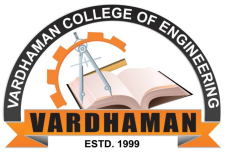

VARDHAMAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade, **ISO 9001:2015** Certified

Kacharam, Shamshabad, Hyderabad - 501218, Telangana, India

www.vardhaman.org

CURRICULUM

For

Master of Technology

Structural Engineering

Under

Choice Based Credit System (CBCS)

M. Tech. - Regular Two Year PG Program

(For batches admitted from the Academic Year 2022 - 2023)

October 2022

M. Tech – Structural Engineering

Regulations: VCE-R22

College Vision:

- **To be a pioneer institute and leader in engineering education to address societal needs through education and practice.**

College Mission:

- **To adopt innovative student centric learning methods.**
- **To enhance professional and entrepreneurial skills through industry institute interaction.**
- **To train the students to meet dynamic needs of the society.**
- **To promote research and continuing education.**

Department Vision:

- To be a center of excellence in civil engineering education, research and consultancy to support community directly or indirectly.

Department Mission:

- To adopt processes enhancing student learning experience and professional skills.
- To enhance entrepreneurial skills among the students through Industry Institute Interactions.
- To work in-tandem with industry to facilitate advancement of technology for societal needs.
- To promote research and continuing education through multi-disciplinary activities.

Program Educational Objectives(PEOs):

- PEO1: Graduates as structural engineers will enhance their analytical skills to face technological challenges by solving real-world problems.
- PEO2: Graduates through lifelong learning will acquire advanced technical skills and the ability to design and execute projects in a constantly changing environment.
- PEO3: Graduates will effectively communicate their ideas to collaborate with industry and R&D centers, work as a team member or leader to meet the obligations to the highest standards.
- PEO4: Graduates will investigate and implement socially and economically viable solutions to open-ended engineering tasks that span multiple disciples while upholding professional and ethical standards of civil engineers.

Program Outcomes(POs):

- **PO1: An ability to independently carry out research/investigation and development work to solve practical problems.**
- **PO2: An ability to write and present a substantial technical report/document.**
- **PO3: An ability to demonstrate a degree of mastery over the area of Structural Engineering.**
- **PO4: An ability to solve engineering problems in a sustainable and ethical way by using critical thinking skills.**
- **PO5: An ability to apply engineering tools, equipment and software to solve structural engineering problems.**

Programme Curriculum Structure
M. Tech – Structural Engineering

Regulations: VCE-R22

I Year I Semester									
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6801	Advanced Structural Analysis	3	0	3	40	60	100
2	B6802	Theory of Elasticity and Plasticity	3	0	3	40	60	100
3		Professional Elective - I	3	0	3	40	60	100
4		Professional Elective - II	3	0	3	40	60	100
5	B6803	Numerical Analysis Laboratory	0	4	2	40	60	100
6	B6804	Advanced Concrete Technology Laboratory	0	4	2	40	60	100
7	B6001	Research Methodology and IPR	2	0	2	40	60	100
8		Audit Course - I	2	0	0	-	100*	100*
Total			16	08	18	280	420	700

I Year II Semester									
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6805	Finite Element Analysis	3	0	3	40	60	100
2	B6806	Structural Dynamics	3	0	3	40	60	100
3		Professional Elective - III	3	0	3	40	60	100
4		Professional Elective - IV	3	0	3	40	60	100
5	B6807	Finite Element Analysis Laboratory	0	4	2	40	60	100
6	B6808	Structural Design Studio	0	4	2	40	60	100
7	B6841	Mini Project with Seminar	0	4	2	100	-	100
8		Audit Course - II	2	0	0	-	100*	100*
9		Dissertation Work Review - I	-	-	-	-	-	-
Total			14	12	18	340	360	700

Programme Curriculum Structure
M. Tech – Structural Engineering

Regulations: VCE-R22

II Year I Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1		Professional Elective - V	3	0	3	40	60	100
2		Open Elective	3	0	3	40	60	100
3	B6842	Dissertation Work Review - II	0	12	6	100	-	100
Total			06	12	12	180	120	300

II Year II Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6843	Dissertation Work Review - III	0	12	6	100	-	100
2	B6844	Dissertation Viva-Voce	0	28	14	-	100	100
Total			0	40	20	100	100	200

Programme Curriculum Structure
M. Tech – Structural Engineering

Regulations: VCE-R22

List of Professional Electives

Professional Elective - I	
Course Code	**Title of the Course**
B6851	Advanced Concrete Technology
B6852	Construction Technology and Project Management
B6853	Theory and Applications of Cementitious Composites

Professional Elective - II	
Course Code	**Title of the Course**
B6854	Advanced Design of Reinforced Concrete Structures
B6855	Structural Health Monitoring
B6856	Microstructure Analysis of Concrete

Professional Elective - III	
Course Code	**Title of the Course**
B6857	Bridge Engineering
B6858	Design of Prestressed Concrete Structures
B6859	Advanced Design of Steel Structures

Professional Elective - IV	
Course Code	**Title of the Course**
B6860	Earthquake Resistant Design of Structures
B6861	Theory of Plates and Shells
B6862	Fracture Mechanics

Professional Elective - V	
Course Code	**Title of the Course**
B6863	Repair and Rehabilitation of Structures
B6864	Design of Tall Structures
B6865	Ground Improvement Techniques

Programme Curriculum Structure
M. Tech – Structural Engineering

Regulations: VCE-R22

Audit Courses		
#	Course Code	Title of the Course
1	B6091	Disaster Management
2	B6092	Value Education
3	B6093	Constitution of India
4	B6094	Stress Management by Yoga
5	B6095	Personality Development through Life Enlightenment Skills
6	B6096	Pedagogy Studies

Open Electives		
#	Course Code	Title of the Course
1	B6081	Business Analytics
2	B6082	Waste to Energy
3	B6083	Operations Research
4	B6084	IoT and Applications
5	B6085	Cybersecurity
6	B6086	Mobile Cloud Computing

I YEAR I SEMESTER

Course Structure

B6801 - Advanced Structural Analysis

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces matrix methods of structural analysis to analyse flexural members and axial members. The stiffness matrix method and flexible matrix methods can be implemented in analysing the continuous beams, portal frames and grid members under different loading conditions. Students are introduced to assembling of local stiffness matrix into global stiffness matrix using transformation of co-ordinates. Also, solutions to the system of linear algebraic equations are discussed using Gauss elimination methods, Cholesky method and frontal equation techniques.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6801.1 Identify determinate and indeterminate structures.
B6801.2 Solve flexibility and stiffness matrices for all types of structures.
B6801.3 Apply various methods to assemble the direct stiffness matrix from member stiffness matrix.
B6801.4 Analyse flexural members and portal frames using matrix methods.
B6801.5 Evaluate solutions for set of equations using various methods.

3. Course Syllabus

Static and Kinematic Indeterminacy: Determinate and Indeterminate structures. **Matrix Methods:** Introduction - coordinate system - structure idealization - stiffness and flexibility matrices – suitability element stiffness equations - elements flexibility equations - mixed force – displacement equations - for truss element, beam element and tensional element. Transformation of coordinates - element stiffness matrix - and load vector – local and global coordinates.

Stiffness matrix assembly: element stiffness matrix - general procedure – band matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

Flexibility matrix method: Application to continuous beams and plane frames - Analysis of plane truss and grids.

Stiffness matrix method: Application to continuous beams and plane frames - Analysis of plane truss and grids.

Equation solution techniques: Solution of system of linear algebraic equations, direct inversion method, Gauss elimination method, Cholesky method, Banded equation solvers, Frontal solution technique.

4. Books and Materials

Text Books:

1. G S Pandit and S P Gupta, Structural Analysis- A Matrix Approach, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008
2. William Weaver J R and James M.Gere, Matrix Analysis of Frames structures, 3rd Edition, C.B.S. Publishers, 1990

Reference Books:

1. Ashok K. Jain, Advanced Structural Analysis, 3rd Edition, Nem Chand & Bros., 2015
2. C. S. Reddy, Basic Structural Analysis, 3rd Edition, McGraw Hill Education, 2017
3. Madhu B. Kanchi, Matrix Structural Analysis, 2nd Edition, John Wiley & Sons, 1994

Course Structure

B6802 - Theory of Elasticity and Plasticity

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course deals with isotropic materials subjected to elastic stresses, strains, and displacements. Different problems related to plane strain, plane stress and other boundary conditions are also covered. Two-dimensional and three-dimensional elastic problems are solved using equilibrium equations, compatibility equations for various boundary conditions. An introduction to plasticity involving one-dimensional elastic-plastic relations, hardening and governing equations is discussed.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6802.1 Demonstrate theory, concepts, principles and governing equations of elasticity.
B6802.2 Illustrate concepts of plasticity and its governing equations.
B6802.3 Develop equations of equilibrium and compatibility for two-dimensional problems in rectangular and polar co-ordinates.
B6802.4 Analyse three-dimensional problems of elasticity in Cartesian coordinates system and able to determine principal stresses and planes of 3D problems.
B6802.5 Solve elastic problems using equilibrium equations, compatibility equations for various boundary conditions.

3. Course Syllabus

Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain – differential equations of equilibrium - boundary conditions - Strain Displacement Relations - compatibility equations - stress function - Orthogonal Transformation of axes.

Normal and Shear Strain: Stress and Strain in three dimensions, Equilibrium con- ditions in three dimensions, Compatibility conditions in three dimensions, stress tensor, strain tensor, principal stress and strain, Stress Invariants - maximum shear stress and strain tensor for Plane Stress and Plane Strain cases. **General Theorems:** Equations of equilibrium in

terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem Strain Energy.

Two dimensional problems in rectangular coordinates: solution by polynomials - Airy's stress function - Saint- Venant's principle - determination of displacements - bending of simple beams - Simple Supported and Cantilever Beam.

Two dimensional problems in polar coordinates: stress distribution symmetrical about an axis -Airy's stress function - pure bending of curved bars - strain components in polar coordinates displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates - application of general solution in polar coordinates. **Analysis of stress and strain in three dimensions:** Stress ellipsoid - director surface - Homogeneous deformation - principal axes of strain rotation.

