BMS COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous College under VTU)

DEPARTMENT OF

CIVIL ENGINEERING

SCHEME & SYLLABUS

FOR AUTONOMOUS COURSE

M.TECH.

Construction Technology

I to IV SEMESTER

(Admission Year: 2018 onwards)

BMS COLLEGE OF ENGINEERING

Bull Temple Road, Bengaluru - 560 019

B.M.S COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous College under VTU)

DEPARTMENT OF CIVIL ENGINEERING
VISION OF INSTITUTE

Promoting prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

MISSION OF INSTITUTE

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

VISION OF THE DEPARTMENT

To be an excellent center for imparting quality higher education in Civil Engineering for a constantly changing societal needs with credibility, integrity and ethical standards.

MISSION OF THE DEPARTMENT

Accomplish excellence in curricular, co-curricular activities with a committed faculty through teaching and research which creates technically competent and dedicated civil engineers to serve their surroundings with pride.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

PEO1: Able to pursue professional career in the constantly changing field of construction, Engineering, Technology and Management.

PEO2: Able to contribute to knowledge base through teaching and research.

PEO3: Able to practice and promote sustainable construction technologies for social needs.

Programme Outcomes (POs):

Graduates Attributes(GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The GAs of PG programmes are examples of the attributes expected from a graduate of an accredited programme. The Graduate Attributes of PG programmes of the NBA are as following:

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 mastery in the domain of the specialization of the program

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DEPARTMENT OF CIVIL ENGINEERING

Percentage Credit Distribution

Sl. No.	Subject area	Percentage distribution of credits
1	Core Courses	28 (32%)
2	Elective Courses	20 (23%)
3	Internship	10 (11%)
4	Major Project	30(34%)

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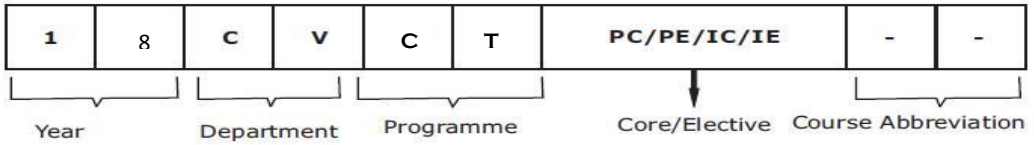
DEPARTMENT OF CIVIL ENGINEERING
M.Tech.- Construction Technology- Scheme- 2018-19

I Semester

Course Code										Course Title	Credits				Contact Hrs/Wk
											L	T	P	Total	
1	8	C	V	C	T	P	C	M	C	Mechanization In Construction	3	-	-	3	3
1	8	C	V	C	T	P	C	P	M	Construction Project Management	3	-	-	3	5
1	8	C	V	C	T	P	C	C	T	Advances in Concrete Technology	3	-	1	4	5
1	8	C	V	C	T	P	C	A	S	Applied Statistics	4	-	-	4	3
1	8	C	V	C	T	P	E	x	x	Elective–I	-	-	-	3	3
1	8	C	V	C	T	P	E	x	x	Elective-II	-	-	-	3	3
1	8	H	S	M	C	I	C	R	M	Research Methodology	2	-	-	2	2
													Total	**22**	**24**

L-Lecture Hours; **T**-Tutorial Hours; **P**-Practical Hours; **S**-Self study



Note : Elective will be offered for a minimum strength of six candidates (out of 18) / eight candidates (out of 24)

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II Semester

Course Code										Course Title	Credits				Contact Hrs/Wk
											L	T	P	Total	
1	8	C	V	C	T	P	C	E	F	Construction Economics and Finance	3	1	-	4	5
1	8	C	V	C	T	P	C	S	C	Sustainable Construction	3	-	1	4	5
1	8	C	V	C	T	P	C	S	M	Structural Masonry	3	1	-	4	5
1	8	C	V	C	T	P	E	x	x	Elective–III	-	-	-	3	3
1	8	C	V	C	T	P	E	x	x	Elective-IV	-	-	-	3	3
1	8	x	x	x	x	O	E	x	x	Elective-V (Institutional)	-	-	-	4	4
													Total	**22**	**25**

L-Lecture Hours; **T**-Tutorial Hours; **P**-Practical Hours; **S**-Self study

Note : Elective will be offered for a minimum strength of six candidates (out of 18) / eight candidates (out of 24)

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III Semester:

Course Code										Course Title	Credits				Contact Weeks
											L	**T**	**P**	**Total**	
1	8	C	V	C	T	P	J	P	1	Major Project Phase - I	-	-	18	18	16 weeks
1	8	C	V	C	T	P	E	x	x	Elective-V	4	-	-	4	
1	8	C	V	C	T	N	C	x	x	Audit course-1	-	-	-	2 units	
Total														**22**	

L-Lecture Hours; **T**-Tutorial Hours; **P**-Practical Hours; S-Self study

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IV Semester

Course Code										Course Title	Credits				Contact Weeks
											L	T	P	Total	
1	8	C	V	C	T	P	J	P	2	Major Project (Dissertation and Viva-Voce)	-	-	12	12	16
1	8	C	V	C	T	N	T	I	T	Industrial training			10	10	
1	8	C	V	C	T	N	C	x	x	Audit course 2	-	-		2 units	
Total														**22**	

