledge about Compaction of soil
vi. Understanding about various methods of dewatering of soil

Text Books / References:

1. Manfred. R. Hausmann, Engineering Principles of Ground Modification, McGraw Hill, 1989
2. P. Purushothamaraj, Ground Improvement Techniques ,University Science Press, 2005

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Introduction to Engineering Ground Modification- Classification of Ground Modification Techniques- Soil distribution in India- Reclaimed soils- Ground Improvement Potential.	6	15

II	Grouting – Aspects – Groutability, Grouting materials, Suspension grouts and solution grouts, Compaction grouting. Procedure and applications of grouting.	6	15
FIRST INTERNAL EXAMINATION			
III	Chemical stabilization – Granular admixtures, Cement, Lime, Calcium Chloride, Fly Ash, Bitumen, Chemical admixtures. Construction Methods.	6	15
IV	Ground Anchors – Applications, types and components, Anchor tests. Rock bolts – Applications and types- Rock bolt action around an excavation. Soil Nailing – construction sequence – analysis of nailed soil	7	15
SECOND INTERNAL EXAMINATION			
V	Compaction- Moisture Density relationship. Shallow surface compaction-Rollers – operational aspects. Deep Compaction – Explosion- heavy tamping- vibro-compaction and vibro-replacement. Properties of compacted soil, Compaction control tests.	9	20
VI	Hydraulic modification- Methods of dewatering- open sumps and ditches, Well point systems, deep well drainage, Vacuum dewatering, Electro osmosis. Design of dewatering for excavations.	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a,b,c,d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE364	ADVANCED FOUNDATION ENGINEERING	3-0-0-3	2016

Prerequisite: CE305 Geotechnical Engineering - II

Course objectives:

- To impart to the students, the advanced topics in foundation engineering
- To enable the students to acquire proper knowledge about the design and analysis in real life situations.

Syllabus :

Advanced topics in shallow foundations- bearing capacity, settlement and allowable bearing pressure. Allowable bearing pressure from penetration test data. Consolidation settlement of footings. Raft foundations and combined footings. Problems of excavations. Deep foundations – need. Types. Classification of piles. static equation – Single piles -– Critical depth concept. Pile capacity in clay and sand by the I.S. code method . Piles in layered soils. Piles with enlarged base in clays (under reamed piles). Pile capacity from SPT and CPT values. Piles for resisting uplift – straight shaft and under reamed piles in clays and sands – Dynamic formulae . Different types of pile load tests. ultimate load from pile load tests. Pile groups –Negative skin friction of single piles and pile groups – Settlement of pile groups in clays and sands –Equivalent raft approach –- Skempton's and Meyerhof's methods- Drilled piers with enlarged base. Well foundations

Expected Outcomes:

i. The students will be equipped to design foundations for field situations.
ii. The students will gain **d**etailed knowledge of shallow foundations and deep foundations.

Text Books:

1. Murthy, V.N. S. Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007
2. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.

References:

1. Gulhati, S. K. and Datta, M. Geotechnical Engineering, Tata McGraw Hill Education, 2005
2. Tomlinson, M. J. and Booman, R. Foundation Design and Construction, Prentice Hall Publishing, 2001.
3. Tomlinson, M. J. and Woodwrd, J. Pile Design and Construction Practice. CRS Press, 2015.
4. Kurien, N. P. Design of foundation systems: principles and practices. Alpha Science International, 2005

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Shallow foundations- estimating bearing capacity- Meyerhof's, Hansen's and I.S code methods- Effect of water table, eccentricity, and inclination of load on Bearing Capacity – Numerical problems using IS method Elastic settlement –Effect of size of footing on settlement. Steinbrenner's method of calculating settlement– Numerical problems.	7	15