Introduction to plasticity: One-dimensional elastic-plastic relations, isotropic and kinematic hardening, yield function, flow rule, hardening rule, consistency condition, incremental stress-strain relationship, governing equations of elasto-plasticity.

4. Books and Materials

Text Books:

1. S. P. Timeshanko and J. N. Goodier, Theory of Elasticity, 3rd Edition, McGrawhill Education Publications, 2017

Reference Books:

1. Sadhu Singh, Theory of Elasticity, 4th Edition, Khanna Publishers, 1978

Course Structure

B6803 - Numerical Analysis Laboratory

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

The lab offers list of experiments to estimate the roots of the system of non-linear equations using bisection and newtons method, curve fitting approximations for the existing data, solving the system of linear equations using Gauss methods, finding integrals using Trapezoidal and Simpson's rules and obtaining numerical solutions to the ordinary differential equations using Euler's method and Range-Kutta method.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6803.1 Apply error approximations to fit the data in a curve.
B6803.2 Determine the roots of non linear equations.
B6803.3 Solve the system of linear equations using Gauss methods.
B6803.4 Evaluate integrals using trapezoidal and Simson's rules.
B6803.5 Estimate numerical solutions of ordinary differential equations.

3. Course Syllabus

1. Find the Roots of Non-Linear Equation Using Bisection Method
2. Find the Roots of Non-Linear Equation Using Newton's Method
3. Curve Fitting by Least Square Approximations
4. Solve the System of Linear Equations Using Gauss - Elimination Method
5. Solve the System of Linear Equations Using Gauss - Seidel Iteration Method
6. Solve the System of Linear Equations Using Gauss - Jorden Method
7. Integrate numerically using Trapezoidal Rule
8. Integrate numerically using Simpson's Rules
9. Numerical Solution of Ordinary Differential Equations by Euler's Method
10. Numerical Solution of Ordinary Differential Equations by Runge- Kutta Method

Course Structure

B6804 - Advanced Concrete Technology Laboratory

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

This lab deals with characterisation of materials and their properties used in concrete preparation. The effects of different constituents and their usage at different proportions and fresh properties of concrete are investigated. Different mechanical properties such as cube strength, cylinder strength and flexural strength for different grades of concrete and stress-strain behaviours are evaluated. The quality control aspects of reinforced concrete structures using NDT are also covered.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6804.1 Evaluate properties of concrete manufacturing materials to check their quality.
B6804.2 Classify properties of various types of admixtures and their applications.
B6804.3 Measure properties of fresh and hardened state of concrete.
B6804.4 Design normal and special concretes and evaluate the parameters affecting its performance.
B6804.5 Conduct Non-Destructive Tests on existing concrete structures.

3. Course Syllabus

1. To study the effect of water/cement ratio on workability and strength for different grades of concrete.
2. To study the effect aggregate/cement ratio on strength of concrete for different sizes (20 mm & 16 mm) aggregates.
3. To draw the Gradation Charts of Aggregates (Fine and Coarse aggregates).
4. To study the effect of mineral admixtures and chemical admixtures on workability of concrete.
5. To develop a Mix design for two grades of concrete using (a) I.S. method (IS 10262-2009) (b) ACI method.
6. To determine the correlation between cube strength, cylinder strength and Flexural strength for a given grade of concrete.

7. To develop the stress-strain curve for given grade of concrete.
8. To evaluate the flexural behaviour of Reinforced Concrete Beam.
9. To study the workability Tests on Fresh self-compacting concrete.
10. To evaluate the quality of concrete by using NDT methods.

Course Structure

B6001 - Research Methodology and IPR

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
2	0	28	0	2	40	60	100

1. Course Description

Course Overview

Research is an art of scientific investigation. Research is an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison and experiment. This course will help students to understand about the research process, tools, importance of ethics. Students can learn about the law of patent and copyrights and knowledge on IPR (Intellectual Property rights)

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6001.1. Identify an appropriate research problem in their suitable domain.
B6001.2. Construct a well-structured research paper and scientific presentations.
B6001.3. Express the importance of research ethics in scientific community.
B6001.4. Explore on various component of IPR and process of filing.
B6001.5. Gain knowledge on patents and copyrights.

3. Course Syllabus

Research Problem: Scope and objectives, Selection criteria, Research Problems, Research Approaches, Data collection, Data analysis, Ethics, Instrumentation, Interpretation.

Literature Studies: Effective literature studies, Types of literature review, Process and Purpose, Survey, Critical analysis, classification and comparison, case study, identifying the knowledge gap and propose a action plan.

Technical Writing: Effective Report/Article/Thesis writing, tools required, documentation using suitable application (Word, LaTeX, Pages), data representation using graphs, bar diagrams, pi-charts, preparation of manuscript, plagiarism, presentation of research work, Abstract and Conclusion.

Research proposal: Problem defining, national and international Scenario of proposed research, key factors, cost and contingencies, preparing timeline for research plan, funding agencies, collaboration, product and patent development.

Patent Rights and IPR: Process of Patenting and Development, Copyright, Trademark, Licensing and transfer of technology, Patent information and databases, New Developments in IPR, Administration of Patent System, Trade Secret, Copyright Infringement.

4. Books and Materials

Text Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology : Methods And Techniques, New Age International Publishers; 4th edition, 2019
2. P Suganda Devi, Research Methodology: A Handbook for Beginners, Notion Press; 1st edition, 2017
3. Brad Sherman and Lionel Bently, Intellectual Property Law, Oxford University Press, 4th edition, 2014

I YEAR II SEMESTER

Course Structure

B6805 - Finite Element Analysis

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces an advanced numerical method to solve civil engineering problems using finite element method. It includes introduction of plane stress - plane strain constitutive relationships along with the matrix algebra and discretization. The course covers formulation of stiffness matrices and load vectors for one-dimensional and two-dimensional systems of various elements. It also gives insights on shape functions, generalized coordinate system, axi-symmetric analysis and convergent requirements of different elements including plates.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6805.1 Illustrate concepts of FEA and relate energy principles in functional approximations.
B6805.2 Develop shape functions and stiffness matrices for 1D and 2D elements.
B6805.3 Solve problems using 2D and 3D iso-parametric elements.
B6805.4 Analyze Lagrange and axisymmetric 2D and 3D elements.
B6805.5 Evaluate plate elements using plate bending concepts.

3. Course Syllabus

Introduction: Concepts of FEA - steps involved - merits and demerits - energy principles – Discretization - Raleigh - Ritz method of functional approximation. Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain.

One dimensional FEA: Stiffness matrix for beam and bar elements - shape functions for 1-D elements. **Two dimensional FEA:** Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices.

Axi-symmetric formulation: Finite element formulation for plane stress, plane strain

and axi-symmetric problems - Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axi-symmetric problems- comparison of CST and LST elements - convergence of solution- interpretation of stresses.

Iso-parametric formulation: Concept - different iso-parametric elements for 2D analysis -formulation of 4-noded and 8-noded iso parametric quadrilateral elements - Lagrange elements - serendipity elements. **Three-dimensional FEA:** Different 3D elements - strain-displacement relationship - formulation of hexahedral and iso parametric solid element.

Introduction to finite element analysis of plates: Basic theory of plate bending - thin plate theory – stress resultants - Mindlin's approximations.

4. Books and Materials

Text Books:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, Concepts and Applications of Finite Element Analysis, 4th Edition, Wiley, 2001

Reference Books:

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite element Method, 3rd Edition, Pearson, 2002
2. C.S. Krishnamoorthy, Finite Element Analysis: Theory and Programming, 2nd Edition, McGraw Hill Education, 2013
3. J.N. Reddy, Introduction to Finite element Method, 3rd Edition, McGraw Hill Education, 2005

Course Structure

B6806 - Structural Dynamics

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces the equations of the motion using D-Alembert's, Hamilton and virtual work principles. Vectorial representation of simple harmonic motion and oscillatory motions are discussed. Free vibrations of single degree of freedom and multi degree of freedom including damping categories, dynamic magnification factors are explained. Also explained the shear building idealizations extends to estimation of natural frequency of discrete and continuous systems. Response of the multi degree of freedom systems giving insight to the modal analysis is presented in the course. Transverse vibrations in the continuous systems are highlighted.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6806.1 Apply equilibrium equations of motion in dynamic systems.
B6806.2 Determine dynamic characteristics of the system subjected to different types of loadings.
B6806.3 Analyse multi-degree of freedom systems using discrete approach.
B6806.4 Estimate natural frequencies using approximate methods.
B6806.5 Deduce natural frequencies and mode shapes for continuous systems.

3. Course Syllabus

Introduction: Elements of vibratory system, degree of freedom, continuous system, lumped mass idealization, oscillatory motion, simple harmonic motion, vectorial representation of S.H.M. **Theories of vibrations:** Free vibrations of single degree of freedom system, undamped and damped vibration, critical damping, logarithmic decrement, forced vibrations of SDOF systems, harmonic excitation, dynamic magnification factor, phase angle, Band width.

Fundamental objectives of dynamic analysis: Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and

Hamilton principle.

Single degree of freedom systems: Formulation and solution of the equation of motion – Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings -Duhamel integral. **Practical vibration analysis:** Selection of the degrees of Freedom - Evaluation of structural property matrices - Formulation of the MDOF equations of motion -Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

Practical vibration analysis: Introduction - Stodola method - Fundamental mode analysis – Analysis of second and higher modes - Holzer method - Basic procedure.

Continuous systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

4. Books and Materials

Text Books:

1. Anil K. Chopra, Dynamics of Structures, 4th Edition, Pearson Education, New Delhi, India, 2011
2. Mario Paz, Structural Dynamics, C.B.S. Publishers, New Delhi, India, 1980

Reference Books:

1. Vinod Hosur, Earthquake Resistant Design of Building Structures, Wiley, India
2. Clough and Penzien, Structural Dynamics, TMH
3. Timoshenko, S Vibration Problems in Engineering, Van-Nostrand Co.