L-Lecture Hours; **T**-Tutorial Hours; **P**-Practical Hours; **S**-Self study

List of Electives

	L	T	P		L	T	P
18CVCTPERC –Advanced Reinforced Concrete Design	3	1	-	18CVCTPE PD- Pavement Design and Construction	3	-	-
18CVCTPE DS- Advanced Design of Sub- Structures	3	1	-	18CVCTPEGT – Soil Exploration & ground Improvement Techniques	3	1	-
18CVCTPEPC –Prestressed concrete	4	-	-	18CVCTPEPT- Pre-Engineered Construction Technology	3	-	-
18CVCTPESM-Building Services and Maintenance	3	-	-	18CVCTPEER- Design of Earthquake Resistant Structures	3	1	-
18CVCTPE BS-Building Science	3	-	-				
18CVCTPE RE- Remedial Engineering	3	-	-	18CVCTOEQS- Construction Quality and Safety	4	-	-

List of Audit Courses

		L	T	P
18CVCTNCEW	English for Research Paper Writing			
18CVCTNCPS	Pedagogy Studies			
18CVCTNCSM	Stress Management by Yoga			
18CVCTNCDM	Disaster Management			
18CVCTNCEW	English for Research Paper Writing			

MECHANIZATION IN CONSTRUCTION

Course Name	MECHANIZATION IN CONSTRUCTION	Course Code	18CVCTPCMC	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Comprehend and present the extent of mechanization in construction activities of regular and landmark structures

CO2: Write and compare conventional and modern construction technologies

Unit I: Introduction to mechanization: Definition, advantages and limitations of mechanization, Indian scenario and Global scenario, Safety and Environmental issues in mechanization

Unit II: Mechanization in earthwork activities: Equipment cost, Machine Power, Production cycle - Dozers, scrapers, Excavators, Finishing equipment, Trucks and Hauling equipment, Hoisting equipment, Draglines and Clamshells

Unit III: Mechanization in construction material production: Natural aggregates and recycled aggregates, Mechanization in rebar fabrication

Unit IV: Mechanization in concrete production and placement: Concrete production and handling, Formwork and scaffolding-types, materials and design principles.

Unit V: Mechanization through construction methods/technologies: Segmental construction of bridges/flyovers, box pushing technology for tunneling, trench-less technology.

REFERENCE BOOKS:

1. Peurifoy R L, "**Construction Planning, Equipment and Methods**", Mc Graw Hill
2. James F Russell, "**Construction Equipment**", Prentice Hall

CONSTRUCTION PROJECT MANAGEMENT

Course Name	CONSTRUCTION PROJECT MANAGEMENT	Course Code	18CVCTPCPM	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify the organization structure of a project, provide an outline of project planning by drawing network diagram using CPM and PERT analysis

CO2: Develop resource plan, resource allocation and resource leveling for a construction project including estimation of time-cost trade–off in a construction project and to work in a team to develop construction schedules for real time projects

Unit – I: Project Organization, Bar Charts, Work Breakdown Structure, Networking techniques, development of network

Unit – II: CPM network analysis

Unit – III: PERT analysis.

Unit – IV: Resource Planning, allocation and levelling, Time-Cost Trade-off, Cost Control in Construction.

Unit – V: Line of Balance Scheduling, Introduction to Material Management, Purchase management and inventory control. Introduction to Building Information Model (BIM), Use of Construction management software packages

REFERENCE BOOKS:

1. Chitkara K K, "Construction Project Management, Planning, Scheduling and Controlling, Mc Graw Hill Education, 3rd Ed., 2014.
2. Peurifoy. R L, "**Construction Planning, Equipment and Methods**"- Mc Graw Hill.
3. Srinath L.S, "**PERT and CPM**", East West Press Pvt Ltd New Delhi.
4. Frank Harris and Roland McCaffer, "**Modern Construction Management**"- 4th Ed. Blackwell Science Ltd. 2009.

ADVANCES IN CONCRETE TECHNOLOGY

Course Name	ADVANCES IN CONCRETE TECHNOLOGY	Course Code	18CVCTPCCT	SEE Duration	03 Hrs
Credits	04	L-T-P	3-0-1	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify constituent of concrete material characteristics and different types of concrete for their appropriate use in construction

CO2: Distinguish concrete behavior based on its fresh and hardened properties and distinguish concrete behavior based on its fresh and hardened properties.

CO3: Prepare a comprehensive report on new knowledge in any one of the topic related to concrete technology and evaluation of concrete mix designed for a specific construction project.

Unit – I: Concrete making materials- cement: physico-chemical characterics, types of cement, aggregates, admixtures (both mineral and chemical). Structure of hydrated cement paste, pores, gel space, relation to strength and durability.

Unit - II: **Fresh and Hardened Properties**: Fresh concrete and its rheology, types of measurements, Mechanical properties of hardened concrete, deformational behaviour of hardened concrete. Creep and Shrinkage of Concrete.