II	Allowable bearing pressure from penetration test data – Meyerhoff's and Teng's expressions. Consolidation settlement of footings - Combined footings and raft foundations (only concepts)– brief discussions on methods of analysis of raft, concept of floating raft, excavations.	6	15
FIRST INTERNAL EXAMINATION			
III	Deep foundations –need. Types. Classification of piles. static equation – Single piles -– Critical depth concept. Pile capacity in clay and sand by the I.S. code method . Piles in layered soils. Piles with enlarged base in clays (under reamed piles). Problems. Pile capacity from SPT and CPT values. problems	6	15
IV	Piles for resisting uplift – straight shaft and under reamed piles in clays and sands – Dynamic formulae – Engineering News formula – Modified Hiley formula – Different types of pile load tests –initial and routine tests maintained load test, CRP test, pullout test, lateral load test and cyclic pile load test. Separation of skin friction and end bearing. – ultimate load from pile load tests.	7	15
SECOND INTERNAL EXAMINATION			
V	Pile groups – Efficiency of pile groups- Group capacity in clays– Minimum spacing of piles in a group – Negative skin friction of single piles and pile groups –Settlement of pile groups in clays – Equivalent raft approach – Settlement of pile groups in sands - Skempton's and Meyerhof's methods- Drilled piers with enlarged base.	8	20
VI	Well foundations– Components of a well foundation–Procedure for construction and sinking of wells–Thickness of well steining for sinking under self weight - Grip length- Problems encountered in well sinking–Tilts and Shifts– Causes – Permissible tilts and shifts - Methods to rectify tilts and shifts – Forces acting on a well foundation –Allowable bearing pressure – Lateral stability of well foundations - Terzaghi's analysis	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a, b, c, d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE366	TRAFFIC ENGINEERING AND MANAGEMENT	3-0-0-3	2016

Pre-requisite: NIL

Course objectives:

- To set a solid and firm foundation in traffic engineering management, traffic regulation, highway capacity, design of introduction and traffic flow theory concepts**.**

Syllabus:

Scope and objective of traffic engineering and management, Traffic regulation rules, Highway capacity and introduction to 2010 manual, Design of at grade, grade separated, rotary and signals, traffic safety , influencing factors and preventive measures for traffic accidents, basic diagrams of traffic flow theory, introduction to car following and queuing**.**

Expected Outcomes:

- This course will enable students to learn advanced topics in traffic engineering and management

Text Books:

1. Kadiyali L.R. Traffic Engineering and Transport planning, Khanna Tech Publishers, 2011
2. Khanna O.P and Justo C.G; Highway Engineering, Nem Chand Publishers, 9e.
3. Donald Drew, Traffic Flow Theory Chapter 14 in Differential Equation Models, Springer, 1983

References:

1. Martin Whol, Brian V Martin , Traffic system Analysis for Engineers and Planners, McGraw Hill, NY, 1967
2. HCM 2010 (3 volume set), TRB Publications, 2010

Module	Contents	Hours	Sem. Exam Marks %
I	Traffic management – scope of traffic management measures – restrictions to turning movements – one way streets – tidal flow operations-Traffic segregation –Traffic calming- Exclusive bus lanes, Introduction to ITS	7	15
II	Regulation of traffic – Need and scope of traffic regulations- Motor Vehicle Act – Speed limit at different locations- regulation of the vehicle – regulations concerning the driver rules of the road enforcement	7	15
FIRST INTERNAL EXAMINATION			

III	Highway capacity: Its importance in transportation studies – basic, possible and practical capacity – determination of theoretical maximum capacity -passenger car units – level of service – concept in HC manual – factors affecting level of service.	**7**	**15**
IV	Design of Intersection: Design of at grade & grade separated intersection – rotary intersection – capacity of rotary intersection – traffic signals – warrants of traffic signals,-types of signals, signal coordination, design of fixed time signal –Websters approach	**7**	**15**
SECOND INTERNAL EXAMINATION			
V	Traffic Safety: causes of road accidents – collection of accident data – influence of road, the vehicle .the driver, the weather and other factors on road accident – preventive measures	**7**	**20**
VI	Traffic Flow: theory of traffic flow – scope – definition and basic diagrams of traffic flow- basic concepts of light hill – Whitham's theory – Introduction to Car 'following theory and queuing'	**7**	**20**
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a,b,c,d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE368	PRESTRESSED CONCRETE	3-0-0-3	2016

Pre-requisite: CE201Mechanics of Solids

Course objectives:

- To make students familiar with the concepts and design of typical pre-stressed concrete structural elements and to have a knowledge of the codal provisions

Syllabus :

Basic concept and principles of pre-stressed concrete systems- analysis for flexure- loss of pre-stress, Design philosophy and design for flexure, codal provisions , Shear and torsional behavior – analysis and design - calculation of deflection (short & long term), Anchorage Zone stresses in post tensioned members, Prestressed concrete poles and sleepers, Partial pre-stressing, composite beams – analysis and design, Statically indeterminate structures

Expected Outcomes:

The students will be able to

i. analyse prestressed concrete members
ii. design prestressed concrete members using codal provisions
iii. design for shear and torsion of prestressed concrete members
iv. design end blocks and provide detailing of reinforcements
v. design composite members and other applications
vi. design continuous members