Course Structure

B6807 - Finite Element Analysis Laboratory

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

The lab introduces a finite element analysis simulation tool to the students. The concepts involved in converting a real physical problem into structural simulation model are discussed. The principles of finite element analysis are used to solve structural engineering problems. Various structural engineering problems with different geometrical configurations and boundary conditions are analysed for different loading conditions to evaluate stresses, strains and displacements.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6807.1 Apply principles of finite element analysis to structural engineering problems.
B6807.2 Model structural components of different geometrical configurations.
B6807.3 Develop structural models for different boundary conditions.
B6807.4 Solve for stresses, strains and displacements using finite element software.
B6807.5 Examine dynamic properties of various structural components.

3. List of Experiments

1. Linear static analysis of bars
   i. constant cross-section
   ii. tapered cross section
   iii. stepped bar
2. Linear static analysis of beams
   i. cantilever
   ii. simply supported
   iii. fixed ends
3. Linear static analysis of truss
4. Linear static analysis of portal frame
5. Stress analysis of a rectangular plate with circular hole

6. Analysis of cylindrical element
7. Thermal analysis of a rectangular plate
8. Mode frequency analysis of beams
   i. Cantilever
   ii. simply supported
   iii. fixed ends

Course Structure

B6808 - Structural Design Studio

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

This lab introduces structural analysis and design simulation tools to the students. Flowcharts and spreadsheets are developed as per design procedures of IS codes. Various structural engineering models such as beams with different support conditions, trusses and frames are analysed for different loading conditions to evaluate reaction forces and displacements. Design of a multi-storey RC frame building for gravity loads as per IS codes is also discussed.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6808.1 Apply principles of structural mechanics for analysis and design of structures.
B6808.2 Develop flowcharts and spreadsheet-based designs as per IS codes.
B6808.3 Model various structural components using simulation tool.
B6808.4 Analyse beams, trusses and frames for different loads.
B6808.5 Design multi-storey RC frame building for gravity loads as per IS codes.

3. List of Experiments

1. Develop flowcharts and design spreadsheets for
   i. singly reinforced rectangular beam
   ii. doubly reinforced rectangular beam
   iii. T-beam
2. Develop flowcharts and design spreadsheets for columns
3. Develop flowcharts and design spreadsheets for
   i. one-way slab
   ii. two-way slab
4. Develop flowcharts and design spreadsheets for
   i. isolated square footing
   ii. combined footing
5. Analysis of beams

i. simply supported
ii. cantilever
iii. fixed
iv. continuous

6. Analysis of trusses
7. Analysis of portal frames
8. Analysis and design of multi-storey RC building for gravity loads

Professional Electives

Course Structure

B6851 - Advanced Concrete Technology

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course starts by covering properties of concrete constituents and usage of admixtures. This course mainly deals with preparation and handling of concrete, and mix design for different grades and special concretes. Tests on fresh and hardened concrete for field applications are also discussed. The quality control aspects of reinforced concrete structures are also covered.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6851.1 Evaluate properties of concrete manufacturing materials to check their quality.
B6851.2 Classify properties of various types of admixtures and their applications.
B6851.3 Measure properties of fresh and hardened state of concrete.
B6851.4 Design Different Grades of Concrete Mixes for various field applications.
B6851.5 Illustrate various types of special concrete and their use.

3. Course Syllabus

Cement: Chemical composition – Bogues compounds – heat of hydration – influence of compound composition on properties of cement. Aggregates: Classification of aggregate – particle shape and texture – gradation – fineness modules – grading curves. Gap graded aggregates – combined grading – alkali aggregate reaction – soundness of aggregate. **Admixtures:** Admixtures – mineral and chemical admixtures– admixtures of RMC & HCC – latest generation admixture.

Concreting methods: Process of manufacturing of concrete-methods of transportation-placing and curing - extreme weather concreting - special concreting methods - vacuum dewatering - under water technology-special form work-Ready mix Concrete. **Fresh concrete:** Workability - factors affecting workability - measurement of workability - effect of time and temperature on work - segregation and bleeding.

Hardened concrete: Concrete – Abram's law – Gel / space ratio – maturity concept – effective water in mix. – Testing of hardness concrete – Non-destructive and semi destructive testing of concrete – Durability of concrete – Strength in compression and tension– modulus of elastics, shrinkage and creep of concrete.

Concrete mix design: Design of mixes by BIS method, ACI method, DOE method – Erntroy and Shacklock's method. High Strength Concrete – Micro structure – Manufacturing and Properties- Design of High Strength Concrete - Ultra High Strength Concrete. High Performance Concrete- Requirements and properties of High-Performance Concrete- Design Considerations.

Quality control of concrete: Quality assurance quality management and quality audit – statistical quality control – Acceptance criteria – codal provisions. **Special concrete:** Light weight concrete mix design – Fiber reinforced concrete – SFRC and GFRC - Self Compacting concrete – polymer concrete – Geo Polymer concrete – high performance concrete – smart concrete.

4. Books and Materials

Text Books:

1. M. S. Shetty, Concrete Technology, S. Chand & Co., 2004
2. A. M. Neville, Concrete Technology, Pearson Education Limited, 2011

Reference Books:

1. Job Thomas, Concrete Technology, Cengage Learning
2. M. L. Gambhir, Concrete Technology, Tata McGraw Hill publishers, New Delhi

Course Structure

B6852 - Construction Technology and Project Management

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The Construction Technology and Project Management course focuses on study of the management and technological aspects of residential, industrial, commercial and institutional construction projects as well as engineering and infrastructure construction. This course provides practical problems for the students to acquire a unique combination of construction and project management skills in conjunction with the added dimension of protecting the environment and sustainability.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6852.1 Select appropriate tools, equipment and techniques required for execution of projects.
B6852.2 Identify key issues of building contracts, contract documentation, specifications, and regulations.
B6852.3 Apply techniques of construction planning and management in the execution of projects.
B6852.4 Examine quality and safety issues involved in construction projects.
B6852.5 Analyse resources, costs, claims, and disputes.

3. Course Syllabus

Introduction to project management: Construction industry and its challenges, Role of Project management, Organisation, Management Functions, Overview of Management Objectives, Tools and Techniques, Life cycle of construction projects, time estimates and construction schedules, CPM and PERT.

Project cost estimation: Approximate cost, detailed cost estimates, administrative approval and expenditure sanctions, rate analysis by client and contractor, bidding processes and strategies, Pre-qualification of bidders.

Construction equipment: Equipment economics, Excavators, Rollers, Dozers, Scrapers, Handling equipment, Concrete equipment, Cranes, Draglines and Clamshells. various items of construction: Earthwork, Excavation, Earth- moving, Drilling, Blasting, dewatering, foundation and Finishing items.

Contract management: Contract definition, its elements, Indian contract Act, documents forming a contract, Tendering and contractual procedures, stages of awarding contract, general conditions of Indian (domestic) contracts, types of contracts, contract administration; Duties and responsibilities of parties; important site documents, importance of specifications and codes in contract documents.

Quality management and safety in construction industry: Quality control by statistical methods, sampling plan, control charts, ISO standards, Safety Measures, Personnel, Fire and Electrical safety, Safety Programmes, Safety Awareness and Implementation of Safety Plan.

4. Books and Materials

Text Books:

1. Kharb K. S., A Guide to Quantity Surveyors, Engineers Architects and Builders (Vol. I: Taking Off Quantities, Abstracting & Billing; Vol. II: Analysis of Prices)
2. K. K. Chitkara, Construction Project Management, Tata McGraw Hill Education

Reference Books:

1. Subir K. Sarkar, Subhajit Saraswati, Construction Technology, Oxford University Press
2. Kumar Neeraj Jha, Construction Project Management – Theory and Practice, Pearson Education
3. U. K. Srivastava, Construction Planning & Management, Galgotia Publications

Course Structure

B6853 - Theory and Applications of Cementitious Composites

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces composite materials and the mechanical properties of their constituent materials. The relationship between various engineering properties of composite materials is also discussed elaborately. Use of cement composites, types and their behaviour in tension, compression, flexure, shear, fatigue and impact, durability and corrosion are also discussed. It also gives understanding of composites comprising binder or matrix and different types of fibers as per the requirements and practical applications.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6853.1 Categorize materials based on orthotropic and anisotropic behaviour.
B6853.2 Examine stress-strain behaviour and develop constitutive relations for composite materials.
B6853.3 Estimate mechanical properties of composite materials.
B6853.4 Analyse structural behaviour of various cementitious composites.
B6853.5 Demonstrate various applications of cement composites.

3. Course Syllabus

Introduction: Classification and characteristics of composite materials - Basic terminology - advantages.

Stress-strain relations: Orthotropic and anisotropic materials - Engineering constants for orthotropic materials – restrictions on elastic constants – plane stress problem – Biaxial strength – theories for an orthotropic lamina.

Mechanical behaviour: Mechanics of materials approach to stiffness – determination of relations between elastic constants - Elasticity approach to stiffness – bounding techniques of elasticity – exact solutions - Elasticity solutions with contiguity – Halpin – Tsai equations - comparison of approaches to stiffness.

Cement composites: Types of cement composites – terminology - Constituent materials and their properties - Construction techniques for fibre reinforced concrete, Ferrocement, SIFCON, Polymer concretes - Preparation of reinforcement – casting and curing.

Mechanical properties of cement composites: Behaviour of ferrocement, fiber reinforced concrete in tension, compression, flexure, shear, fatigue and impact, durability and corrosion. **Application of cement composites:** FRC and Ferrocement - housing – Water storage - Boats and miscellaneous structures.