Unit – III: Proportioning of Mixes- Normal Concrete, High Performance, Ultra High Performance concrete, Self-Compacting Concrete, Roller Compacted Concrete, and Geo-polymer Concrete.

Unit – IV: Evaluation of Concrete strength: In-situ testing of concrete, NDT methods, core strength, and quality assurance as per codal provisions.

Unit – V: **Durability of Concrete:**. Durability of Plain and Reinforced Concrete- Factors influencing durability (internal and external), effect of sulphate, chloride, and acid on concrete. Alkali aggregate reaction, Chloride/carbonation induced corrosion, Permeability of concrete, methods of measurement of durability.

Laboratory session:

Open ended experiments to be carried out for a concrete mix designed for a real time project situation in groups to evaluate fresh, hardened and durable properties of concrete to supplement laboratory component of learning.

REFERENCE BOOKS:

1. Neville A.M. "**Properties of Concrete**"- 5th Ed., Pearson Education Ltd., 2011.
2. Mehta .P.K., and Paulo J.M. Monteiro, "**Concrete- Microstructure, Properties and Materials**"-(Indian Ed., McGraw Hill Education, 2014.

E-Resources:

1. http://nptel.ac.in/courses/105102012/,
2. http://nptel.ac.in/courses/105106053/

APPLIED STATISTICS AND OPTIMIZATION TECHNIQUES

Course Name	APPLIED STATISTICS AND OPTIMIZATION TECHNIQUES	Course Code	18CVCTPCAS	SEE Duration	03 Hrs
Credits	04	L-T-P	4-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Use appropriate statistical decision making testing tools in the data analysis.

CO2: Apply the optimization techniques in construction

Unit – I: Various Statistical Measures – Statistical methods, scope and limitations, population and sample, frequency distribution – measure of central tendency- Measures of Dispersion – Mean, Median, Mode, Standard deviation, Coefficient of Variation, skewness and their applications

Unit – II: Multiple regressions - Distributions, Bernoulli, Binomial, Poisson, Uniform, Normal, Exponential, Chisquare T and F.

Unit – III: Sample statistics - Empirical distributions, and goodness of fit, sampling from normal population, Hypothesis Testing, Significance Intervals.

Unit – IV: Linear Programming- Problem formulation, graphical method of LP, Simplex method, Big - M method, Two phase method and Duality problems

Unit – V: Optimization techniques- Sensitivity analysis, Transportation and Assignment problems

REFERENCE BOOKS:

1. Gajaria GT, "**Sampling techniques-Cochran, Wiley Series**
2. Walpole R. E and R. H. Mayers (1982): **"Probability and statistics for Engineers and Scientists, Wiley Intl. 2002"**
3. Johnson R and G. Bhattacharya (1985**), "Statistics – principles and methods. John Wiley, N Y."**
4. **Ossenbruggen P J, "System Analysis for Civil Engineering", John Wiley & Sons**
5. **Rao S S, " Engineering Optimisation" , New Age International**
6. **Taha H A, "Optimization Research An Introduction", Pearson Prentice Hall**

RESEARCH METHODOLOGY

Course Name	RESEARCH METHODOLOGY	Course Code	16APRDICRM	SEE Duration	03 Hrs
Credits	02	L-T-P	2-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Define the research problem, identify objectives and develop a methodology for the research problem

CO2: Intrepret the literature, analyse the findings of research and technical reports and thesis

Module 1:

Meaning, Objectives and Characteristics of research - Research methods Vs Methodology - Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs.Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research - Developing a research plan.

Module 2:

Defining the research problem - Selecting the problem - Necessity of defining the problem -Techniques involved in defining the problem-Importance of literature review in defining a problem- Survey of literature - Primary and secondary sources - Reviews, treatise, monographs-patents - web as a source - searching the web - Identifying gap areas from literature review -Development of working hypothesis.

Module 3:

Research design and methods – Research design – Basic Principles- Need of research design –Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models - Developing a research plan - Exploration, Description, Diagnosis, and Experimentation- Determining experimental and sample designs.

Module 4:

Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques- Methods of data collection – Collection of primary data - Data collection instruments

Module 5:

Testing of hypotheses - Basic concepts – Procedure for hypotheses testing flow diagram for hypotheses testing - Data analysis with Statistical Packages – Correlation and Regression - Important parametric test - Chi-square test – Analysis of variance and Covariance

Module 6:

IPRs- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs- Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures**.**

Module 7:

Interpretation and report writing - Techniques of interpretation - Structure and components of scientific reports - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis

REFERENCE BOOKS:

1.Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. "**An introduction to Research Methodology"**, RBSA Publishers.

2.Kothari, C.R., 1990. "**Research Methodology: Methods and Techniques**". New Age International. 418p.

3.Anderson, T. W., "**An Introduction to Multivariate Statistical Analysis**", Wiley Eastern Pvt., Ltd., New Delhi

4.Sinha, S.C. and Dhiman, A.K., 2002. "**Research Methodology**", Ess Ess Publications. 2 volumes.

5.Trochim, W.M.K., 2005. "**Research Methods: the concise knowledge base**", Atomic Dog Publishing. 270p.

6.Day, R.A., 1992."**How to Write and Publish a Scientific Paper**", Cambridge University Press.