Text Books :

1. G S Pandit & S P Gupta, ” Prestressed Concrete”, CBS Publishers,2014
2. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi 1998
3. Rajagopalan, N, “Prestressed Concrete”, Alpha Science, 2002

References:

1. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 1995
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt. Ltd., 1997
3. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990
4. IS 1343 – 1998 ISCode Bureau of Indian Standards

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Review- Basic concept and principles of pre-stressed concrete, materials, prestressing systems – Analysis of prestress and bending stresses loss of pre-stress Stresses at transfer and service loads.	6	15

II	Limit state design criteria: Inadequacy of elastic and ultimate load method, criteria for limit states, strength and serviceability. Design of sections for flexure codal provisions- ultimate strength in flexure	6	15
FIRST INTERNAL EXAMINATION			
III	Shear and torsional resistance: design of shear reinforcement, design of reinforcement for torsion, shear and bending.	7	15
IV	Deflections of prestressed concrete members: Importance, factors, short term and long term deflection. Codal provisions	7	15
SECOND INTERNAL EXAMINATION			
V	Anchorage Zone stresses in post tensioned members: Stress distribution in end block, anchorage zone reinforcement. Prestressed concrete poles and sleepers: Design of sections for compression and bending Partial pre-stressing- Definitions, principles and design approaches and applications	8	20
VI	Composite beams –Analysis and design – Ultimate strength – applications, Elementary idea of composite construction for tee beams in bridges. Statically Indeterminate structures: advantages of continuous member(Concepts and steps for analysis)-	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a, b, c, d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE372	ENGINEERING HYDROLOGY	3-0-0-3	2016

Pre-requisite : CE309 : Water Resources Engineering

Course objectives:

- To have a good understanding of all the components of hydrologic cycle
- To understand the mechanics of rainfall, its spatial and temporal distribution.
- To understand the fitting of probability distribution and statistical analysis of rainfall and Runoff.

Syllabus :

Basic concept of Hydrology and Hydrologic cycle - Test for consistency of rainfall records - Analysis of rainfall data - Hydrologic abstractions-infiltration-Evapotranspiration - methods of estimation-catchment characteristic-stream gauging - stage-discharge curve - its extension and adjustment. Computation of runoff- Rainfall- runoff correlation using linear regression techniques- Partial differential equation governing unsteady groundwater flow- Evaluation of aquifer parameters- Well flow near aquifer boundaries - Method of images - surface investigation of groundwater- Graphical representation of hydrochemical data- Pollution of ground water, sources, Seawater intrusion, Artificial recharge of groundwater- Design flood –Estimation of design flood- Flood frequency studies-Gumbel's method- Flood routing through reservoirs and Channel routing- Flood control methods, Flood forecasting and warning.

Expected Outcomes:

The students will be able to

1. understand the procedure, applicability and limitations of various methods of geotechnical investigation;
2. make proper engineering judgments and take appropriate decisions related to geotechnical investigations.

Text Books:

1. Deodhar.M.J., Elementary Engineering Hydrology, Pearson, 2009
2. Ojha, C.S.P, R. Berndtsson, P.Bhunya, Engineering Hydrology, Oxford University Press, 2015.
3. Reghunath. H M, Hydrology, New Age International Publications, 1987.
4. Subramanya. K, Engineering Hydrology, Tata McGraw Hill, 1984

References:

1. Garg S. K. Hydrology and Water Resources Engineering, Khanna Publishers, 2005
2. Ghanshyam Das, Hydrology and soil conservation Engineering, Prentice-hall of India, 2004.
3. Jayarami Reddy P, A Text Book of Hydrology, Laxmi Publications, 2005.
4. Maidment D.R., Hand book of Hydrology, Mc Graw Hill, 1993
5. Todd D. K., Ground Water Hydrology, Wiley, 2005
6. Ven Te Chow, David R Maidment, L. W. Mays, Applied Hydrology, McGraw Hill, 1988
7. Warren Viessman, Gary L Lewis, Introduction to Hydrology, Pearson, 2015.