4. Books and Materials

Text Books:

1. Robert M. Jones, Mechanics of Composite Materials, 2nd Edition, Taylor and Francis/BSP Books, New Delhi, 2015
2. S. P. Shah, P. N. Balaguru, Fiber reinforced cement composites, McGraw-Hill Inc., US, 1992
3. Ronald F. Gibson, Principles of Composite Material Mechanics, 4th Edition, CRC Press, 2016

Reference Books:

1. R.N. Swamy, New Concrete Materials, 1st Edition, Blackie, Academic and Professional, Chapman & Hall, 1983
2. R.P.Pama, Ferrocement – Theory and Applications, IFIC, 1980
3. Madhujit Mukhop, Mechanics of FRP Composite Materials & Structure, Universities Press, 2004

Course Structure

B6854 - Advanced Design of Reinforced Concrete Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course mainly deals with a sound background of the design of reinforced concrete structures, an understanding of selected advanced topics in the field including the use of new concepts. This course starts by covering yield line analysis of slabs. Thereafter, it covers the ribbed slabs, flat slabs, deep beams, and also covers the design of retaining walls.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6854.1 Apply concepts of reinforced concrete design to the singly reinforced, doubly reinforced and flanged sections.
B6854.2 Illustrate shear, torsion and bond behaviour of beams, and serviceability.
B6854.3 Distinguish one-way and two-way slabs design procedures.
B6854.4 Assess short and slender columns for different loading conditions.
B6854.5 Design of deep beams and corbels as per the provisions of IS 456.

3. Course Syllabus

Concepts of RC design: Characteristic and Design values - Partial safety factor Aims of design - RCC- Limit State method- Assumptions- Stress-Strain behavior of Steel and Concrete- Stress block parameters- Working stress method - Comparison of design process - Neutral axis – Balanced - Under Reinforced - Over Reinforced Sections - Moment of Resistance - Analysis and Design of Singly and Doubly Reinforced Rectangular Beams Design parameters- Design examples - Analysis of flanged RC section- Singly and Doubly reinforced- Effective flange width- Moment of Resistance design examples.

Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion - concept of bond, anchorage and development length. I.S. code provisions. Design examples.
Serviceability: Concept of Serviceability- Deflection- Span to depth ratio - Short term - Long term deflection due to Shrinkage, Creep – Cracking - Crack width calculation.

Design of RCC Slabs: Concept of yield line theory - Design of One- and Two-way slabs - Effect of edge conditions - Moment of resistance - Torsion reinforcement at corners - Design examples.

Design of Continuous Slab and Beams: Effect of continuity- analysis of continuous beam/slab - Moment and shear coefficients for continuous beam/slab - Critical sections.

Design of RC Columns: Design principles of RC columns- Assumptions - Rectangular and Circular columns- Helical reinforcement- Minimum eccentricity - Use of Interaction diagrams for Axial load and Moment.

Design of Slender Columns: Slenderness limits, Methods of Design of Slender Columns, Additional Moment Method, Design of slender columns subjected to combined bending moment and axial force.

Design of RC deep beams: Design of deep Beams, Design by IS 456, Checking for Local failures. Detailing of Deep Beams.

Design and analysis of corbels: Analysis of Forces in Corbels, Design procedure of Corbels.

4. Books and Materials

Text Books:

1. S. Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, 2nd Edition, Tata McGraw Hill, New Delhi, 2004
2. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India, New Delhi, India, 2008

Reference Books:

1. P. Purusthotham, Reinforced Concrete Structural Elements - Behavior, Analysis and Designs, Tata McGraw Hill, India, 1994
2. Kennath Leet, Reinforced Concrete Design, 2nd Edition, Tata McGraw Hill, India, 1991

Course Structure

B6855 - Structural Health Monitoring

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces different structural health monitoring techniques and instruments used for sensing and methodologies. Different field-testing methods along with their corresponding data acquisition systems are thoroughly discussed. Also, concept of remote structural health monitoring and its hardware are discussed along with their importance and applications in IoT and machine learning techniques.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6855.1 Illustrate structural sensing technologies for health monitoring.
B6855.2 Identify various types of structural health monitoring techniques.
B6855.3 Utilise appropriate testing methods for field tests.
B6855.4 Make use of various data acquisition systems.
B6855.5 Apply software and hardware for remote health monitoring of structures.

3. Course Syllabus

Introduction: Definition of SHM – Classification, Types and Components of SHM – Advantages and Benefits of SHM. **Sensing technologies:** Strain Measurement – LVDT – Temperature Sensors – Fiber Optic Sensing Technology - DIC.

Methodology: Sensors – Selection of Sensors – Installation and placement – Data acquisition – Communication – Processing and Analysis – Storage – Diagnostics and Prognostics – Retrieval of data.

Testing: Static Field Testing – Dynamic field testing - Stress history data - Dynamic load allowance tests - Ambient vibration tests - Forced Vibration Method - Dynamic response methods.

Data acquisition: Static data acquisition systems - Dynamic data acquisition systems - Components of Data acquisition system - Hardware for Remote data acquisition systems.

Remote structural health monitoring: Remote Structural Health Monitoring – Importance and Advantages – Methodology – IoT applications in SHM – Application Machine leaning Techniques in SHM.

4. Books and Materials

Text Books:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, John Wiley and Sons, 2006
2. Douglas E Adams, Health Monitoring of Structural Materials and Components - Methods with Applications, John Wiley and Sons, 2007

Reference Books:

1. J. P. Ou, H. Li and Z. D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol 1, Taylor and Francis Group, London, UK, 2006
2. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007

Course Structure

B6856 - Microstructure Analysis of Concrete

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the students to characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. This course primarily focusses on investigation of cement chemistry and microstructure characterization of concrete using techniques such as X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), 3D X-Ray Tomography, EDAX. The physics of the techniques and their application to cement science are also discussed.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6856.1 Identify suitable methods and equipment for characterisation of materials.
B6856.2 Illustrate the operation principles of different characterisation tools.
B6856.3 Interpret the results from various characterisation techniques.
B6856.4 Examine rheological behaviour of cement paste and concrete.
B6856.5 Assess influence of corrosion on reinforced concrete structures.

3. Course Syllabus

Concrete science: Introduction, Methods for Evaluation of Aggregates, Chemical methods of analysis of Concrete: hardened concrete analysis, Mortars, Grouts and Plasters.

IR spectroscopy: Spectra of rocks, minerals, clays, flyash and slags, Structural investigations of anhydrous cement phases.

Scanning electron microscopy: Simple Microscopy analysis, concrete under the SEM, Interpretation of concrete deterioration from SEM/EDXA.

X-ray diffraction: Basic principles, X-ray difractometry of clinker, cement and hydrated cement and concrete. Rheological behaviour of cement paste and concrete, physiochemical

interactions in porous media of concrete.

Techniques for corrosion investigation in reinforced concrete: Basic principles of corrosion, Reinforcing steel corrosion in concrete, corrosion assessment techniques, Surface Area Measurements, Pore structure, Permeation Analysis, Image analysis, Introduction to X-ray Microtomography.

4. Books and Materials

Text Books:

1. Karen Scrivener, Ruben Snellings and Barbara Lothenback, A practical guide to Microstructural Analysis of Cementitious materials, CRC Press, Taylor and Francis, Oct 2018
2. V. S. Ramachandran and James J. Beaudoin, Handbook of analytical Techniques in concrete Science and technology-Principles, Techniques, and Applications, Noyes publications, 2000
3. P. Kumar Mehta, Paulo J. M. Monteiro, Concrete: Microstructure, Properties, and Materials, 4th Edition, McGraw Hill Education, 2017

Reference Books:

1. Wieslaw Kurdowski, Cement and Concrete Chemistry, Springer, 2014
2. HFW Taylor, Cement chemistry, 2nd Edition, Thomas Telford, 1997
3. Peter Hewlett adn Martin Liska, Lea's chemistry of cement and concrete, Elsevier Science and Technology books, 2019

Course Structure

B6857 - Bridge Engineering

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course starts with the classification of bridges along with the bridge components to the design of abutment, pier and pier caps. Characteristics of flood discharge over the bridge elements are discussed. Design and analysis of superstructure elements such as slabs, beams and box girder bridges are elaborated. Design of cable stayed bridge is also introduced. Bridge bearings and expansion joints are included. Design of elastomeric bearings and expansion joints used in bridges under different conditions are explained.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6857.1 Classify the types of bridges and load patterns as per IRC standard recommendations.
B6857.2 Discuss the selection of bearings and expansion joints.
B6857.3 Analyse cables and towers for various loadings Design bridge superstructure.
B6857.4 Estimate the forces and moments acting on bridge elements abutments.
B6857.5 Design structural elements of bridge substructure and superstructures for various loadings.

3. Course Syllabus

Introduction: Bridge components - Classification – Investigation for bridges – Loads and Loading standards – IRC and Railway loads – Impact.

Bridge substructure: Determination of maximum flood discharge - Determination of linear water way - Determination of maximum depth of scour - Loads acting on substructure - Design of abutment, pier and pier cap - Design of well elements - Sinking of wells.

Bridge superstructure: Pigeaud's curves method for design of slab - Analysis of beams – Courbon's Method – Hendry Jaeger Method – Guyon and Massonet Method - Box Girder Bridges - Grillage analogy.

Cable bridges: Advantages - Arrangement of stay cables - types of towers - Linear analysis of cables and towers.

Bridge bearings and expansion joints: Functions, types and selection of bearings - Bearing materials - Design of elastomeric bearings and spherical pot bearings for different conditions - Expansion joints – types of expansion joints.

4. Books and Materials

Text Books:

1. Swami Saran, Analysis and Design of Substructures: Limit State Design, 2nd Edition, Oxford & IBH Publishing Co., 2018
2. D. Johnson Victor, Essentials of Bridge Engineering, 6th Edition, Oxford, 2017

Reference Books:

1. N. Krishna Raju, Design of Bridges, 5th Edition, Oxford and IBH publishing, 2019
2. T.R. Jagdeesh and M.A. Jayaram, Design of Bridge Structures, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2020

Course Structure

B6858 - Design of Prestressed Concrete Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course offers concepts of prestressing of concrete by giving basic idea about pre- and post-tensioning systems and general principles. Different methods of prestressing like Hoyer and Freyssinet systems along with the losses in prestress due to secondary stresses are discussed. Analysis and design of prestressed beams for flexure and shear conditions under straight, concentric, eccentric, bent and parabolic tendons are elaborated. Analysis of anchorage stresses and stress distribution in the PSC members are highlighted.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6858.1 Describe the basic concepts and principles of prestressed concrete.
B6858.2 Calculate the losses of prestress.
B6858.3 Analyse prestressed beams under flexure.
B6858.4 Estimate the anchorage stresses and stress distribution in the members.
B6858.5 Design of prestressed beams under flexure and shear.