7.Fink, A., 2009. "**Conducting Research Literature Reviews: From the Internet to Paper**".Sage Publications

8.Coley, S.M. and Scheinberg, C. A., 1990, "**Proposal Writing**", Sage Publications.

9. Keith Eugene Maskus , "**Intellectual Property Rights in the Global Economy**":, Institute for International Economics, Washington, DC, 2000

10.Subbarau NR-"**Handbook on Intellectual Property Law and Practice**"-S Viswanathan Printers and Publishing Private Limited.1998

CONSTRUCTION ECONOMICS AND FINANCE

Course Name	CONSTRUCTION ECONOMICS AND FINANCE	Course Code	18CVCTPCEF	SEE Duration	03 Hrs
Credits	04	L-T-P	3-1-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Apply the concept of time value of money to different real time situations

CO2: Analyse different economic feasible alternatives using present worth/rate of return methods of investment and demonstrate construction accounting principles to prepare financial statements.

CO3: Appraise financial health of construction organizations using financial evaluation tools and develop a comprehensive investment proposal on any construction enterprise

Unit – I: Engineering economics: Time value of money, Cash flow diagrams, Equivalence-Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F).

Unit – II: Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, and Incremental analysis,

Unit – III: Depreciation of Assets: Methods of depreciation, taxes, inflation, cost estimates and valuation of properties.

Unit – IV: Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options. Replacement analysis.

Unit – V: Financial management: Construction accounting, Profit and loss, Balance sheets, Financial ratios, Working capital management.

REFERENCE BOOKS:

1. Blank L and Anthony T, " **Basics of Engineering Economy**", Mc Graw Hill Education, Indian Edition, 2013.
2. Peurifoy, R. L., Schexnayder, C. J. and Shapira, A., "**Construction Planning, Equipment, and Methods**", 7th ed., Tata McGraw-Hill, New Delhi, 2010.

3. Van Horne J.C, "**Fundamentals of Financial Management**" Prentice Hall.

4. Bose, D. C., "**Fundamentals of Financial management**", 2nd ed., PHI, New Delhi, 2010.

E-Resources:

1. http://nptel.ac.in/courses/105103023/

SUSTAINABLE CONSTRUCTION

Course Name	SUSTAINABLE CONSTRUCTION	Course Code	18CVCTPCSC	SEE Duration	03 Hrs
Credits	04	L-T-P	3-0-1	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify principles of sustainability, assess sustainability through rating systems and carry out life cycle analysis of a typical building

CO2: Develop recycling process, characterize marginal materials and evaluate recycled products

Unit I: Introduction to sustainability: Sustainability principles, concept of zero waste, 3 R's principles, sustainability concept in construction industry, need, objectives, achieving sustainability at various stages of construction, resource economics, waste minimization techniques, Governmental and citizen's role, demolition and De-construction techniques.

Unit II: Energy concepts for sustainability: Concept of Embodied energy, importance of embodied energy, constituents of embodied energy, Operational energy, Life cycle energy, case study of a typical building, typical embodied energy values of few materials of construction,

Unit III: Sustainable buildings – Zero carbon buildings, energy efficiency, energy monitoring, energy modeling, carbon reduction in buildings, renewable energy sources, concept of net zero energy building

Unit IV: Sustainable materials and resources: Concept of recyclability, use of marginal materials in construction of civil engineering structures, use of processed demolished materials and construction waste, use of recycled materials: aluminum, steel, wood, flyash, GGBS, gypsum, manufactured sand

Unit V: Assessment of Sustainability: Introduction and brief description of existing rating systems for sustainable building design and construction (both new and for renovations), LEED rating system, GRIHA rating system for green buildings.

Laboratory session:

Testing of marginal materials, material characterization, evaluation of mortar/concrete/masonry units made with marginal materials.

REFERENCE BOOKS:

1. Richard Ian Stessel.,"**Recycling and Resource Recovery Engineering**", Springer-Verlag Berlin Heidelberg (1996)

2. Greg Winkler, "**Recycling Construction and Demolition waste: A LEED-Based Toolkit**" (Green Source) (Google ebook), McGraw Hill Professional

3. V M Tam, Chi Ming Tam, "**Reuse of Construction and Demolition Waste in Housing Development**", Nova Science Publishers, 2008

4. Meg Calkins , " **Materials for sustainable sites**", John Wiley and Sons Inc.

5. Charles Kibert, "**Sustainable construction- Green Building Design and Delivery**", John Wiley and sons

6. Michael Ashby, "**Material and Environment**", Elsevier Inc

7. "**Recycling, Use and Management of C & D wastes**", ICI Bulletin 01, Indian Concrete Institute, 2015

STRUCTURAL MASONRY

Course Name	STRUCTURAL MASONRY	Course Code	18CVCTPCSM	SEE Duration	03 Hrs
Credits	04	L-T-P	3-1-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Characterize and evaluate the strength of masonry materials

CO2: Design masonry elements under different loads

Unit I: Characterization of masonry materials: Materials for Masonry, Strength and elastic properties of masonry materials

Unit II: Characterization of masonry properties: Parameters influencing Masonry properties

Unit III: Behaviour of masonry: Masonry under shear, flexure, and axial loads (static and dynamic).

