VARDHAMAN
COLLEGE OF ENGINEERING

CURRICULUM
For
Master of Technology
Structural Engineering

Under

Choice Based Credit System (CBCS)

M. Tech. - Regular Two-Year Degree Program

(For batches admitted from the Academic Year 2025 - 2026)

October 2025

VARDHAMAN COLLEGE OF ENGINEERING
(Autonomous)
Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade
Kacharam, Shamshabad, Hyderabad- 501 218, Telangana, India
www.vardhaman.org, info@vardhaman.org

Department Vision

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

Department Mission

M1: To adopt processes enhancing student learning experience and professional skills.

M2: To enhance entrepreneurial skills among the students through Industry Institute Interaction.

M3: To work in-tandem with industry to facilitate advancement of technology for societal needs.

M4: 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 disciplines while upholding professional and ethical standards of civil engineers.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost,reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

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.

United Nations Sustainable Development Goals (SDGs)

SDG1: **No Poverty** – End poverty in all its forms everywhere.

SDG2: **Zero Hunger** – End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

SDG3: **Good Health and Well-Being** – Ensure healthy lives and promote well-being for all at all ages.

SDG4: **Quality Education** – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG5: **Gender Equality** – Achieve gender equality and empower all women and girls.

SDG6: **Clean Water and Sanitation** – Ensure availability and sustainable management of water and sanitation for all.

SDG7: **Affordable and Clean Energy** – Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG8: **Decent Work and Economic Growth** – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG9: **Industry, Innovation and Infrastructure** – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG10: **Reduced Inequalities** – Reduce inequality within and among countries.

SDG11: **Sustainable Cities and Communities** – Make cities and human settlements inclusive, safe, resilient and sustainable.

SDG12: **Responsible Consumption and Production** – Ensure sustainable consumption and production patterns.

SDG13: **Climate Action** – Take urgent action to combat climate change and its impacts.

SDG14: **Life Below Water** – Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

SDG15: **Life on Land** – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

SDG16: Peace, Justice and Strong Institutions – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG17: Partnerships for the Goals – Strengthen the means of implementation and revitalize the global partnership for sustainable development.

I M.Tech. I Semester												
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	B7801	Advanced Structural Analysis	PC	45	-	-	45	90	3	40	60	100
2	B7802	Theory of Elasticity and Plasticity	PC	45	-	-	45	90	3	40	60	100
3	B7001	Research Methodology and IPR	MC	30	-	-	30	60	2	40	60	100
Professional Elective – I												
4	B7851	Advanced Concrete Technology	PE	45	-	-	45	90	3	40	60	100
	B7852	Construction Technology and Project Management										
	B7853	Theory and Applications of Cementitious Composites										
Professional Elective – II												
5	B7854	Advanced Design of Reinforced Concrete Structures	PE	45	-	-	45	90	3	40	60	100
	B7855	Structural Health Monitoring										
	B7856	Microstructure Analysis of Concrete										
Practical Courses												
6	B7803	Numerical Analysis Laboratory	PC	-	-	60	-	60	2	40	60	100
7	B7804	Advanced Concrete Technology Laboratory	PC	-	-	60	-	60	2	40	60	100
Audit Course												
8		Audit Course - I	AC	30	-	-	-	30	0	-	100	100
Total				240	0	120	210	570	18	280	520	800

I M.Tech. II Semester												
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	B7805	Finite Element Analysis	PC	45	-	-	45	90	3	40	60	100
2	B7806	Structural Dynamics	PC	45	-	-	45	90	3	40	60	100
Professional Elective – III												
3	B7857	Bridge Engineering	PE	45	-	-	45	90	3	40	60	100
	B7858	Design of Prestressed Concrete Structures										
	B7859	Advanced Design of Steel Structures										
Professional Elective – IV												
4	B7860	Earthquake Resistant Design of Structures	PE	45	-	-	45	90	3	40	60	100
	B7861	Theory of Plates and Shells										
	B7862	Fracture Mechanics										
Practical Courses												
5	B7807	Finite Element Analysis Laboratory	PC	-	-	60	-	60	2	40	60	100
6	B7808	Structural Design Studio	PC	-	-	60	-	60	2	40	60	100
Experiential Learning Course												
7	B7041	Mini-Project with seminar	PW	-	-	-	90	90	2	40	60	100
8		Dissertation Work Review - I	PW	-	-	-	-	-	-	-	-	-
Audit Course												
9		Audit Course - II	AC	30	-	-	-	30	0	-	10	100
Total				210	0	120	270	600	18	280	520	800

II M.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Professional Elective – V													
1	B7863	Repair and Rehabilitation of Structures	PE	45	-	-	45	90	3	40	60	100
	B7864	Design of Tall Structures										
	B7865	Ground Improvement Techniques										
Open Elective													
2	B7081	Business Analytics	OE	45	-	-	45	90	3	40	60	100
	B7082	Waste to Energy										
	B7083	Operations Research										
	B7084	Blockchain Technology										
	B7085	Cyber Security										
Experiential Learning Course													
3	B7042	Dissertation Work Review – II	PW	-	-	-	270	270	6	100	-	100
Total				90	0	0	360	450	12	180	120	300

II M.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Experiential Learning Course													
1	B7043	Dissertation Work Review – II	PW	-	-	-	270	270	6	100	-	100
2	B7044	Dissertation Viva-Voce	PW	-	-	-	630	630	14	-	100	100
Total				0	0	0	900	900	20	100	100	200

List of Audit Courses

#	Course Code	Title of the Course
1	B7091	Disaster Management
2	B7092	Value Education
3	B7093	Constitution of India
4	B7094	Stress Management by Yoga
5	B7095	Pedagogy Studies
6	B7096	English for Research Paper Writing

Common Abbreviations Used in the Curriculum

PC	–	Professional Core	L	–	Lecture Hours
MC	–	Mandatory Course	T	–	Tutorial Hours
AC	–	Audit Course	P	–	Practical Hours
PE	–	Professional Elective	TW	–	Team Work
OE	–	Open Elective	SL	–	Self Learning
PW	–	Project Work	H	–	Hours
CI	–	Classroom Instruction	C	–	Credits
LI	–	Laboratory Instruction	CIE	–	Continuous Internal Evaluation
SDG	–	Sustainable Development Goals	SEE	–	Semester End Examination

I M.Tech. I Semester

B7801 – Advanced Structural Analysis

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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 pre-requisite and co-requisite.

Course Outcomes

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

A9101.1. Identify determinate and indeterminate structures.

A9101.2. Solve flexibility and stiffness matrices for all types of structures.

A9101.3. Apply various methods to assemble the direct stiffness matrix from member stiffness matrix.

A9101.4. Analyse flexural members and portal frames using matrix methods.

A9101.5. Evaluate solutions for set of equations using various methods.

Course Syllabus

Unit-I:

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.