3. Course Syllabus

Introduction: Historic development, basic concepts, terminology, materials, concrete, steel, necessity of high-grade concrete and steel, advantages of PSC, classification and types, tensioning devices, pre and post tensioning system, assumptions, general principles, analysis of beams with concentric tendon, eccentric tendon, beams with bent tendon. Different methods and systems of prestressing like Hoyer system, Freyssinet system.

Losses of Prestress: Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional loss.

Analysis of prestressed beams: Basic concepts, Analysis of sections for flexure, stresses at transfer and service loads, Prestressing by straight, concentric, eccentric, bent and parabolic

tendons, Pressure line, concept of load balancing, cracking moment. **Deflections of Prestressed Concrete Beams:** Short term deflections of un-cracked members, Prediction of long-time deflections, IS code requirements for maximum deflections.

Design of Sections for Flexure: Allowable stresses, Elastic design of simple beams having rectangular and I-sections, kern lines, cable profile and cable layout. **Design of Sections for Shear:** Shear and Principal Stresses, improving shear resistance by different prestressing techniques - horizontal, inclined and vertical prestressing, Design of beams having rectangular and I-sections, Design of shear reinforcement, IS code provisions.

Transfer of Prestress in Pretensioned Members: Transmission of prestressing force by bond, Transmission length, Bond stresses, IS code provisions. **Anchorage zone stresses in Post-tensioned Members:** Stress distribution in End block - Analysis by Guyon and Magnel methods, Anchorage zone reinforcement.

4. Books and Materials

Text Books:

1. Krishna Raju, Prestressed Concrete, 6th Edition, Tata McGraw-Hill Publications, 2018

Reference Books:

1. N. Rajagopalan, Prestressed Concrete, 2nd Edition, Alpha Science International Ltd., 2005
2. Ramamrutham, Prestressed Concrete, 5th Edition, Dhanpat Rai Publishing Company Private Limited, New Delhi, 2013
3. Muthu K. U., Ibrahim Azmi, Janardhana Maganti, Vijayanand M., Prestressed Concrete, PHI Learning Pvt. Ltd., 2016

Course Structure

B6859 - Advanced Design of Steel Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course provides foundation knowledge and skills relevant to the concepts, principles and components of structural design. It introduces the design of steel structures using the limit state design philosophy. Students will gain an understanding of statutory requirements, design standards, steel industry practices and design documentation. Steel structural members, structural design principles and evaluation of loads and estimation of member capacities for steel structures will all be addressed by this course.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6859.1 Classify the different design philosophies.
B6859.2 Determine strength parameters of different end connections.
B6859.3 Apply the principles, procedures and current code requirements.
B6859.4 Identify the different failure modes as well as design strength of axial members.
B6859.5 Design various members of steel structures.

3. Course Syllabus

Simple connections – riveted, bolted, pinned and welded connections: Riveted Connections – Bolted Connections –Load Transfer Mechanism – Failure of Bolted Joints – Specifications for Bolted Joints – Bearing – Type Connections – Tensile Strength of Plate – Strength and Efficiency of the Joint – Combined Shear and Tension – Slip-Critical connections – Prying Action. Design of Groove Welds - Design of Fillet Welds – Design of Intermittent Fillet Welds – Failure of Welds.

Eccentric and moment connections: Introduction – Beams – Column Connections – Connections Subjected to Eccentric Shear – Bolted Framed Connections –Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections- Welded Bracket Connections – Moment Resistant Connections.

Analysis and design of industrial buildings: Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform. Design of purlins for roofs. Design of bracings.

Design of steel truss girder bridges: Types of truss bridges, component parts of a truss bridge, economic Proportions of trusses, self-weight of truss girders, design of bridge Compression members, tension members; wind load on truss girder Bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing Design of Lacing.

Plastic analysis and design: Introduction – Plastic Theory – Plastic neutral Axis plastic moment, Elastic & Plastic Section modulii shape factors plastic Hinge – Fundamental condition conditions in plastic analysis, methods of plastic analysis – collapse load – simply supported, propped cantilever beam, fixed beams continuous beams, portal frame single bay single storey portal frame at different level subjected to vertical and horizontal loads.

4. Books and Materials

Text Books:

1. S.K. Duggal, Limit State Design of Steel Structures, McGraw Hill Education Private Ltd., New Delhi
2. Dr. Ramachandra and Virendra Gehlot, Design Steel Structures Volume – I & II, Scientific Publishers Journals Department

Reference Books:

1. Beer, F.P., Johuston, Jr., E.R., Dewolf, J.T. and Mazureu, D.E., Mechanics of Materials, 5th Edition, McGraw Hill, 2009
2. Irving H. Shames and James M. Pitarresi, Introduction to Solid Mechanics, 3rd Edition, PHI Publications, New Delhi, 2009
3. S. M. Khazimi, Solid Mechanics, 1st Edition, TMH New Delhi Publications, 2009
4. Indian Standard Code – IS – 800-2007.
5. Indian Standard Code – IS – 875 – Part III - 2015.

Course Structure

B6860 - Earthquake Resistant Design of Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces fundamental concepts of engineering seismology and characteristics of seismic-resistant buildings. Seismic resistant building architecture through lateral load resisting systems are discussed. Principles and concepts of earthquake resistant design of RC buildings are elaborated. Calculation of seismic design forces using Indian Standard code proposed methods are introduced. The course also deals with ductility provisions as per IS 13920, and its importance in earthquake resistant design of RC buildings as per IS 1893. A detailed example of earthquake-resistant design of a two-storey, two-bay RC building is also discussed. The basics of performance-based design methodology are also introduced to the students.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6860.1 Discuss the causes of earthquake, and seismic-resistant building architecture.
B6860.2 Apply concepts of seismic design philosophy of structural systems.
B6860.3 Implement ductility provisions in earthquake resistant design of RC buildings.
B6860.4 Estimate the seismic forces in the RC buildings.
B6860.5 Categorise the performance levels of the building.

3. Course Syllabus

Engineering seismology: Earthquake phenomenon - cause of earthquakes - Faults - Plate tectonics - Seismic waves - Terms associated with earthquakes - Magnitude/Intensity of an earthquake scales - Energy released. **Seismic-resistant building architecture:** Introduction - Lateral load resisting systems - moment resisting frame, building with shear wall or bearing wall system, building with dual system - Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyperstability/redundancy, non-structural

elements.

Design forces for RC buildings: Principles of earthquake resistant design - Seismic analysis methods - Mode superposition technique - Dynamic inelastic time history analysis - Advantages and disadvantages of these methods - Determination of lateral forces as per IS 1893 (Part 1) – Equivalent static method, Modal analysis using response spectrum.

Ductility considerations in earthquake resistant design of RC buildings: Introduction - Impact of ductility - Requirements for ductility - Assessment of ductility – Member/element ductility, Structural ductility - Factors affecting ductility - Ductility factors - Ductility considerations as per IS 13920.

Earthquake resistant design of a two-storey, two-bay RC building: Determination of lateral forces on an intermediate plane frame using Equivalent static method and Modal analysis using response spectrum - Analysis of the intermediate frame for various load combinations as per IS 1893 (Part 1) - Identification of design forces and moments in the members - Design and detailing of typical flexural member, typical column, footing and detailing of an exterior joint as per IS 13920.

Base isolation of structures: Introduction - Considerations for seismic isolation - Basic elements of seismic isolation - Seismic-isolation configurations. **Performance-based design:** Force-based vs. displacement-based design - introduction to performance-based design - Structure performance objectives - performance levels and limit states - Structural and non-structural performance - performance evaluation of structures - quantification of performance - Concept of overstrength and ductility.

4. Books and Materials

Text Books:

1. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, Prentice-Hall of India, 2006
2. S. K. Duggal, Earthquake Resistant Design of Structures, Oxford University press, 2007

Reference Books:

1. T. Paulay and M.J.N. Priestley, Seismic design of reinforced concrete and masonry buildings, John Wiley & Sons, 1991
2. F. Naeim, The seismic design handbook, Kluwer Academic publishers, 2001
3. Bureau of Indian Standards, Criteria for Earthquake Resistant Design of Structures, IS 1893, New Delhi, 2016.
4. Bureau of Indian Standards, Ductile detailing of concrete structures subjected to seismic force – Guidelines, IS 13920, New Delhi, 2016.

Course Structure

B6861 - Theory of Plates and Shells

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course covers basic concepts of shells and their displacement relations under boundary conditions. It also deals with analysis of rectangular and circular plates for various loading conditions. Analysis of different shapes of shells structures using membrane theory is also discussed. The structural behaviour of different folded plates is also introduced.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6861.1 Illustrate concepts, displacement relations and boundary conditions of shells.
B6861.2 Evaluate rectangular plates for various loading and boundary conditions.
B6861.3 Analyse circular plates under axi-symmetric loading.
B6861.4 Apply membrane theory to analyse shells structures of different shapes.
B6861.5 Outline structural behaviour of different types of folded plates.

3. Course Syllabus

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

Static analysis of plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

Circular plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

Static analysis of shells: Membrane Theory of Shells - Cylindrical, Conical and Spherical

Shells.

Folded plates: Introduction of folded plate structures – Structural behaviour – Various types.

4. Books and Materials

Text Books:

1. Chandrashekhara K., Theory of Plates, Universities Press
2. Bhavikatti S. S., Theory of Plates and Shells, New Age International

Reference Books:

1. Timoshenko, Theory of Plates and Shells, McGraw Hill Book Co., New York
2. N. K. Bairagi, Plate Analysis, Khanna Publishers, New Delhi
3. P. Szilard, Theory and Analysis of Plates, Prentice Hall

Course Structure

B6862 - Fracture Mechanics

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course deals with study of propagation of cracks in materials and different failure modes of fracture. It covers various characteristics of fracture such as energy release rate, stress intensity factor, crack tip opening displacement, J-integral and other toughness properties. It also introduces concepts of linear elastic fracture mechanics and its application to various cementitious composites.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6862.1 Classify cracking in concrete structures based on fracture mechanics principles.
B6862.2 Evaluate stress intensity factor and implement to notched members.
B6862.3 Make use of concepts of LEFM and compute J-Integral for various sections.
B6862.4 Examine crack toughness properties for different crack openings.
B6862.5 Apply fracture mechanics models to high strength concrete and FRC structures.