Unit IV: Behaviour of masonry structures: Masonry arches, shells, reinforced masonry

Unit V: Design of masonry structures: Tutorial sessions on design problems of masonry structures

REFERENCE BOOKS:

1. Hendry A W, "**Structural Masonry**"
2. Sven Sahlin, "**Structural Masonry**"
3. Curtin, "**Design of Reinforced and Pre-stressed Masonry**"
4. Dayaratnam P,"**Brick and Reinforced Brick Structures**"-Oxford and IBH pub.

ADVANCED REINFORCED CONCRETE DESIGN

Course Name	ADVANCED REINFORCED CONCRETE DESIGN	Course Code	18CVCTPERC	SEE Duration	03 Hrs
Credits	04	L-T-P	4-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify the yield line patterns of slabs and apply the concepts to design the slabs.

CO2: Analyse and design components of complex RC structures as per BIS code and generate the reinforcement detailing of the designed RC structures.

Unit – I: Design of grid floors.

Unit – II: Design of continuous beams.

Unit – III: Design of portal frames. Art of detailing earthquake resistant construction – expansion and construction joints

Unit – IV: Design of silos and bunkers.

Unit – V: Design of flat slabs

REFERENCE BOOKS:

1. A Park and Paulay, "**Reinforced Reinforced and Prestressed Concrete**"-John Wiley & Sons
2. Lin TY and Burns N H, "**Reinforced Concrete Design**". John Wiley & Sons
3. Kong KF and Evans T H "**Design of Prestressed Concrete Structures**"
4. P.C.Varghese, "**Advanced Reinforced Concrete Design**"- Prentice-Hall of India, New Delhi, 2005.
5. Dr.B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, " **Comprehensive RCC Design**"

CONSTRUCTION QUALITY AND SAFETY

Course Name	CONSTRUCTION QUALITY AND SAFETY	Course Code	18CVCTOEQS	SEE Duration	03 Hrs
Credits	04	L-T-P	4-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Outline the importance of Quality and Safety and explain the various Quality assessing tools as applied to construction industry.

CO2: Understand the importance and need of a safety division and its role in construction projects and examine ACT 1996, BIS Safety standards and rules.

Unit I: Construction Quality, Inspection and Testing, Quality control, Quality Assurance

Unit II: Quality Certification for companies and laboratories (ISO Certification, NABL certification)

Unit III: Total Quality Management, Critical factors of TQM, TQM in Projects, Benchmarking, concepts of quality policy, standards, manual, Third Party Certification

Unit IV: Construction Safety-meaning and scope, Safety in construction-Technological aspects, organizational aspects and behavioral aspects, Safety legislation and Standards

Unit V: Contract conditions on safety in civil Engineering projects, Safety rules in construction, Safety in construction operations, Safety in the use of construction equipment, Ergonomics, Accident Prevention and safety, Construction Safety Management.

REFERENCE BOOKS:

1.N. Logothetis, "**Management for Total Quality**", Prentice Hall

2.David Gold Smith, "**Safety Management in construction and Industry**", Mc Graw Hill

3.K N Vaid, "**Construction Safety Management**", NICMAR, Bombay

4.D S Rajendra Prasad, "**Quality Management System in Civil Engineering**", Sapna Book House, Bangalore

5."**The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996"**, Universal Law Publishing Co. Pvt. Ltd.

ADVANCED DESIGN OF SUB STRUCTURES

Course Name	ADVANCED DESIGN OF SUB STRUCTURES	Course Code	18CVCTPEDS	SEE Duration	03 Hrs
Credits	04	L-T-P	4-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Classify and suggest foundation type for various field and loading conditions, understand the basic requirements of a satisfactory foundation and the determinants of foundation location and depth, and proportion shallow foundations

CO2: Estimate individual vertical pile load capacity, pile group capacity, and pile group efficiency and comprehend the application and requirements of other types of deep foundations namely drilled piers, caissons and well foundations.

CO3: Develop an understanding of the various structural features, assessing the forces, design criteria and choice of foundation for a port structure and transmission line tower .

Unit – I: Introduction: Introduction to sub structure, definition, purpose, requirements, types. **Foundation:** Types, selection criteria, requirements, load computation, design steps.

Unit – II: Shallow foundation: Types, depth of footings, loads, principles of design, proportioning of strip, spread, rectangular, trapezoidal, combined footings (no structural design), numerical problems on proportioning, raft foundation-design method, modulus of subgrade reaction.

Unit – III: Pile foundation: Introduction, necessity, various classifications, load carrying capacity, static method for driven piles in sand and clay, negative skin friction, dynamic formulae, pile group, group efficiency, numerical problems on above, under reamed piles, pile load test, concept of batter piles.

Unit – IV: Drilled pier, Caissons, well foundation

Introduction, construction of drilled pier, merits & demerits of drilled piers, caissons-open type, pneumatic and floating caissons concept, advantages, disadvantages, stability of floating caissons. Well foundation types, shapes, forces acting, components, sinking of wells, tilts and shifts.