Unit-II:

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

Unit-III:

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

Unit-IV:

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

Unit-V:

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

Books and Materials

Text Books:

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

Reference Books:

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

B7802 – Theory of Elasticity and Plasticity

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course deals with isotropic materials subjected to elastic stresses, strains, and dis- placements. 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 pre-requisite and co-requisite.

Course Outcomes

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

B7802.1. Demonstrate theory, concepts, principles, and governing equations of elasticity.

B7802.2. Illustrate concepts of plasticity and its governing equations.

B7802.3. Develop equations of equilibrium and compatibility for two-dimensional problems in rectangular and polar coordinates.

B7802.4. Analyse three-dimensional elasticity problems to determine principal stresses and planes.

B7802.5. Solve elastic problems using equilibrium and compatibility equations under various boundary conditions.

Course Syllabus

Unit-I:

Introduction: Elasticity – notation for forces and stresses – components of stress and strain – Hooke's law. Plane stress and plane strain analysis – differential equations of equilibrium – boundary conditions – strain displacement relations – compatibility equations – stress function – orthogonal transformation of axes.

Unit-II:

Normal and Shear Strain: Stress and strain in three dimensions – equilibrium and compatibility conditions in 3D – stress and strain tensors – principal stresses and strains – stress invariants – maximum shear stress – plane stress and plane strain cases – strain energy – general theorems including superposition, uniqueness, and reciprocal theorem.

Unit-III:

Two-Dimensional Problems in Rectangular Coordinates: Solution by polynomials – Airy's stress function – Saint-Venant's principle – determination of displacements – bending of simple beams – simply supported and cantilever beams.

Unit-IV:

Two-Dimensional Problems in Polar Coordinates: Axisymmetric stress distribution – Airy's stress function – pure bending of curved bars – strain components in polar coordinates – displacements for symmetrical stress distribution – general and specific polar coordinate problems – applications to symmetric and asymmetric stress states.

Unit-V:

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 relations – governing equations of elasto-plasticity.

Books and Materials

Text Book:

1. S. P. Timoshenko and J. N. Goodier. *Theory of Elasticity.* 3rd ed., McGraw-Hill Education, 2017.

Reference Books:

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

B7001 – Research Methodology and IPR

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
30	0	0	30	60	2	40	60	100

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.

Course Outcomes

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

B7001.1. Identify an appropriate research problem in their suitable domain.

B7001.2. Construct a well-structured research paper and scientific presentations.

B7001.3. Express the importance of research ethics in scientific community.

B7001.4. Explore on various component of IPR and process of filing.

B7001.5. Gain knowledge on patents and copyrights.

Course Syllabus

Unit-I:

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

Unit-II:

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.

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

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

PROFESSIONAL ELECTIVE-I

B7851 – Advanced Concrete Technology

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course covers the properties of concrete constituents along with the influence of admixtures on performance. It focuses on preparation, handling, and mix design for various grades and types of concrete, including special concretes. Testing of fresh and hardened concrete for field applications is emphasized. The course also deals with the quality control aspects of reinforced concrete structures, providing insights into advanced concrete performance and durability.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7851.1. Evaluate properties of concrete manufacturing materials to check their quality.

B7851.2. Classify properties and applications of different types of admixtures.

B7851.3. Measure properties of concrete in fresh and hardened states.

B7851.4. Design different grades of concrete mixes for specific field applications.

B7851.5. Illustrate various types of special concretes and their uses.

Course Syllabus

Unit I

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.

Unit II:

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 con- crete: Workability - factors affecting workability - measurement of workability - effect of time and temperature on work - segregation and bleeding.

Unit III:

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.

Unit IV:

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.

Unit V:

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

Books and Materials

Text Books:

1. Shetty, M. S., and A. K. Jain. *Concrete Technology: Theory and Practice.* 8th ed., S. Chand Publishing, 2019.
2. Neville, A. M., and J. J. Brooks. *Concrete Technology.* 2nd ed., Pearson Education Limited, 2019.

Reference Books:

1. Thomas, Job. *Concrete Technology.* 2nd ed., Cengage Learning, 2015.
2. Gambhir, M. L. *Concrete Technology: Theory and Practice.* 5th ed., Tata McGraw Hill Education, 2017.

B7852 – Construction Technology and Project Management

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7852.1. Select appropriate tools, equipment, and techniques for project execution.

B7852.2. Identify key issues of building contracts, documentation, specifications, and regulations.

B7852.3. Apply construction planning and management techniques during project execution.

B7852.4. Examine quality and safety aspects involved in construction projects.

B7852.5. Analyze resources, costs, claims, and disputes in project environments.

Course Syllabus

Unit I:

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.

Unit II:

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

Unit III:

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.

Unit IV:

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.

Unit V:

Quality and Safety Management: 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.

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. Sushila Publications, 2005.
2. Chitkara, K. K. *Construction Project Management: Planning, Scheduling and Controlling.* 4th ed., McGraw-Hill Education, 2019.

Reference Books:

1. Sarkar, Subir K., and Subhajit Saraswati. *Construction Technology.* Oxford University Press, 2008.
2. Jha, Kumar Neeraj. *Construction Project Management: Theory and Practice.* 3rd ed., Pearson Education India, 2025.
3. Srivastava, U. K. *Construction Planning and Management.* 3rd ed., Galgotia Publications, 2016.

B7853 – Theory and Applications of Cementitious Composites

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7853.1. Categorize materials based on orthotropic and anisotropic behaviour.

B7853.2. Examine stress–strain relationships and develop constitutive models for composite materials.

B7853.3. Estimate mechanical properties of different composite systems.

B7853.4. Analyse structural behaviour of various cementitious composites.

B7853.5. Demonstrate real-world applications of cement-based composites.

Course Syllabus

Unit I:

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

Unit II: Stress–Strain Relationships: Orthotropic and anisotropic materials - Engineering constants for orthotropic materials – restrictions on elastic constants – plane stress problem – Bi- axial strength – theories for an orthotropic lamina.

Unit III:

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.

Unit IV:

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.

Unit V:

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.

Books and Materials

Text Books:

1. Jones, Robert M. *Mechanics of Composite Materials.* 3rd ed., Taylor & Francis, 2020.
2. Shah, S. P., and P. N. Balaguru. *Fiber Reinforced Cement Composites.* 2nd ed., McGraw-Hill, 2020.
3. Gibson, Ronald F. *Principles of Composite Material Mechanics.* 5th ed., CRC Press, 2020.

Reference Books:

1. Swamy, R. N., editor. *New Concrete Materials.* 2nd ed., Blackie Academic & Professional, 2020.
2. Pama, R. P. *Ferrocement – Theory and Applications.* 2nd ed., IFIC, 2020.
3. Mukhopadhyay, Madhujit. *Mechanics of Composite Materials and Structures.* 2nd ed., Universities Press, 2020.