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %

I	Basic concept of Hydrology and Hydrologic cycle -Test for consistency of rainfall records - Analysis of rainfall data - correlation between intensity and duration – intensity, duration and frequency - depth area duration (DAD) curve. Hydrologic abstractions- infiltration- - Green Ampt method-Evapotranspiration – different methods - Blaney Criddle method - penman method.	7	15
II	Catchment characteristics - classification of streams - stream pattern-stream order – stream gauging – rating of current meter - Extension of stage discharge curve - Adjustment of stage discharge curve-selection of site for stream gauging stations.	6	15
FIRST INTERNAL EXAMINATION			
III	Runoff - Computation of runoff– Hydrograph analysis-Rational method –- S-hydrograph - unit hydrograph from complex storm - synthetic unit hydrograph- Instantaneous unit hydrograph (Brief description only) – linear reservoir model.	7	15
IV	Partial differential equation governing unsteady groundwater flow- Evaluation of aquifer parameters - Theis method -Jacob's approximation method. Well flow near aquifer boundaries - Method of images - surface investigation of groundwater - Electrical resistivity method. Graphical representation of hydrochemical data - Pollution of groundwater, sources. Seawater intrusion- Ghyben-Herzberg relationship –Method of control of seawater intrusion- Artificial recharge of groundwater.	6	15
SECOND INTERNAL EXAMINATION			
V	Rainfall- runoff correlation using linear regression and multiple linear regression analysis. Design flood and their Estimation - Different methods - Flood frequency studies -Gumbel's method.	8	20
VI	Flood routing through reservoirs - ISD method- Modified Pulse method. Flood routing through channels by Muskingum method. Flood control methods - Flood forecasting and warning (Brief descriptions only)	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a,b,c,d)

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE374	AIR QUALITY MANAGEMENT	3-0-0-3	2016

Pre-requisites: Nil

Course objectives:

- To understand the various forms of air pollutants and their effects on human and environment
- To know the various methods of controlling air pollutants

Syllabus : Air pollution-sources, effects on human, vegetation, environment, air pollutants. Indoor pollution. Meteorology, factors affecting dispersion of pollutants, Plume behaviour. Modelling of air pollutants, Dispersion modelling. Monitoring of pollutants-Particulate and gaseous, Control of air pollutants-Methods for particulate and gaseous pollutants, Air quality legislations

Course Outcomes:

- Create an awareness among students regarding air pollution problems
- To understand the various techniques that can be adopted for managing air pollution related problems.

Text Books

1. C.S.Rao, "Environmental Pollution Control Engineering", New Age International Pub., 2006
2. M.N. Rao & H.V.N Rao ,Air Pollution, Tata McGraw Hill Co. Ltd, Delhi, 1990.
3. Peavy H S, Rowe, D.R. Tchobanaglous "Environmental Engineering" McGraw Hill Education, 1985

References:

1. Chhatwal G.R, Encyclopedia of Environmental Pollution and Control, Volumes 1,2,3, Anmol Publications, 1996
2. J. R. Mudakavi, Principles and Practices of Air Pollution Control and Analysis, IK International Pvt Ltd, 2012
3. Perkins H.C, "Air Pollution" McGraw Hill Publications, 2004
4. S C Bhatia, Textbook of Air Pollution and Its Control , Atlantic publishers, 2007
5. S P Mahajan, Air Pollution Control, Common Wealth of Learning, Canada, Indian Institute of Science, Bangalore, 2006
6. Stern.A, "Air Pollution" (Volume I ,II & III) ,Academic Press New York, 1962

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks %
I	Introduction- Components of Environment- Definition –Air Pollution- History of air pollution episodes-Various Sources of Air pollution – Air Pollutants- Types of Air Pollutants	6	15
II	Effect of air pollutants on health, vegetation, animals and materials and environment, Green house effect - Indoor Air Pollution, sources of indoor air pollutants	6	15

FIRST INTERNAL EXAMINATION			
III	Meteorological aspects of Air Pollutant Dispersion - Temperature and Pressure relationships-Atmospheric Stability- Temperature Lapse Rate- Inversions- Types, Plume behavior	7	15
IV	Dispersion of Air pollutants-Plume dispersion theory- Gaussian plume model (Derivation not required)- Assumptions-Advantages and Disadvantages- Pasquill's stability curves , Dispersion problems involving point source and line source - Estimation of plume rise.	7	15
SECOND INTERNAL EXAMINATION			
V	Air Quality monitoring - Ambient air sampling - Collection of gaseous air pollutants-Collection of particulate Pollutants- Ambient Air Quality standards	8	20
VI	Control of Air Pollutants- Particulate emission control-methods, Scrubbing-Cyclones- Filtration- Electrostatic Precipitation-Gaseous emission control- adsorption, absorption, thermal methods	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester examination)

Maximum Marks :100 **Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2 Each question can have a maximum of 4 subdivisions (a, b, c, d)