Unit – V: Marine substructures: Introduction, types, concepts of breakwater, wharves, pier, seawall, docks, quay walls, design loads, combined loads, and design method of break waters.

Foundation of transmission line towers: Introduction, necessary, forces, design criteria, choice of foundation, design procedure.

REFERENCE BOOKS:

1. Gopal Ranjan and ASR Rao, "**Basic and Applied Soil Mechanics**", New Age Int. (P) Ltd.
2. Swamisaran, "**Analysis and Design of Sub-Structures**", IBH & Oxford
3. B.M.Das, "**Principles of Foundation Engineering**", PWS Kent, Boston.
4. J.E. Bowles, "**Foundation Analysis and Design**", McGraw-Hills
5. Teng, "**Foundation Design**", Prentice Hall, Ind
6. K.R. Arora, "**Soil mechanics and foundation engineering**", Standard publishers distributors

BUILDING SCIENCE

Course Name	BUILDING SCIENCE	Course Code	18CVCTPEBS	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Interpret the physical phenomenon of weather on buildings

CO2: Identify and analyse materials suitable for optimal environmental performance on buildings and design integrated systems to optimize building performance

Unit – I: Climatic factors, Classification of tropical climates, site climate, micro climate of human settlements.

Unit – II:. **Thermal comfort factors**: Thermal indices, thermal quantities, heat exchange in buildings, periodic heat flow, mechanical and structural means of thermal control.

Unit – III: Ventilation: Ventilation requirements for health, mechanisms and estimation of natural ventilation, airflow patterns in building

Unit – IV: Noise control in Buildings: Sound insulation, absorption, transmission reverberation roofing and walling system for sound absorption and insulation, noise and noise control in buildings.

Unit – V: Principles of day lighting in buildings: Day lighting: Lighting principles and fundamentals, Sky, Indian sky, daylight prediction and design of fenestration.

REFERENCE BOOKS:

1. Koenighsberger, O.H. et al, "**Manual Of Tropical Housing And Building Part-I Climatic Design**", Orient Longman. 1973.
2. B C Punmia, "**Building Construction**", Laxmi Pub
3. Bureau of Indian Standards, " **Hand Book Of Functional Requirements Of Buildings, (Sp-41 & Sp- 32**)", BIS 1987 and 1989.

PRE ENGINEERED CONSTRUCTION TECHNOLOGY

Course Name	PRE ENGINEERED CONSTRUCTION TECHNOLOGY	Course Code	18CVCTPEPT	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Investigate Pre-Engineered building technology and plan simple buildings using various types of prefabricated elements

CO2: Design and outline production of precast elements

Unit I: General Principles of Fabrication

Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames.

Unit II: Prefabricated Elements

Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural Connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings –Expansion joints in pre-cast construction. Designing and detailing of precast unit for factory structures –Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames –Single storeyed buildings – slabs, beams and columns.

Unit III: Production of Prefabricated elements

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening.

Unit IV: Hoisting and erection of prefabricated elements

Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns. Vacuum lifting pads.

Unit V: Pre-Engineered Buildings

Introduction – Advantages - Pre Engineered Buildings Vs Conventional Steel Buildings - Design of Pre Engineered Buildings (PEB) – Applications

REFERENCE BOOKS:

1. L. Mokk, "**Prefabricated Concrete for Industrial and Public Structures"**, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, "**Manual of Precast Concrete Construction, Vol. I, II, III & IV**", Berlin, 1971.

3. B. Lewicki, "**Building with Large Prefabricates**", Elsevier Publishing Company, Amsterdam, London, New York, 1998.
4. "**Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete**", Netherland Betor Verlag, 2009.
5. Hass, A.M. "**Precast concrete design and Applications**", Applied Science Publishers, 1983.
6. "**Handbook on Precast concrete for buildings**", ICI Bulletin 02, Indian Concrete Institute, 2016
7. "**National Building Code of India**", BIS, New Delhi, 2016

PAVEMENT DESIGN AND CONSTRUCTION

Course Name	PAVEMENT DESIGN AND CONSTRUCTION	Course Code	18CVCTPEPD	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Analyse the difference between the design principles of flexible and rigid pavements including evaluation of stresses from loads from vehicles, EWL concepts and layered system concepts.

CO2: Prepare flexible pavement design based on laboratory and theoretical methods as per IRC guidelines.

CO3: Prepare rigid pavement design based on laboratory and theoretical methods as per IRC guidelines.

CO4: Learn the various equipments to be used for road construction including some special equipments.

CO5: Understand the construction procedure principles for various layers of flexible pavement like earthwork, GSB, Base course and surface course including specification and quality control tests.

CO6: Understand the construction procedure principles for various layers of rigid pavement like laying of pavement quality concrete including specification and quality control tests.

Unit – I: Introduction: Highway and airport pavements, Types and component parts of pavements, their differences - Factors affecting design and performance of pavements.

Stresses and Deflections In Flexible Pavements: Stresses and deflections in homogeneous masses. wheel load stresses, various factors in traffic wheel loads;

ESWL and EWL factors.