PROFESSIONAL ELECTIVE-II

B7854 – Advanced Design of Reinforced Concrete Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course covers advanced design and analysis of reinforced concrete (RC) elements as per IS codes. It includes RC deep beams and corbels with emphasis on force transfer, detailing, and local failure checks. Students will study design principles and code provisions for rectangular and cylindrical bunkers and silos, including pressure theories and stability. The course addresses flat slabs using the direct design method, moment distribution, and shear capacity evaluation. Ribbed slabs are analyzed and designed for moment, shear, deflection, and reinforcement layout. The final module covers cantilever and counterfort retaining walls, ensuring stability against earth pressures. Emphasis is on practical application of IS codes, structural detailing, and achieving safety and serviceability.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7854.1. Determine the stress behaviour of RC deep beams and corbels, and design them as per IS 456 guidelines.

B7854.2. Design rectangular bunkers and cylindrical silos as per IS 4995 (Part I)–1974.

B7854.3. Design and analyse flat slabs using direct design and moment distribution methods as per IS 456:2000.

B7854.4. Assess ribbed slabs for strength, serviceability, and develop reinforcement detailing.

B7854.5. Evaluate and design cantilever and counterfort retaining walls for stability and safety.

Course Syllabus

Unit I:

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.

Unit II:

Silos and Bunkers: Bunkers and Silos: Introduction - Design principles and theories - IS Code provision - design of rectangular bunkers - design of cylindrical soils.

Unit III:

Design of Flat Slabs: Flat Slabs, Direct design method, Distribution of moments in column strip and middle strip, moment and shear transfer from slabs to columns, shear in Flat slabs, Check for one way and two way shears.

Unit IV:

Design of Ribbed slabs: Analysis of the Slabs for moment and shears, Ultimate moment of Resistance, Design for shear, deflection, Arrangement of Reinforcements.

Unit V: Retaining Walls: Analysis and Design of Cantilever Retaining wall, Counterfort Retaining wall.

Books and Materials

Text Books:

1. Raju, N. Krishna. *Advanced Reinforced Concrete Design.* 3rd ed., CBS Publishers & Distributors Pvt. Ltd., 2020.
2. Pillai, S. Unnikrishna, and Devdas Menon. *Reinforced Concrete Design.* 4th ed., McGraw-Hill Education India, 2021.
3. Varghese, P. C. *Advanced Reinforced Concrete Design.* 2nd ed., Prentice-Hall of India Pvt. Ltd., 2005.

Reference Books:

1. Purushotham, P. *Reinforced Concrete Structural Elements: Behavior, Analysis, and Design.* Tata McGraw-Hill Education, 1994.
2. Leet, Kenneth, and Chia-Ming Uang. *Reinforced Concrete Design.* 2nd ed., Tata McGraw-Hill Education, 1991.
3. Punmia, B. C., and Ashok Kumar Jain. *Comprehensive R.C.C. Designs.* Laxmi Publications, 2005.

B7855 – Structural Health Monitoring

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7855.1. Illustrate various structural sensing technologies used for health monitoring.

B7855.2. Identify and differentiate between various SHM techniques and their applications.

B7855.3. Apply appropriate field-testing and monitoring methods for data collection.

B7855.4. Utilize different data acquisition systems for structural assessment.

B7855.5. Integrate IoT-based hardware and software for remote monitoring and data analysis using machine learning.

Course Syllabus

Unit I:

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.

Unit II:

SHM Methodology

Sensors – Selection of Sensors – Installation and placement – Data acquisition – Communication – Processing and Analysis – Storage – Diagnostics and Prog- nostics – Retrieval of data.

Unit III:

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

Unit IV:

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

Unit V:

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

Books and Materials

Text Books:

1. Balageas, Daniel, et al., editors. *Structural Health Monitoring.* 1st ed., John Wiley & Sons, 2006.
2. Adams, Douglas E. *Health Monitoring of Structural Materials and Components: Methods with Applications.* John Wiley & Sons, 2007.

Reference Books:

1. Ou, J. P., H. Li, and Z. D. Duan, editors. *Structural Health Monitoring and Intelligent Infrastructure.* Vol. 1, Taylor & Francis Group, 2006.
2. Giurgiutiu, Victor. *Structural Health Monitoring with Piezoelectric Wafer Active Sensors.* 3rd ed., Academic Press, 2023.

B7856 – Microstructure Analysis of Concrete

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7854.1. Identify suitable methods and equipment for characterisation of materials.

B7854.2. Illustrate the operation principles of different characterisation tools.

B7854.3. Interpret the results from various characterisation techniques.

B7854.4. Examine rheological behaviour of cement paste and concrete.

B7854.5. Assess influence of corrosion on reinforced concrete structures.

Course Syllabus

Unit I:

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

Unit II:

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

Unit III:

Scanning electron microscopy:

Simple Microscopy analysis, concrete under the SEM, Interpretation of concrete deterioration from SEM/EDXA.

Unit IV:

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.

Unit V:

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.

Books and Materials

Text Books:

1. Scrivener, Karen, Ruben Snellings, and Barbara Lothenbach, editors. *A Practical Guide to Microstructural Analysis of Cementitious Materials.* CRC Press, 2018.
2. Ramachandran, V. S., and James J. Beaudoin, editors. *Handbook of Analytical Techniques in Concrete Science and Technology: Principles, Techniques, and Applications.* Noyes Publications, 2000.
3. Mehta, P. K., and Paulo J. M. Monteiro. *Concrete: Microstructure, Properties, and Materials.* 4th ed., McGraw-Hill Education, 2017.

Reference Books:

1. Kurdowski, Wiesław. *Cement and Concrete Chemistry.* Springer, 2014.
2. Taylor, H. F. W. *Cement Chemistry.* 2nd ed., Thomas Telford, 1997.
3. Hewlett, Peter, and Martin Liska, editors. *Lea's Chemistry of Cement and Concrete.* 5th ed., Elsevier Science & Technology, 2019.

B7803 – Numerical Analysis Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	-	30	1	40	60	100

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 pre-requisite and co-requisite.

Course Outcomes

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

B7803.1. Apply error approximations to fit data in a curve.

B7803.2. Determine the roots of nonlinear equations.

B7803.3. Solve systems of linear equations using Gauss methods.

B7803.4. Evaluate integrals using trapezoidal and Simpson's rules.

B7803.5. Estimate numerical solutions of ordinary differential equations.

Course Syllabus

List of Experiments:

1. Find the roots of nonlinear equations using Bisection Method.
2. Find the roots of nonlinear equations 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–Jordan Method.
7. Integrate numerically using Trapezoidal Rule.
8. Integrate numerically using Simpson's Rules.
9. Numerical solution of Ordinary Differential Equations using Euler's Method.
10. Numerical solution of Ordinary Differential Equations using Runge–Kutta Method.