3. Course Syllabus

Introduction to fracture mechanics: Kinds of Failure - Historical Aspects - Brittle and Ductile Fracture - Modes of Fracture Failure - How Potent is a Crack - Point of View - Damage Tolerance. **Energy release rate:** Griffith Dilemma - Energy Release Rate - Mathematical Formulation - Change in Compliance Approach - Change in the Strain Energy Approach – Energy Release Rate of DCB Specimen - Inelastic Deformation at Crack-tip - Crack Resistance - Stable and Unstable Crack Growth - R-curve for Brittle Cracks - Thin Plate vs Thick Plate - Critical Energy Release Rate.

Stress intensity factor: Introduction - Linear Elastic Fracture Mechanics (LEFM) - Stress and Displacement Fields in Isotropic Elastic Materials - Stress Intensity Factor - Background for Mathematical Analysis - Field Equations - Elementary Properties of Complex Variables

- Westergaard's Approach for Models with Opening Mode, Sliding Mode & Tearing Mode.

Inelastic deformation at the crack tip: Further Investigation at the Crack Tip - Approximate Shape and Size of the Plastic Zone - Plastic Zone Shape for Plane Stress - Plastic Zone Shape for Plane Strain - Effective Crack Length - Approximate Approach - The Irwin Plastic Zone Correction - Plastic Zone Size through the Dugdale Approach - Effect of Plate Thickness - Closure.

J integral: Relevance and Scope - Definition - Path Independence - Stress-Strain Relation. **Crack tip opening displacement:** Introduction - Relationship between CTOD, Kr and Gr for Small Scale Yielding - Equivalence between CTOD and J.

Application to cementitious composites: Material models - General concepts – crack models – band models - Models based on continuum damage mechanics– applications to high strength concrete – fibre reinforced concrete - crack concepts and numerical modelling.

4. Books and Materials

Text Books:

1. Prasant Kumar, Introduction to Fracture Mechanics, McGraw Hill Publications
2. Suri C. T. and Jin Z. H., Fracture Mechanics, Elsevier Academic Press

Reference Books:

1. Broek David, Elementary Engineering Fracture Mechanics, Springer
2. Elfgreen L., Fracture Mechanics of Concrete Structures – Theory and Applications, RILEM Report, Chapman and Hall

Course Structure

B6863 - Repair and Rehabilitation of Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces the concept as well as techniques associated with repairs and rehabilitation of existing structures. The course enables the students to understand the functionality of any structures depends on various factors during its life time. The theoretical knowledge of rehabilitation will enable students to develop skills to carry out repairing or retrofitting of existing structure. The course also discusses the modern tools/instrumentation to measure the level of damage or strength present in the structure.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6863.1 Illustrate various maintenance and repair strategies.
B6863.2 Categorize the causes and prevention mechanisms of corrosion and damages occur in structures.
B6863.3 Apply various methods and techniques for damage assessment and diagnosis.
B6863.4 Formulate the usage of different techniques for structural retrofitting.
B6863.5 Estimate the structural damage and recommend suitable repair and strengthening methods.

3. Course Syllabus

Causes of Deterioration and Durability Aspects: Holistic Model for Deterioration of RCC; Permeability of Concrete: Capillary Porosity, Air Void, Micro and Macro Cracks; Aggressive **Deteriorating Chemical Agents:** Corrosion of reinforcing bars, Sulphate Attack, Alkali Silica Reaction, Intrinsic and Extrinsic Causes and Stages of Distress.

Condition Survey & Non-Destructive Evaluation: Definition, Objective, Stages, Consideration for Repair Strategy. **Non-Destructive Evaluation Tests:** Concrete Strength Assessment: Rebound Hammer Test, Ultrasonic Pulse Velocity (UPV) Test, Penetration Resistance (Windsor Probe & PNR Test), Pull- out (LOK) Test, Core Sampling and Testing; Chemical Tests: Carbonation Test, Chloride Content; Corrosion Potential Assessment: Cover meter survey, Half-cell potential survey, Resistivity Measurement; Fire Damage As-

sessment: Differential Thermal Analysis (DTA), X-ray Diffraction (XRD); Structural Integrity/Soundness Assessment: Radiography, Impact-echo Test, Dynamic Testing of Structures.

Selection of Repair Materials for Concrete: Essential Parameters for Repair Materials; Materials for Repair: Premixed Cement Concrete/Mortars: Cements, Mineral and Chemical Admixtures, Water Cement Ratio; Epoxies and Epoxy Systems including Epoxy Mortars/Concretes: Epoxies, Modifies Epoxy Systems, Precautions to be taken, Field of Applications; Polyester Resins; Surface Coatings: Essential Parameters for coatings, Types of surface coatings.

Polymer Modified Mortars and Concrete (PMM/PMC): Materials, Process of Polymer Modification in Cement Concrete/Mortar, Composition of Polymers, General Requirements, Classification and Properties of Polymer Latexes, Physical and Mechanical Properties of Polymer Modified Mortars/Concretes, Mix Proportioning, General Guidelines & Precautions for use of Polymer Modified Cement Mortar/Concrete, Field of Applications. **Repair Methods:** Repair options; Performance Requirements of Repair Systems; Important factors to be considered for Selection of Repair Methods; Repair Stages; Repair Methods: Repairs using Mortars, Dry Pack and Epoxy Bonded Dry Pack, Pre-placed Aggregate Concrete (PAC), Shotcrete, Concrete Replacement, Epoxy Bonded Concrete, Polymer Concrete System, Strengthening Concrete by Surface Impregnation using Vacuum Methods, Thin Polymer Overlays, Thin Epoxy Overlays, Resin/Polymer Modified Cement Slurry Injection, Protective Seal Coats on the Entire Surface.

Rehabilitation Strategies: Ferro-cement, Plate Bonding, RCC Jacketing, Propping and Supporting, Fibre Wrap Technique, Foundation Rehabilitation Methods, Chemical and Electro - chemical Methods of Repair; Repair/Rehabilitation Strategies – Stress Reduction, Repair/Strengthening of Columns, Beams and Slabs, Compressive Strength of Concrete, Cracks/Joints, Masonry, Protection, Foundation, Base Isolation.

4. Books and Materials

Text Books:

1. Mehta, P. K. and Monteiro, P. J., Concrete – Microstructure, Properties and Materials, Tata McGraw Hill, New Delhi, 2004
2. Handbook on Repair and Rehabilitation of RCC Buildings, Director General (Works), Central Public Works Department (CPWD), Government of India Press, New Delhi

Reference Books:

1. Woodson R. D., Concrete Structures – Protection, Repair and Rehabilitation, 1st Edition, Butterworth Heinemann Elsevier Publishers, 2009

Course Structure

B6864 - Design of Tall Structures

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces the design criteria for structural design of tall buildings and development of high-rise architecture. The course evolves the strategic development of tall structures through environmental requirements, material handling and mechanization. Design considerations of tall structures subjected to wind and seismic loads are discussed. Flooring systems related to the tall building architecture is included. Various approaches for modelling and analysing tall structures with the predefined assumptions are highlighted.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6864.1 Discuss the design criteria of tall structures under height development architecture.
B6864.2 Prepare tall building architecture with respect to environmental aspects.
B6864.3 Illustrate material handling considerations for horizontal and vertical movements.
B6864.4 Explain structural forms and flooring systems made of concrete and steel for tall structures.
B6864.5 Analyse tall buildings using various approaches.

3. Course Syllabus

Evolution of tall buildings: Introduction - Design criteria for structural design of tall building - Concept of premium for height - Development of high-rise architecture. **Assembly of building and site investigation:** Building performance – cost, quality and time.

Environmental requirements: Industrialization & Robotics in Construction - Introduction to safety and Health Management System - Stages of site Investigation - Site Reconnaissance & Ground investigation -Field tests and Laboratory tests - Foundation systems.

Material handling and mechanization: Material handling considerations – Earthmoving equipment's - Horizontal and vertical movements - Selection & Utility of Cranes (Tower

Cranes & Climbing Cranes).

Wind & seismic effects on behaviour of tall structures: Outlook of Design considerations and Characteristics of wind - Codal wind loads and cladding pressures on behaviour of tall buildings - Introduction to Tall building behaviour during earthquakes and seismic design philosophy.

Structural forms & flooring systems: Introduction of Various structural forms and their importance to high rise architecture - Introduction to various Flooring Systems in concrete & steel. **Modelling for analysis:** Approaches for analysis - Assumptions involved in modelling - Reduction techniques - Application using Structural engineering Software.

4. Books and Materials

Text Books:

1. Taranath B., Tall Building Design: Steel, concrete and composite system, 1st Edition, CRC Press, 2016
2. Feng Fu, Design and analysis of Tall and Complex Structures, Butterwoth Heinemann, 2018

Reference Books:

1. Yit Lin Michael Chew, Construction Technology for Tall Buildings, World Scientific Publication, 2017
2. B.S. Taranath, Reinforced Concrete Design of Tall Buildings, CRC Press, 2010

Course Structure

B6865 - Ground Improvement Techniques

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The aim of the course is to introduce the basic concepts of soil mechanics. The basic soil-water interactions and the stress distribution within the soil masses are brought into picture. The classical theories of soil mechanics are used to explain the index and the engineering properties of the soil. These include the density index, the grain size analysis and the consistency characteristics of the soil used for the preliminary classification of the soils and for the primary estimation of the engineering properties. The engineering properties are used in the design and analysis for various works like earth retaining walls and foundation design.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6865.1 Classify the soils based on index properties.
B6865.2 Apply the principles of soil mechanics in order to find the permeability and compaction characteristics.
B6865.3 Analyze the stress distribution of soil under various loading conditions.
B6865.4 Estimate magnitude and rate of settlement of soil.
B6865.5 Evaluate the shear strength of soil.