Unit – II: Flexible Pavement Design Methods For Highways : CBR method-Principle – Testing as per IRC, AASHTO and Asphalt Institute and Shell Method. Problems on above

Unit – III: Stresses in Rigid Pavements: Factors affecting design and performance of pavements. Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL, wheel load stresses, warping stresses, frictional stresses, combined stresses. Problems on above Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacing; design of CC

pavement for roads and runways, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements, Problems on above

Unit – IV: Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction

Unit – V: Subgrade: Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests

Flexible Pavements: Specifications of materials, construction method and field control checks for various types of flexible pavement layers – WBM-BM- BC

Cement Concrete Pavements: Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.

REFERENCE BOOKS:

1. Yoder, E.J., and Witczak, "**Principles of Pavement Design**"- 2nd ed. John Wiley and Sons, 1975.

2. Yang, "**Design of Functional Pavements**"- McGraw Hill Book Co.

3. Khanna and Justo, "**Test Book of Highway Engineering**"- Nemchand brothers, Roorke-2004.

4. Huang, "**Pavement Analysis**"- Elsevier Publications

5. HRB/TRB/IRC/International Conference on "**Structural Design of Asphalt Pavements**".

6. "**Relevant IRC Publications**"

7. "**CMA Hand Book**"

8. Sharma, S.C."**Construction Equipment and its Management**"- Khanna Publishers

PRE-STRESSED CONCRETE

Course Name	PRE-STRESSED CONCRETE	Course Code	18CVCTPEPC	SEE Duration	03 Hrs
Credits	04	L-T-P	3-1-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Evaluate the internal stresses of a PSC element, estimate the resultant stress at any section, generate the pressure line and evaluate the losses in PSC members to determine the effective prestressing force.

CO2: Analyse, design PSC members for flexure shear and torsion, evaluate anchorage zone stresses and design the anchorage zones

Unit – I: High strength materials, Pre-stressing systems, losses in pre-stress.

Unit – II: Analysis of P.C. Members for flexure, shear, torsion.

Unit – III: Design of reinforcement for flexure. Introduction to Post-tensioning of flat slabs.

Unit – IV: Design of reinforcement for shear, and torsion.

Unit – V: Anchorage zone stresses in Pre-tensioned and Post – tensioned members.

Concept of transmission, length, bond stresses. **Design** of anchorage zone reinforcement.

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REFERENCE BOOKS:

1. A Park and Paulay, "**Reinforced Reinforced and Pre-stressed Concrete**", John Wiley & Sons.

2. Lin TY and Burns N H, "**Reinforced Concrete Design**".

3. Kong KF and Evans T H "**Design of Pre-stressed Concrete Structures**"

BUILDING SERVICES AND MAINTENANCE

Course Name	BUILDING SERVICES AND MAINTENANCE	Course Code	18CVCTPESM	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Apply fire/MEP systems to any given building systems as per NBC standards.

CO2: Identity causes of deterioration and plan maintenance schedule for building systems

Unit – I: Fire Protection of Buildings: Basic concepts, fire resistance, Process of combustion, Effect of fire on construction materials, design of fire resistance-concrete, steel, Fire safety: detection and suppression.

Unit – II: Lifts and Escalators: Introduction of lift design, design of lift systems, expected stops and floor of reversal, different cases, escalators.

Unit – III: Water and Electric systems: Introduction to flow systems, cold and hot water systems, waste water systems and electrical systems, design of electrical systems.

Unit – IV: HVAC: Introduction of HVAC, governing factors for HVAC process, examples.

Unit – V: Building Maintenance: Planning of building maintenance, Periodicity of maintenance, Preventive and protective maintenance, Scheduled and contingency maintenance planning, condition survey and health monitoring.

REFERENCE BOOKS:

1. **NBC-2016," Relevant Parts**: BIS, New Delhi

2. Jain V K," **Services in Building Complex and High Rise Buildings**", Khanna Pub.

3. V. P. Bushev, V. A. Pchelintsev, V. S. Fedorenko and D. A. I. Yakovlev; Editor V. A. Pchelintsev, **"Fire Resistance of Buildings**", Amerind Publishing Co., Pvt. Ltd, New Delhi, 1978

SOIL EXPLORATION AND GROUND IMPROVEMENT TECHNIQUES

Course Name	SOIL EXPLORATION AND GROUND IMPROVEMENT TECHNIQUES	Course Code	18CVCTPEGT	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify and prioritize different methods of boring and sampling techniques for soil exploration with Laboratory and field testing of soil exploration samples and prepare the test reports to evaluate the economics of soil exploration.

CO2: Implement different methods of soil improvement techniques, analyse different case histories of soil exploration methods and ground improvement techniques.

Unit – I: Principles of exploration: Geophysical and sounding methods, Modern methods of boring and sampling ; Preservation and transportation of samples; Sampling records, Soil profiles,

Unit – II: Various types of field tests; Instrumentation; Investigation below sea/river bed; offshore investigation; investigation; interpretation of exploration data and report preparation; economics of field testing & lab testing.