Laboratory Equipment / Software / Tools Required

1. Computer PCs
2. MATLAB

Books and Materials

Text Book:

1. S. C. Chapra and R. P. Canale. *Numerical Methods for Engineers.* 8th ed., McGraw-Hill Publishers, 2021.

Reference Book:

1. S. K. Gupta. *Numerical Methods for Engineers.* 3rd ed., New Age International (P) Ltd. Publishers, 2015.

B7804 – Advanced Concrete Technology Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	-	30	1	40	60	100

Course Description

Course Overview

This laboratory course deals with the characterization of materials and their properties used in concrete preparation. It investigates the effects of different constituents, varying proportions, and fresh properties of concrete. The course covers mechanical properties such as cube strength, cylinder strength, and flexural strength for different grades of concrete, along with evaluation of stress-strain behaviors. Quality control aspects of reinforced concrete structures using Non-Destructive Testing (NDT) methods are also included.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7804.1. Evaluate properties of concrete manufacturing materials to check their quality.

B7804.2. Classify properties of various types of admixtures and their applications.

B7804.3. Measure properties of fresh and hardened states of concrete.

B7804.4. Design normal and special concretes and evaluate the parameters affecting performance.

B7804.5. Conduct Non-Destructive Tests on existing concrete structures.

Course Syllabus

List of Experiments:

1. To determine the fineness and specific gravity of OPC and PPC.
2. To determine the fineness and specific gravity of mineral admixtures: Fly Ash and GGBFS.
3. To draw the Gradation Charts of Fine Aggregate.
4. To draw the Gradation Charts of Coarse Aggregate.
5. To study the effect of water/cement ratio on workability and strength for different grades of concrete.
6. To study the effect of aggregate/cement ratio on strength of concrete for different aggregate sizes (20 mm & 16 mm).
7. To study the effect of mineral admixtures and chemical admixtures on the workability of concrete.
8. To develop a mix design for two grades of concrete using the I.S. method (IS 10262 – 2009).
9. To develop a mix design for two grades of concrete using the ACI method.
10. To determine the correlation between cube strength, cylinder strength, and flexural strength for a given grade of concrete.
11. To develop the stress-strain curve for a given grade of concrete.
12. To evaluate the flexural behaviour of a reinforced concrete beam.
13. To study the workability tests on fresh self-compacting concrete.
14. To evaluate the quality of concrete using NDT methods.

Laboratory Equipment/Software/Tools Required:

1. Vicat's Apparatus
2. Specific Gravity Bottle
3. Le-Chatelier Mould
4. Le-Chatelier Water Bath
5. Sieve Sets for Fine and Coarse Aggregates
6. Cylindrical Metal Measures (1L, 3L, and 5L)
7. Slump Test Apparatus
8. Compaction Factor Apparatus
9. Vee-Bee Consistometer
10. Compression Testing Machine
11. Flexural Testing Machine
12. Rebound Hammer
13. Ultrasonic Pulse Velocity Test Setup
14. Moulds (cube, cylindrical, and flexural)

Books and Materials

Text Books:

1. M. S. Shetty, *Concrete Technology*. 8th ed., S. Chand & Co., 2006.
2. A. M. Neville, *Concrete Technology*. 2nd ed., Pearson Education Ltd., 2010.

Reference Books:

1. Job Thomas, *Concrete Technology*. 2nd ed., Cengage Learning, 2015.
2. M. L. Gambhir, *Concrete Technology*. 5th ed., Tata McGraw Hill Publishers, New Delhi, 2017.

I M.Tech. II Semester

B7805 – Finite Element Analysis

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

The course introduces advanced numerical methods to solve civil engineering problems using the Finite Element Method (FEM). It includes concepts of plane stress and plane strain constitutive relationships along with matrix algebra and discretization techniques. The course focuses on the formulation of stiffness matrices and load vectors for one-dimensional and two-dimensional systems of various elements. It provides an understanding of shape functions, generalized coordinate systems, axi-symmetric analysis, and convergence requirements of different elements, including plates.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7805.1. Illustrate concepts of Finite Element Analysis (FEA) and relate energy principles in functional approximations.

B7805.2. Develop shape functions and stiffness matrices for 1D and 2D elements.

B7805.3. Solve problems using 2D and 3D iso-parametric elements.

B7805.4. Analyse Lagrange and axisymmetric 2D and 3D elements.

B7805.5. Evaluate plate elements using plate bending concepts.

Course Syllabus

Unit I:

Introduction: Concepts of FEM - 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.

Unit II:

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.

Unit III:

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.

Unit IV:

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 FEM:** Different 3D elements – strain-displacement relationships – formulation of hexahedral and iso-parametric solid elements.

Unit V:

Introduction to finite element analysis of plates: Concept and types of iso-parametric elements for 2D analysis – formulation of 4-noded and 8-noded iso-parametric quadrilateral elements – Lagrange elements – serendipity elements.

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 ed., Wiley, 2001.

Reference Books:

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

B7806 – Structural Dynamics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7806.1. Apply equilibrium equations of motion in dynamic systems.

B7806.2. Determine dynamic characteristics of systems subjected to various loadings.

B7806.3. Analyse multi-degree-of-freedom systems using discrete approach.

B7806.4. Estimate natural frequencies using approximate methods.

B7806.5. Deduce natural frequencies and mode shapes for continuous systems.

Course Syllabus

Unit I:

Introduction: Elements of vibratory system, degree of freedom, continuous system, lumped mass idealization, oscillatory motion, simple harmonic motion, vectorial representation of S.H.M.

Fundamental objectives of dynamic analysis: Types of prescribed loading - Meth- ods 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.

Unit II:

Single Degree of Freedom Systems: Free vibrations of single degree of freedom system, un-damped and damped vibration, critical damping, logarithmic decrement, forced vibrations of SDOF systems, harmonic excitation, dynamic magnification factor, phase angle, Band width. Formulation and solution of the equation of motion – Response to Harmonic, Periodic, Impulsive and general dynamic loadings -Duhamel integral.

Unit III:

Multi-Degree of Freedom Systems: 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.

Unit IV:

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

Unit V:

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.

Books and Materials

Text Books:

1. Anil K. Chopra, *Dynamics of Structures.* 4th ed., 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.* Tata McGraw-Hill.
3. Timoshenko, S., *Vibration Problems in Engineering.* Van-Nostrand Co.

PROFESSIONAL ELECTIVE-III

B7857 – Bridge Engineering

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7857.1. Classify various types of bridges and load patterns based on IRC standard recommendations.

B7857.2. Select suitable bearings and expansion joints for different structural conditions.

B7857.3. Analyse cables and towers under various loadings and perform design of bridge superstructure.

B7857.4. Estimate forces and moments acting on bridge components such as abutments and piers.

B7857.5. Design structural elements for both substructure and superstructure considering codal provisions.

Course Syllabus

Unit I:

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

Unit II:

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.

Unit III:

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.

Unit IV:

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

Unit V: 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.

Books and Materials

Text Books:

1. Saran, Swami. *Analysis and Design of Substructures: Limit State Design.* 2nd ed., Oxford & IBH Publishing Co., 2015.
2. Victor, D. Johnson. *Essentials of Bridge Engineering.* 6th ed., Oxford & IBH Publishing Co., 2017.

Reference Books:

1. Raju, N. Krishna. *Design of Bridges.* 5th ed., Oxford & IBH Publishing Co., 2019.
2. Jagadeesh, T. R., and M. A. Jayaram. *Design of Bridge Structures.* 2nd ed., Prentice Hall of India Pvt. Ltd., 2020.