3. Course Syllabus

Introduction: Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability - Densification of cohesionless soils – Deep Compaction – Vibroflobation – Vibro Composer method - Blasting – Densification at Ground. - Vibrocompaction - Heavy Tamping.

Improvement of cohesive soils: Preloading - Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains – Dynamic Compaction.

Stabilisation: Mechanical Stabilisation, Lime Stabilisation, Cement Stabilisation, Bitumen

Stabilisation, Thermal Stabilisation, Chemical Stabilisation and Stabilisation with Different Admixtures.

Dewatering: Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electro – kinetic dewatering – Electro-osmosis. **Grouting:** Overview of grouting - Suspension grouts – Solution grouts – Emulsion grouts- Categories of grouting – Grouting Techniques – ascending stage, descending stage and stage grouting – Grouting Plant - Grout control - Grouting applications – Dams, Tunnels, Shafts and drifts, excavations.

Stone columns: Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns Lime columns and granular trenches – Installation – In situ ground reinforcement – ground anchors – types – Components and applications – uplift capability- Stability of foundation trenches and surrounding structures through soil Nailing, tie backs.

4. Books and Materials

Text Books:

1. M. R. Hausmann, Engineering Principles of Ground Modifications, McGraw Hill publications, 1990
2. Dr. P. Purushothama Raj, Ground Improvement Techniques, Laxmi Publications, 2016

Reference Books:

1. R. M. Koerner, Designing with Geosynthetics, Prentice Hall, New Jersey, 1994
2. K. Krisch & F. Krisch, Ground Improvement by Deep Vibratory Methods, Spon Press, Taylor and Francis, 2010
3. Donald P. Coduto, Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012

Audit Courses

Course Structure

B6091 – Disaster Management

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course has been framed with an intention to provide a general concept in the dimensions of disasters caused by nature beyond human control as well as the disasters and environmental hazards induced by human activities with emphasis on Natural disaster, Man-made disaster, vulnerability and risks of disasters, Disaster Management Mechanism, Capacity Building and disaster coping Strategies and Disaster management planning.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6091.1 Identify concepts, hazards and vulnerabilities of different types of disasters.
B6091.2 Examine the components of disaster management mechanism.
B6091.3 Select suitable capacity building framework for disaster management.
B6091.4 Interpret various disaster coping strategies.
B6091.5 Develop Strategies for disaster management planning.

3. Course Syllabus

Introduction: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **Disaster Prone Areas in India:** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

4. Books and Materials

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi

Course Structure

B6092 – Value Education

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The present education system does not prepare students well for dealing with life. Primarily, it prepares them for profession or jobs. It concentrates on providing "How to do" rather than "What to do" or "Why to do?". This course will be helpful for students to develop critical ability, commitment and courage in real life problems. Students will learn about happiness, character development, self control, honesty, time management.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6092.1 Identify the importance of value based living for character development.
B6092.2 Emerge as responsible citizens with clear conviction to practice values and ethics in life.
B6092.3 Interpret their role in nation building for a better tomorrow .
B6092.4 Develop a sense of commitment and decision making capability.

3. Course Syllabus

Values and Self - Development: Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgments.

Importance of Cultivation of Values: Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truth fullness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature Discipline.

Personality and Behavior Development: Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.

Achieving Happiness: Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for

truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Character and Competence: Holy Books vs Blind faith. Self-Management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, and Studying effectively.

4. Books and Materials

Text Books:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.
2. David N. Aspin, Judith D. Chapman, "Values Education and Lifelong Learning: Principles, Policies, Programmes" Springer, 2007

Course Structure

B6093 – Constitution of India

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course enables the students to understand the constitution of India as the Supreme law of India. The student will also gain knowledge about the parliament of India and how it functions. This course will survey the basic structure and operative dimensions of the Indian constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian constitution.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6093.1 Identify the important components of Indian Constitution.
B6093.2 Explore the basics of Constitutional right in various domains .
B6093.3 Illustrate the evolution of Indian Constitution.
B6093.4 Analyze the Administrative process in India from grass-root level.
B6093.5 Relate the basic concepts of democracy, liberty, equality, secular and justice.

3. Course Syllabus

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble, Salient Features.

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

4. Books and Materials

Text Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015

Reference Books:

1. M. P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis, 2014
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Structure

B6094 - Stress Management by Yoga

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

Stress has been determined to be a key factor of illness and disease. Prolonged stress in any person can lead to negative thinking, depression and worse. The course is based on managing stress by practice of yogic principles that are proven to be highly effective and easy to learn. In this course the students will learn about different types of yoga practices, Meditation, Yoga asanas, Pranayama for stress, anger and fear management.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6094.1 Make use of yoga for stress management in educational environments.
B6094.2 Improve emotional intelligence to better deal with stress.
B6094.3 Develop flexibility through participation in yoga.
B6094.4 Learn methods of performing asanas, pranayama, mudras and bandhas.
B6094.5 Practice meditation for holistic living.

3. Course Syllabus

Meaning and Definition of Stress: Eutress, Distress, Anticipatory Anxiety, Intense Anxiety and Depression. Necessity of Stress Management, Concept of Stress according to Yoga.

Introduction to Yoga: Definition and Meaning of Yoga, Historical Perceptive on yoga – yoga before the time of Patanjali (Indus valley civilization, Vedas, Brahmnas, Upanishads, Epics, Puranas).

Schools of Yoga: Eight Limbs of Yoga: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana & Samathi. General principles of practicing Asana, Pranay- ama, Meditation, Kriyas Bandhas and Mudra.

Essentials of yoga practices: Prayer, Disciplines in Yogic Practices, Place & Timing, Diet & Schedule for Yoga Practitioner. Obstacles in the Path of Yoga Practice, Sequence for yogic

practices, Different between yogic & non yogic system of exercise. Do's and donts during Yoga

Personality development by yoga: Yoga and development of Social qualities of personality, Co-operation, Simplicity, Tolerance, Social adjustments, Yoga and personal efficiency. Improvement of personal efficiency through yoga.

4. Books and Materials

Text Books:

1. Wasmer Linda Andrews, Stress Control For Peace of Mind, Barnes & Noble Publisher, 2005
2. H.R. Nagendra, and R. Nagarathana, Yoga practices for anxiety & depression. Bangalore: Swami Sukhabodhanandha Yoga Prakashana 2004.

Reference Books:

1. BKS Iyengar, The Art of Yoga. New Delhi: Harper Collins Publishers, 2003.

Course Structure

B6095 - Personality Development through Life Enlightenment Skills

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course aims to provide a basic awareness about the significance of Life Enlightenment skills in all-round development of personality. Personality development boosts confidence level in students and help them achieve high esteem. In this course the holistic development of personality in students will be done by practicing some basic Veres of Srimad Bhagavath Geetha by explaiing the true meaning of Wisdom, Pride, Virtue, Happiness, Pain.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6095.1 Create Holistic development of personality.
B6095.2 Exercise the role model in the Bhagavath Geetha by practicing it.
B6095.3 Develop a sense of spirituality and heart fullness in mind and body.
B6095.4 Demonstrate knowledge of beliefs and values to continuing personal reflection and reassessment.

3. Course Syllabus

Neetisatakam - Holistic Development of Personality:

Verses- 19, 20, 21,22 (Wisdom)

Verses- 29, 31, 32 (Pride & Heroism)

Verses- 26, 28, 63, 65 (Virtue)

Do's and Dont's

Verses- 52, 53, 59 (Dont's)

Verses- 71, 73, 75, 78 (Do's)

Approach to Day to Day Work and Duties:

Chapter 2: Verses 41, 47,48

Chapter 3: Verses 13, 21, 27, 35

Chapter 6: Verses 5,13,17, 23, 35

Chapter 18: Verses 45, 46, 48.

Statements of basic knowledge :

Chapter 2: Verses 56, 62, 68

Chapter 12: Verses 13, 14, 15, 16,17, 18

Personality of Role Model

Chapter 2: Verses 17

Chapter 3: Verses 36,37,42

Chapter 4: Verses 18, 38,39

Chapter 18: Verses 37,38,63

4. Books and Materials

Text Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.

Reference Books:

1. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Samskrit Sansthanam, New Delhi.

Course Structure

B6096 - Pedagogy Studies

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

Pedagogy is the relationship between learning techniques and culture. It requires meaningful classroom interactions between educators and learners. The objective of this course is to help students build on prior learning and develop skills and attitudes. Furthermore it can improve the quality of your teaching and the way students learn, helping them gain a deeper grasp of fundamental material.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6096.1 Develop a positive attitude towards life and teaching profession
B6096.2 Critically analyze the classroom teaching, learning and behavior.
B6096.3 Compare the teaching and learning practices in educational institutes in the past decade.
B6096.4 Summarize the aspects of effective teaching process.

3. Course Syllabus

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic Overview: Pedagogical practices in formal and informal classrooms in developing countries, Curriculum development, Teacher education.

Evidence on the Effectiveness of Pedagogical Practices : Quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Professional Development: Alignment with classroom practices and followup support. Peer support, Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.

Research Gaps and Future Directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment. Dissemination and research impact.

4. Books and Materials

Text Books:

1. Ackers J, Hardman F (2001) Classroom Interaction in Kenyan Primary Schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular Reform in Schools: The Importance of Evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher Training in Ghana - does it count? Multi-site Teacher Education Research Project (MUSTER) Country Report 1. London: DFID.

Reference Books:

1. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving Teaching and Learning of Basic Maths and Reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
2. Alexander RJ (2001) Culture and Pedagogy: International Comparisons in Primary Education. Oxford and Boston: Blackwell.
3. Chavan M (2003) Read India: A mass scale, rapid, 'Learning to Read' campaign.

Open Electives

Course Structure

B6081 - Business Analytics

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course addresses the scope of business analytics, process and tools used to get competitive advantages of business analytics. It covers the forecasting techniques to predict the given data for various decision making. Apart from prediction it also establishes the relationship between the given data to formulate the strategies for business decisions.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6081.1	Demonstrate knowledge of data analytics.
B6081.2	Demonstrate the ability of think critically in making decisions based on data and deep analytics.
B6081.3	Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making,
B6081.4	Demonstrate the ability to translate data into clear, actionable insights.