B7858 – Design of Prestressed Concrete Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the principles and practices of prestressed concrete design, covering pre-tensioned and post-tensioned systems. It discusses methods of prestressing such as Hoyer and Freyssinet systems and examines various losses of prestress. Analysis and design of prestressed concrete beams for flexure and shear under different tendon profiles, along with anchorage zone stresses and stress distribution, are emphasized. The course focuses on IS 1343:2012 codal provisions for practical and safe design applications in prestressed structures.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7858.1. Describe basic concepts and principles of prestressed concrete systems.

B7858.2. Calculate losses of prestress in pre-tensioned and post-tensioned members.

B7858.3. Analyse prestressed concrete beams for flexure under various tendon profiles.

B7858.4. Design prestressed members for flexure and shear according to IS code provisions.

B7858.5. Assess anchorage stresses and stress distribution in prestressed concrete members.

Course Syllabus

Unit I:

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.

Unit II:

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.

Unit III:

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.

Unit IV:

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 pre-stressing techniques - horizontal, inclined and vertical prestressing, Design of beams having rectangular and I-sections, Design of shear reinforcement, IS code provisions.

Unit V:

Transfer and Anchorage Zone Stresses: Transfer of prestress in pre-tensioned members – Bond behaviour, transmission length, bond stresses.

Anchorage zone stresses in post-tensioned members: Analysis of end blocks using Guyon and Magnel methods – Design of anchorage zone reinforcement.

Books and Materials

Text Books:

1. Raju, N. Krishna. *Prestressed Concrete*. 6th ed., McGraw-Hill Education India, 2018.
2. Rajagopalan, N. *Prestressed Concrete*. 2nd ed., Alpha Science International Ltd., 2005.
3. Muthu, K. U., Ibrahim Azmi, Janardhana Maganti, and Vijayanand M. *Prestressed Concrete*. PHI Learning Pvt. Ltd., 2016.

Reference Books:

1. Nawy, Edward G. *Prestressed Concrete: A Fundamental Approach*. 5th ed., Pearson Education, 2009.
2. Leonhardt, F. *Prestressed Concrete: Design and Construction*. 2nd ed., Wilhelm Ernst & Sohn, 1986.
3. Dayaratnam, P. *Prestressed Concrete Structures*. S. Chand & Co., 2004.

B7859 – Advanced Design of Steel Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

TThis 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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7859.1. Classify the different structural design philosophies.

B7859.2. Determine the strength parameters of different connection types.

B7859.3. Apply design principles, procedures, and current IS code requirements.

B7859.4. Identify failure modes and assess design strength of axial steel members.

B7859.5. Design various members and connections in steel structural systems.

Course Syllabus

Unit I:

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.

Unit II:

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.

Unit III:

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. De- sign of purlins for roofs. Design of bracings.

Unit IV:

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.

Unit V:

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 – sim- ply 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.

Books and Materials

Text Books:

1. Duggal, Shashikant K. *Limit State Design of Steel Structures.* 3rd ed., McGraw Hill Education, 2019.
2. Ramachandra, Dr., and Virendra Gehlot. *Design of Steel Structures: Volume I & II.* 12th ed., Scientific Publishers, 2009.

Reference Books:

1. Beer, Ferdinand P., E. Russell Johnston Jr., John T. DeWolf, and David F. Mazurek. *Mechanics of Materials.* 5th ed., McGraw Hill, 2009.
2. Shames, Irving H., and James M. Pitarresi. *Introduction to Solid Mechanics.* 3rd ed., Pearson, 2009.
3. Kazimi, S. M. A. *Solid Mechanics.* 1st rev. ed., Tata McGraw-Hill, 1981.
4. Bureau of Indian Standards. *IS 800: 2007: General Construction in Steel – Code of Practice.* Bureau of Indian Standards, 2007.
5. Bureau of Indian Standards. *IS 875: Part 3: 2015: Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Part 3: Wind Loads.* Bureau of Indian Standards, 2015.

PROFESSIONAL ELECTIVE-IV

B7860 – Earthquake Resistant Design of Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the fundamentals of engineering seismology and the principles of seismic-resistant design. Students learn about earthquake phenomena, seismic waves, and vibration characteristics of buildings. The course emphasizes lateral load-resisting systems, ductility provisions, and seismic design of reinforced concrete (RC) buildings using IS 1893 and IS 13920. It also covers performance-based design methodology and provides step-by-step examples of designing earthquake-resistant buildings.

Course Pre/Co-requisites

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7860.1. Discuss the causes of earthquakes and the principles of seismic-resistant building architecture.

B7860.2. Apply fundamental concepts of seismic design philosophy to structural systems.

B7860.3. Implement ductility provisions for earthquake-resistant RC design as per IS 13920.

B7860.4. Evaluate and estimate seismic forces in RC buildings using IS 1893 recommendations.

B7860.5. Categorize structural performance levels and apply performance-based design principles.

Course Syllabus

Unit I:

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.

Unit II:

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

Unit III:

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.

Unit IV:

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.

Unit V:

Base isolation of structures: Introduction - Considerations for seismic isolation - Ba- sic 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.

Books and Materials

Text Books:

1. Agarwal, Pankaj, and Manish Shrikhande. *Earthquake Resistant Design of Structures.* 2nd ed., Prentice-Hall of India, 2013.
2. Duggal, Shashikant K. *Earthquake Resistant Design of Structures.* 2nd ed., Oxford University Press, 2013.

Reference Books:

1. Paulay, Thomas, and M. J. N. Priestley. *Seismic Design of Reinforced Concrete and Masonry Buildings.* 1st ed., John Wiley & Sons, 1992.
2. Naeim, Farzad. *The Seismic Design Handbook.* 2nd ed., Springer, 2001.
3. Bureau of Indian Standards. *IS 1893: Part 1: 2016: Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings.* Bureau of Indian Standards, 2016.
4. Bureau of Indian Standards. *IS 13920: 2016: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision).* Bureau of Indian Standards, 2016.

B7861 – Theory of Plates and Shells

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7861.1. Illustrate concepts, displacement relations and boundary conditions of shells.

B7861.2. Evaluate rectangular plates for various loading and boundary conditions.

B7861.3. Analyse circular plates under axi-symmetric loading.

B7861.4. Apply membrane theory to analyse shells structures of different shapes.

B7861.5. Outline structural behaviour of different types of folded plates.

Course Syllabus

Unit I:

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.

Unit II:

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

Unit III:

Circular plates: 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.

Unit IV:

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

Unit V:

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

Books and Materials

Text Books:

1. Chandrashekhara, K. *Theory of Plates.* 1st ed., Universities Press, 2001.
2. Bhavikatti, S. S. *Theory of Plates and Shells.* 1st ed., New Age International, 2005.

Reference Books:

1. Timoshenko, S. P., and S. Woinowsky-Krieger. *Theory of Plates and Shells.* 2nd ed., McGraw-Hill, 1959.
2. Bairagi, N. K. *Plate Analysis.* Khanna Publishers, 2009.
3. Szilard, P. *Theory and Analysis of Plates.* Prentice Hall, 2003.

B7862 – Fracture Mechanics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7862.1. Classify cracking in concrete structures based on fracture mechanics principles.

B7862.2. Evaluate stress intensity factor and implement to notched members.

B7862.3. Make use of concepts of LEFM and compute J-Integral for various sections.

B7862.4. Examine crack toughness properties for different crack openings.

B7862.5. Apply fracture mechanics models to high strength concrete and FRC structures.

Course Syllabus

Unit I:

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.

Unit II:

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.

Unit III:

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.

Unit IV:

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.

Unit V:

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.

Books and Materials

Text Books:

1. Kumar, Prashant. *Elements of Fracture Mechanics.* 1st ed., McGraw-Hill Education, 2009.
2. Sun, C. T., and Zhihe Jin. *Fracture Mechanics.* 1st ed., Elsevier Academic Press, 2012.

Reference Books:

1. Broek, David. *Elementary Engineering Fracture Mechanics.* 3rd ed., Springer, 1982.
2. Elfgren, Lennart. *Fracture Mechanics of Concrete Structures: Theory and Applications.* RILEM Report, Chapman & Hall, 1989.

B7807 – Finite Element Analysis Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	-	30	1	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7807.1. Solve for stresses, strains, and displacements using finite element software.

B7807.2. Determine the stresses in brackets, plates with holes, and cylindrical components.

B7807.3. Perform thermal stress analysis of bar elements and rectangular plates.

B7807.4. Evaluate buckling and vibration behavior of structural members.

B7807.5. Model structural components of varying geometric configurations.

Course Syllabus

List of Experiments:

1. Linear static analysis of bar.
2. Linear static analysis of tapered bar.
3. Linear static analysis of stepped bar.
4. Linear static analysis of beams:
   (a) Cantilever beam
   (b) Simply supported beam
   (c) Fixed beam
5. Linear static analysis of truss.
6. Linear static analysis of portal frame.
7. Stress analysis of rectangular L-bracket.
8. Stress analysis of a rectangular plate with circular hole.
9. Analysis of cylindrical element.
10. Thermal analysis of a bar.
11. Thermal analysis of a rectangular plate.
12. Buckling analysis of a slender column.
13. Modal frequency analysis of beams:

(a) Cantilever beam

(b) Simply supported beam

(c) Fixed-end beam

14. Harmonic analysis of a 2D component.

Laboratory Equipment/Software/Tools Required:

1. ANSYS Workbench 17.1

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 ed., Wiley, 2001.
2. Anil K. Chopra, *Dynamics of Structures.* 4th ed., Pearson Education, New Delhi, India, 2011.

Reference Books:

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu. *Introduction to Finite Element Method.* 3rd ed., Pearson, 2002.
2. C. S. Krishnamoorthy. *Finite Element Analysis: Theory and Programming.* 2nd ed., McGraw Hill Education, 2013.
3. P. Seshu, *Textbook of Finite Element Analysis.* PHI Publishers, 2013.

B7808 – Structural Design Studio

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	-	30	1	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7808.1. Apply principles of structural mechanics for analysis and design of structures.

B7808.2. Develop flowcharts and spreadsheet-based designs as per IS codes.

B7808.3. Model various structural components using simulation tools.

B7808.4. Analyse beams, trusses, and frames under different loading conditions.

B7808.5. Design a multi-storey RC frame building for gravity loads as per IS codes.

Course Syllabus

List of Experiments:

1. Develop flowcharts and design spreadsheets for:
   (a) Singly reinforced rectangular beam.
   (b) Doubly reinforced rectangular beam.
2. Develop flowcharts and design spreadsheets for T-beam.
3. Develop flowcharts and design spreadsheets for columns.
4. Develop flowcharts and design spreadsheets for one-way slab.
5. Develop flowcharts and design spreadsheets for two-way slab.
6. Develop flowcharts and design spreadsheets for isolated square footing.
7. Develop flowcharts and design spreadsheets for combined footing.
8. Analysis of beams:
   (a) Simply supported

(b) Cantilever
(c) Fixed
(d) Continuous

9. Analysis of trusses.

10. Analysis of portal frames.

11. Analysis of multi-storey RC building for gravity loads.

12. Design of multi-storey RC building for gravity loads.

Laboratory Equipment/Software/Tools Required:

1. Computer PCs
2. MS Excel
3. STAAD.Pro

Books and Materials

Text Books:

1. P. C. Varghese, *Limit State Design of Reinforced Concrete*. 2nd ed., PHI Learning Pvt. Ltd., 2019.

Reference Books:

1. Raju, N. Krishna. *Design of Reinforced Concrete Structures*. 4th ed., CBS Publishers & Distributors, 2016.

II M.Tech. I Semester

PROFESSIONAL ELECTIVE-V

B7863 – Repair and Rehabilitation of Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

The course introduces the concept as well as techniques associated with repairs and re- habilitation 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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7863.1. Illustrate various maintenance and repair strategies.

B7863.2. Categorize the causes and prevention mechanisms of corrosion and damages occur in structures.

B7863.3. Apply various methods and techniques for damage assessment and diagnosis.

B7863.4. Formulate the usage of different techniques for structural retrofitting.

B7863.5. Estimate the structural damage and recommend suitable repair and strengthening methods.

Course Syllabus

Unit I:

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.

Unit II:

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 Sam- pling and Testing; Chemical Tests: Carbonation Test, Chloride Content; Corrosion Po- tential Assessment: Cover meter survey, Half-cell potential survey, Resistivity Measurement; Fire Damage Assessment: Differential Thermal Analysis (DTA), X-ray Diffraction (XRD); Structural Integrity/Soundness Assessment: Radiography, Impact echo Test, Dynamic Testing of Structures.

Unit III:

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 coat- ings, Types of surface coatings.

Unit IV:

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 Guide- lines & 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.

Unit V:

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 Re- duction, Repair/Strengthening of Columns, Beams and Slabs, Compressive Strength of Concrete, Cracks/Joints, Masonry, Protection, Foundation, Base Isolation.

Books and Materials

Text Books:

1. Mehta, P. K., and Paulo J. M. Monteiro. *Concrete: Microstructure, Properties, and Materials.* 4th ed., McGraw Hill, 2014.
2. Director General (Works), Central Public Works Department. *Handbook on Repair and Rehabilitation of RCC Buildings.* Government of India Press, New Delhi, 2002 (reprinted 2011).

Reference Books:

1. Woodson, R. D. *Concrete Structures: Protection, Repair and Rehabilitation.* 1st ed., Butterworth-Heinemann, 2009.

B7864 – Design of Tall Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7864.1. Discuss the design criteria of tall structures under height development architecture.

B7864.2. Prepare tall building architecture with respect to environmental aspects.

B7864.3. Illustrate material handling considerations for horizontal and vertical movements.