3. Course Syllabus

Theory

Business analytics and Statistical Tools: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Forecasting Techniques and Monte Carlo Simulation and Risk Analysis: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model,Overbooking Model, Cash Budget Model.

Decision Analysis and recent trends: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

4. Books and Materials

Text Books:

1. Varshney & Maheswari , Business analytics Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, 1st Ed., Pearson FT Press, 2014
2. Jamesh R Evans, Business Analytics, Global Edtion, Pearson Higher Education & Professional Group, 2020

Course Structure

B6082 - Waste to Energy

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course deals with the production of energy from different types of wastes through thermal, biological and chemical routes. This course provides insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production. This course is explores Biomass Pyrolysis, Biomass gasification, Biomass combustions and Bio energy systems.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6082.1 Classify different waste material produces from all sources.
B6082.2 Analyze Bio energy systems resources, process and application.
B6082.3 Apply emerging methods for Bio mass Pyrolysis, gasification and combustion to improve the efficiency.
B6082.4 Analyze different case studies for understanding success and failure of waste to energy technologies.

3. Course Syllabus

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers - Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,

fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

4. Books and Materials

Text Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Structure

B6083 - Operations Research

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The courses in Operational Research offer a unique blend of traditional coursework, practical skills, and real-world problem-solving experience designed to position students for success in today's competitive world. This course covers Linear Programming, Non-Linear Programming Problem, Mathematical Models and problems.

Course Pre/co-requisites

Industrial Management concepts

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6083.1 Gain knowledge in concepts and techniques of Operations Research.
B6083.2 Determine the optimal solution for Linear Programming problems.
B6083.3 Formulate and obtain the optimal solution for non- Linear Programming problems.
B6083.4 Solve to get optimal solution using queuing and inventory models .
B6083.5 Determine solution for non- Linear Programming problems using dynamic programming

3. Course Syllabus

Linear Programming Problem & Its Application I: Introduction, Formulation of LPP. Slack Variable, Surplus Variable and Artificial Variables. Standard Form and Matrix Form. Concept of Duality. Graphical Method. Simplex Method. Big - M method & Two - Phase Method. Problems of Degeneracy.

Linear Programming Problem & Its Application II: Parametric Programming introduction . Types of Linear Variations. Graphical and Analytical Sensitivity Analysis.

Non-Linear Programming Problem I: Introduction, Formulation and Graphical Method, Kuhn-Tucker Conditions, Quadratic Programming Problems by Wolfe's and Beale's Method.

Non-Linear Programming Problem II: Geometric programming introduction and analytical methods , Fractional programming introduction and analytical methods, Dynamic

programming introduction and analytical methods.

General Mathematical Models: Sequencing - n Jobs and m Machines, Inventory Control - introduction and its analytical methods. Single server queuing model.

4. Books and Materials

Text Books:

1. S.D. Sharma, Operations Research Theory, Methods and Applications, 18th Edition, Kedarnath Ramnath Publishers, Delhi 2017
2. H.A. Taha, Operations Research- An Introduction,8th Edition PHI, 2008.
3. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

Reference Books:

1. J.C. Pant, Introduction to Optimization: Operations Research, 7th Edition,Jain Brothers, Delhi, 2008.
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009.
3. Pannerselvam, Operations Research:2nd Edition, Prentice Hall of India 2010.
4. Harvey M Wagner, Principles of Operations Research:2nd Edition, Prentice Hall of India 2010.

Course Structure

B6084 - IoT and Applications

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces you to advance concepts and design methodologies to design IoT systems and developing IoT applications programming languages and tools optimized for IoT domain. The course covers python languages in great detail with set of packages which makes it obvious choice as a leading IoT language. It also exposes participants to communication technologies and legacy protocols as well as newly developed IoT specific application and physical layer protocols. The course covers Cloud based service in great detail with set of packages which makes it obvious choice as a leading IoT Technology.

Course Pre/co-requisites

The course has no specific prerequisite and co-requisite

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6084.1 Identify the basic Architecture of IoT and its characteristics
B6084.2 Determine the most appropriate IoT Devices and communication system management
B6084.3 Utilize Python standard libraries for implementing various IoT Applications
B6084.4 Analyze the appropriate protocol for establishing communication between various IoT Devices
B6084.5 Analyze cloud infrastructure, services, APIs and architectures of commercial and industrial cloud platforms

3. Course Syllabus

Introduction to Internet Of Things : Introduction, Definition & Characteristics of IoT,Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Templates DOMAIN SPECIFIC IOTS - Introduction, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle.

IoT , M2M and IoT System Management with NETCONF-YANG : Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT IoT System Management with NETCONF-YANG - Need for IoT Systems Management, Simple Network Management

Protocol (SNMP), Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG.

IoT Platforms Design Methodology : IoT Platforms Design Methodology - Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring, Motivation for Using Python IoT SYSTEMS - LOGICAL DESIGN USING PYTHON - Introduction, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations, Classes,Python Packages of Interest for IoT.

IoT Physical Devices & Endpoints : What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interface, Programming Raspberry Pi with Python, Other IoT Devices IoT PHYSICAL SERVERS & CLOUD OFFERINGS - Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework,Designing a RESTful Web API, Amazon Web Services for IoT, SkyNet IoT Messaging Platform.

Case Studies Illustrating IoT Design : What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interface, Programming Raspberry Pi with Python, Other IoT Devices IoT PHYSICAL SERVERS & CLOUD OFFERINGS - Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework,Designing a RESTful Web API, Amazon Web Services for IoT, SkyNet IoT Messaging Platform.

4. Books and Materials

Text Books:

1. Arshdeep Bahga,Vijay Madisetti(2015), "Internet of Things A Hands-On Approach", University Press, India.
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011

Course Structure

B6085 - Cyber Security

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course drawing upon a wealth of experience from academia, industry, and government service, Cyber Security details and dissects, in current organizational cyber security policy issues on a global scale—taking great care to educate students on the history and current approaches to the security of cyberspace. It includes thorough descriptions of Cyber Offences, Cyber Crime, tools and methods used in Cyber Crime. It also delves into organizational implementation issues, and equips students with descriptions of the positive and negative impact of specific policy choices.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6085.1 Demonstrate the basics of cybercrime in computer, networked device or a network.
B6085.2 Identify various cyber offences in real time.
B6085.3 Identify the different attacks in cybercrime.
B6085.4 Use various methods and tools to control cybercrimes and cyber offences.
B6085.5 Examine how to protect organizations from intruders, attackers and cyber criminals.

3. Course Syllabus

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, who are Cybercriminals, Classifications of Cybercrimes. The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing

Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Tools and Methods: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications. Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

4. Books and Materials

Text Books:

1. Nina Godbole and Sunil Belapure., Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley INDIA. 2011.

Reference Books:

1. James Graham, Richard Howard and Ryan Otson., Cyber Security Essentials, 1st Edition, CRC Press, 2011.
2. Chwan-Hwa(John) Wu,J.David Irwin., Introduction to Cyber Security, , 1st Edition, CRC Press T&F Group, 2013.
3. Richard A. Clarke, Robert Knake., Cyberwar: The Next Threat to National Security & What to Do About It, Ecco, 2010.

Course Structure

B6086 - Mobile Cloud Computing

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This Course provides a comprehensive overview of how to integrate cloud and mobile technology. It is an emerging field and this course explores how distributed resources can be shared by mobile users in different ways and issues arising there from. This course also provides understanding of Architecture, Applications of Mobile Cloud Computing along with Offloading concept and Resource allocation techniques. This also introduces concept called Green Mobile Computing and also discusses about the security issues in Mobile Cloud Computing. This course enables the student to choose as research area of interest.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

B6086.1 Identify the architecture, issues and applications in mobile cloud computing.
B6086.2 Make use of remote cloud and offloading techniques for storage and computation.
B6086.3 Choose a resource allocation method in mobile cloud computing.
B6086.4 Use green mobile computing for an energy efficient mobile network.
B6086.5 Identify the trust and privacy requirements in a mobile cloud computing environment.

3. Course Syllabus

Mobile Cloud Computing: : Introduction to cloud computing, Basic cloud architecture, Motivation to MCC, Architecture, Platform and Technologies, Mobile Augmentation approaches, Issues of Mobile Cloud Computing, Advantages and Applications of Mobile Cloud Computing.

Offloading in Mobile Cloud Computing: Introduction, Offloading Decision, Types of Offloading, offloading in CC and MCC: Similarities and Differences, Adaptive Computation offloading from Mobile Devices, Cloud Path selection for Offloading, Mobile Data Offloading Using Opportunistic Communication, Three-Tier Architecture of Mobile Cloud Computing,

Requirements of Data Offloading, Performance Analysis of Offloading Techniques, Multi-Cloud Offloading in Mobile Cloud Computing Environment.

Resource Allocation in MCC: Introduction, Significance of Resource Allocation, Resource-Allocation Strategies- Semi-Markov Decision Process (SMDP), Task Scheduling Using Activity-Based Costing Algorithm, Resource Allocation Using Middleware, Energy-Aware Resource Allocation, Resource Allocation in MCC Using Entropy-Based FIFO Method, Auction Mechanism for Resource Allocation in MCC.

Green Mobile Computing: Introduction, Green Mobile Computing, Green Mobile Network, Green Cloud Computing, Green Mobile Cloud Computing, Green Mobile Devices Using Mobile Cloud Computing, Green Femtocell Using MCC.

Privacy and Security in MCC: Introduction, Security Levels, Security Issues. Trust in MCC: Introduction, Properties, Components, types of Trust, Trust Issues, and Trust Establishment.

4. Books and Materials

Text Books:

1. Debashis De., Mobile Cloud Computing-Architectures, Algorithms and Applications, CRC Press, Taylor and Fransis group, 2016.

Reference Books:

1. Frank H.P. Fitzek and Marcos D. Katz., Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks, 1st Edition, WILEY publications, 2014.
2. Valentino Lee, Heather Schneider, and Robbie Schell., Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.