B7864.4. Explain structural forms and flooring systems made of concrete and steel for tall structures.

B7864.5. Analyse tall buildings using various approaches.

Course Syllabus

Unit I:

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.

Unit II:

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

Unit III:

Material handling and mechanization: Material handling considerations – Earth- moving equipment's - Horizontal and vertical movements - Selection & Utility of Cranes (Tower Cranes & Climbing Cranes).

Unit IV:

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.

Unit V:

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 in- volved in modelling - Reduction techniques - Application using Structural engineering Software.

Books and Materials

Text Books:

1. Taranath, Bungale S. *Steel, Concrete, and Composite Design of Tall and Supertall Buildings.* 3rd ed., McGraw-Hill, 2025.
2. Fu, Feng. *Design and Analysis of Tall and Complex Structures.* 1st ed., Butterworth-Heinemann, 2018.

Reference Books:

1. Chew, Yit Lin Michael. *Construction Technology for Tall Buildings.* 6th ed., World Scientific, 2025.
2. Taranath, Bungale S. *Reinforced Concrete Design of Tall Buildings.* 1st ed., CRC Press, 2009.

B7865 – Ground Improvement Techniques

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

There are no specific prerequisites or co-requisites for this course.

Course Outcomes

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

B7865.1. Classify the soils based on index properties.

B7865.2. Apply the principles of soil mechanics in order to find the permeability and compaction characteristics.

B7865.3. Analyze the stress distribution of soil under various loading conditions.

B7865.4. Estimate magnitude and rate of settlement of soil.

B7865.5. Evaluate the shear strength of soil.

Course Syllabus

Unit I:

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.

Unit II:

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.

Unit III:

Stabilisation: Mechanical Stabilisation, Lime Stabilisation, Cement Stabilisation, Bitumen Stabilisation, Thermal Stabilisation, Chemical Stabilisation and Stabilisation with Different Admixtures.

Unit IV:

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.

Unit V:

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.

Books and Materials

Text Books:

1. Hausmann, Manfred R. *Engineering Principles of Ground Modification.* 1st ed., McGraw-Hill, 1990.
2. Purushothama Raj, P. *Ground Improvement Techniques.* 1st ed., Laxmi Publications, 2016.

Reference Books:

1. Koerner, Robert M. *Designing with Geosynthetics.* 6th ed., Xlibris, 2012.
2. Kirsch, Klaus, and Fabian Kirsch. *Ground Improvement by Deep Vibratory Methods.* 2nd ed., CRC Press / Taylor & Francis, 2017.
3. Coduto, Donald P., William A. Kitch, and Man-chu Ronald Yeung. *Foundation Design: Principles and Practices.* 3rd ed., Pearson, 2022.

OPEN ELECTIVES

B7081 - Business Analytics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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.

Course Outcomes

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

B7081.1 Describe the fundamentals and techniques of data analytics.

B7081.2 Evaluate data and apply critical thinking to make informed decisions using deep analytics.

B7081.3 Develop predictive models to support business decision-making.

B7081.4 Design prescriptive models to recommend optimal business solutions.

B7081.5 Interpret analytical results and present them as clear, actionable insights.

Course Syllabus

Unit-I:

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.

Unit-II:

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.

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

1. Varshney, N., and Maheswari. *Business Analytics: Principles, Concepts, and Applications.* By Marc J. Schniederjans, Dara G. Schniederjans, and Christopher M. Starkey, 1st ed., Pearson FT Press, 2014.
2. Evans, James R. *Business Analytics.* Global Edition, Pearson Higher Education & Professional Group, 2020.

B7082 - Waste to Energy

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7082.1. Classify different waste material produces from all sources.

B7082.2. Analyze Bio energy systems resources, process and application.

B7082.3. Apply emerging methods for Bio mass Pyrolysis, gasification and combustion to improve the efficiency.

B7082.4. Analyze different case studies for understanding success and failure of waste to energy technologies.

Course Syllabus

Unit-I:

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

Unit-II:

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

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

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

Reference Books:

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

B7083 - Operations Research

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7083.1. Gain knowledge in concepts and techniques of Operations Research.

B7083.2. Determine the optimal solution for Linear Programming problems.

B7083.3. Formulate and obtain the optimal solution for non- Linear Programming problems.

B7083.4. Solve to get optimal solution using queuing and inventory models.

B7083.5. Determine solution for non- Linear Programming problems using dynamic programming.

Course Syllabus

Unit-I:

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.

Unit-II:

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

Unit-III:

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

Unit-IV:

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

Unit-V:

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

Books and Materials

Text Books:

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

Reference Books:

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

B7084 - Blockchain Technology

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries, and is predicted to be just as impactful as the Internet. A blockchain is a permanent, sequential list of transaction records distributed over a network. The course introduces consensus, proof of work, mining, in Bitcoin. The course introduces ethereum blockchain and smart contracts.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7084.1. Identify and explain the fundamental concepts, architecture, and working principles of blockchain technology.

B7084.2. Demonstrate the process of cryptocurrency transactions using Bitcoin and analyze its underlying mechanisms.

B7084.3. Compare and choose suitable blockchain platforms such as Ethereum for ensuring data security and integrity.

B7084.4. Design and implement smart contracts based on given problem requirements using Ethereum or similar platforms.

B7084.5. Evaluate blockchain applications and deployment on Testnet environments for real-world use cases.

Course Syllabus

Unit-I:

Introduction to Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency. How Bitcoin Achieves Decentralization: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity: the Block Chain, Incentives and Proof of Work, Putting It All Together.

Unit-II:

Mechanics of Bitcoin: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations Improvements. Store Usage: How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Unit-III:

Bitcoin Mining: The Task of Bitcoin Miners, Mining Hardware, Energy Consumption Ecology, Mining Pools, Mining Incentives and Strategies. Bitcoin and Anonymity: Anonymity Basics, How to de-anonymizeBitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, Tor and the Silk Road.

Unit-IV:

Ethereum: What is Ethereum, smart contracts, Solidity Ethereum Virturalmachine. Installing solidity ethereum wallet, basics of solidity by example, Layout of a solidity source file structure of smart contracts, General value types, ether units, Time units, Globally available variables and functions.

Unit-V:

Operators: Arithmetic, Logical Bitwise operators, Control structure (if-else, for, while, do-while), Scoping and declarations, Input parameters and output parameters, Function calls return types, Function Modifiers, Fallback functions, Abstract contract, Creating contracts via new operator, Inheriting smart contracts, Importing smart contracts compiling contracts, Events logging, exceptions, Examples of smart contract : crowd funding, voting ballot.

Books and Materials

Text Books:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., Goldfeder, S.,Bitcoin and cryptocurrency technologies: a comprehensive introduction, Princeton University Press, 2016.
2. Dave Hoover, Kevin Solorio, and Randall Kanna., Hands–On Smart Contract Development with Solidity and Ethereum, O'Reilly Media, Inc., 2019.

Reference Books:

1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 1st Edition, O'Reilly Media, Inc., 2019.

B7085 - Cyber Security

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7085.1. Demonstrate the basics of cybercrime in computer, networked device or a network.

B7085.2. Identify various cyber offences in real time.

B7085.3. Identify the different attacks in cybercrime.

B7085.4. Use various methods and tools to control cybercrimes and cyber offences.

B7085.5. Examine how to protect organizations from intruders, attackers and cyber criminals.

Course Syllabus

Unit-I:

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.

Unit-II:

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.

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

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

Reference Books:

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

AUDIT COURSES

B7091 – Disaster Management

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7091.1. Identify concepts, hazards and vulnerabilities of different types of disasters.

B7091.2. Examine the components of disaster management mechanism.

B7091.3. Select suitable capacity building framework for disaster management.

B7091.4. Interpret various disaster coping strategies.

B7091.5. Develop Strategies for disaster management planning.

Course Syllabus

Unit-I:

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.

Unit-II:

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.

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

1. Nishith, R., and A. K. Singh. *Disaster Management in India: Perspectives, Issues and Strategies.* New Royal Book Company.
2. Sahni, Pardeep, et al., editors. *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.

B7092 – Value Education

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7092.1. Identify the importance of value-based living for character development.

B7092.2. Emerge as responsible citizens with clear conviction to practice values and ethics in life.

B7092.3. Interpret their role in nation building for a better tomorrow.

B7092.4. Develop a sense of commitment and decision-making capability.

B7092.5. Demonstrate ethical reasoning and leadership in personal and professional life.

Course Syllabus

Unit-I:

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.

Unit-II:

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.

Unit-III:

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

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

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

B7093 – Constitution of India

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7093.1. Identify the important components of Indian Constitution.

B7093.2. Explore the basics of Constitutional right in various domains .

B7093.3. Illustrate the evolution of Indian Constitution.

B7093.4. Analyze the Administrative process in India from grass-root level.

B7093.5. Relate the basic concepts of democracy, liberty, equality, secular and justice.

Course Syllabus

Unit-I:

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

Unit-II:

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.

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

1. The Constitution of India, 1950. Government Publication.
2. Busi, S. N., and B. R. Ambedkar. *Framing of the Indian Constitution.* 1st ed., 2015.

Reference Books:

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

B7094 - Stress Management by Yoga

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7094.1. Make use of yoga for stress management in educational environments.

B7094.2. Improve emotional intelligence to better deal with stress.

B7094.3. Develop flexibility through participation in yoga.

B7094.4. Learn methods of performing asanas, pranayama, mudras and bandhas.

B7094.5. Practice meditation for holistic living.

Course Syllabus

Unit-I:

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

Unit-II:

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).

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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.

Books and Materials

Text Books:

1. Andrews, Wasmer Linda. *Stress Control for Peace of Mind.* Barnes & Noble Publisher, 2005.
2. Nagendra, H. R., and R. Nagarathana. *Yoga Practices for Anxiety & Depression.* Bangalore: Swami Sukhabodhanandha Yoga Prakashana, 2004.

Reference Books:

1. Iyengar, B. K. S. *The Art of Yoga.* New Delhi: Harper Collins Publishers, 2003.

B7095 - Pedagogy Studies

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

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

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7095.1. Develop a positive attitude towards life and the teaching profession.

B7095.2. Critically analyze classroom teaching, learning processes, and student behavior.

B7095.3. Compare teaching and learning practices in educational institutes over the past decade.

B7095.4. Summarize the aspects of an effective teaching process.

B7095.5. Apply innovative strategies to enhance teaching and learning outcomes.

Course Syllabus

Unit-I:

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.

Unit-II:

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

Unit-III:

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.

Unit-IV:

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.

Unit-V:

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

Books and Materials

Text Books:

1. Ackers, J., and F. Hardman. "Classroom Interaction in Kenyan Primary Schools." *Compare*, vol. 31, no. 2, 2001, pp. 245-261.
2. Agrawal, M. "Curricular Reform in Schools: The Importance of Evaluation." *Journal of Curriculum Studies*, vol. 36, no. 3, 2004, pp. 361-379.
3. Akyeampong, K. *Teacher Training in Ghana—Does It Count?* Multi-site Teacher Education Research Project (MUSTER) Country Report 1, London: DFID, 2003.

Reference Books:

1. Akyeampong, K., K. Lussier, J. Pryor, and J. Westbrook. "Improving Teaching and Learning of Basic Maths and Reading in Africa: Does Teacher Preparation Count?" *International Journal of Educational Development*, vol. 33, no. 3, 2013, pp. 272–282.
2. Alexander, R. J. *Culture and Pedagogy: International Comparisons in Primary Education.* Oxford and Boston: Blackwell, 2001.
3. Chavan, M. *Read India: A Mass Scale, Rapid, 'Learning to Read' Campaign.* 2003.

B7096 - English for Research Paper Writing

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course equips students with essential academic writing skills, including sentence and paragraph structuring, clarity, conciseness, and avoidance of ambiguity. Students will learn to structure research papers effectively, covering abstracts, introductions, literature reviews, methods, results, discussions, and conclusions. Emphasis is placed on ethical writing practices, paraphrasing, and avoiding plagiarism. By the end of the course, students will be able to produce clear, coherent, and professionally written research papers suitable for publication.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Course Outcomes

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

B7096.1. Develop effective planning and preparation skills for academic writing, including sentence structuring and paragraph development.

B7096.2. Apply techniques to clarify meaning, avoid ambiguity, and maintain conciseness and coherence in writing.

B7096.3. Demonstrate the ability to structure research papers, including abstracts, introductions, literature review, methods, results, discussion, and conclusions.

B7096.4. Utilize skills for proper paraphrasing, citation, avoiding plagiarism, and critically analyzing findings in research writing.

B7096.5. Employ advanced writing skills for finalizing papers, including crafting titles, abstracts, and ensuring first-time submission quality.

Course Syllabus

Unit-I:

Planning and Preparation: Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit-II:

Clarifying and Writing Techniques: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Unit-III:

Paper Structure: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit-IV:

Writing Key Sections of a Research Paper: Skills needed when writing a Title, Abstract, Introduction, and Review of the Literature.

Unit-V:

Writing and Finalizing Research Papers: Skills needed when writing the Methods, Results, Discussion, Conclusions, useful phrases, and ensuring the paper is as good as possible for first-time submission.

Books and Materials

Text Books:

1. Goldbort, R. *Writing for Science.* Yale University Press, 2006. Available on Google Books.
2. Day, R. *How to Write and Publish a Scientific Paper.* Cambridge University Press, 2006.

Reference Books:

1. Highman, N. *Handbook of Writing for the Mathematical Sciences.* SIAM, 1998.
2. Wallwork, Adrian. *English for Writing Research Papers.* Springer, New York, Dordrecht, Heidelberg, London, 2011.

Vision

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

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.

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We at Vardhaman College of Engineering, endeavor to uphold excellence in all spheres by adopting the best practices in effort and effect.

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