Unit – III: Engineering properties of soft & weak and compressible deposits; principles of treatment;

Unit – IV: Methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods; Dynamic consolidation; vibroflotation; compaction by blasting; pre-consolidation with vertical drains;

Unit – V: Granular piles; soil nailing; Anchors; Grouting; Electro-osmosis; Soil freezing; Vacuum consolidation; Case histories Soil confinement

REFERENCE BOOKS:

1. Hvorslev MJ, "**Subsurface Exploration and Sampling of Soils for Civil Engg. Purposes**" Elsevier Pub. Co

2. Manfredd RH, "**Engineering Principles of Ground Modification**", Mc Graw Hill

3. Head KH, "**Manual of Soil Laboratory Testing**".

4. Purushotham Raj, "**Ground Improvement Techniques**".

REMEDIAL ENGINEERING

Course Name	REMEDIAL ENGINEERING	Course Code	18CVCTPERE	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Identify the various causes of deterioration of structures and relate it to the effects and choose the diagnostic methods and tools after identifying the levels of distress in structures.

CO2: Formulate a strategy for repair and rehabilitation by selecting appropriate repair materials and techniques and infer the results of a case study and provide techniques for repair.

Unit – I: General : Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT

Unit – II: Influence on Serviceability And Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

Unit – III: Materials for Repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete.

Unit – IV: Techniques for Repair: Rust eliminators and polymers coating for rebar during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete, Epoxy injection, Mortar repair for cracks, shoring and underpinning.

Unit – V: Examples of Repair: To Structures Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures - case studies

REFERENCE BOOKS

1. Sidney., M. Johnson "**Deterioration Maintenance and Repair of Structures**"

2. R.N. Raikar "**Rehabilitation of Structures**"- Edited by, Vol. 1, 2 and 3, Proc., Int. Symposium, Maharashtra Indian Chapter of ACI, Bombay

3. Denison Campbell, Allen & Harold Roper," **Concrete Structures– Materials, Maintenance and Repair**"- Longman Scientific and Technical

4. **CPWD Hand book on Repair and Rehabilitation of RCC Buildings**, DG(W), Central Public Works Department, New Delhi, 2002.

DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Course Name	DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	Course Code	18CVCTPEER	SEE Duration	03 Hrs
Credits	04	L-T-P	3-1-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Describe the fundamentals of engineering seismology, characterise the earthquake ground motions and prepare the basis for estimations of seismic forces.

CO2: Analysis, design and detailing the building components for seismic resistance as per BIS codal provisions, identify and discuss the failure patterns of building during earthquake.

Unit – I: Introduction to engineering seismology, characteristics of earthquake and its quantification, seismological instrumentation in buildings, introduction to structural dynamics of buildings, Seismic response of buildings and sites –

Unit – II: Dynamic properties of buildings and sites, building code requirements for earthquake effects, forms of seismic response, structural response, structural failures, non-structural damage, behaviour of ordinary construction, site failures, building foundation failures.

Unit – III: Desirable features of earthquake resistant buildings, damping, ductility and energy absorption in buildings, details of providing ductility in structures, lessons from structural damage during past earthquakes.

Unit – IV: Earthquake analysis of linear systems- Response history analysis and response spectrum analysis. Earthquake analysis of multistoried RC structure, discussion of IS code provisions of Earthquake resistant design of buildings.

Unit – V: Design of basic structural elements (Reinforced concrete) such as beams, columns and slabs subjected to dynamic loads by limit state method. Concepts for Earthquake resistant masonry – IS codal provisions

REFERENCE BOOKS:

1. Minoru Wakabayashi, "**Design of Earthquake Resistant Buildings**"- McGraw Hill Pub.

2. Anil K Chopra, "**Dynamics of Structures – Theory and Application to Earthquake Engineering**"- 2nd ed., Pearson Education pub.

3. Anderson,R.A., "**Fundamentals of Vibrations**"- Mc Millan

4. **IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993**

5. Timoshenkeo, S., "**Vibration and Stuctural Dynamics**"-VanNostrand Co.,
6. Clough and Penzien, "**Dynamics of Structures**".
7. Mukyopadhyaya, "**Vibration and Structural Dynamics**"- Oxford &IBH
8. James Ambrose and Dimitry Vergun, "**Design for Earthquakes**".
9. David Key, "**Earthquake Design Practice for Buildings**",Thomas Telford.

CONSTRUCTION AND CONTRACT MANAGEMENT

Course Name	CONSTRUCTION AND CONTRACT MANAGEMENT	Course Code	18CVCTPECC	SEE Duration	03 Hrs
Credits	04	L-T-P	4-0-0	CIE+SEE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Prepare the project cost estimate and compose the tender / contract documents.

CO2: Identify the appropriate types of contract for a given construction project and interpret claim records to solve arbitration cases.

Unit – I: Project cost estimation, rate analysis-labour, materials and equipment production, Overhead charges, Bidding models and strategies, Qualification of bidders.

Unit – II: Tendering and contractual procedures, Indian Contract Act 1872 as applied to construction,

Unit – III: Types of contracts, International contracts, Conditions and specifications of contract, Contract administration,

Unit – IV: Claims, compensation and disputes, Dispute resolution techniques, Arbitration and Conciliation Act 1996 – case studies,

Unit – V: Professional ethics, Duties and responsibilities of parties.

REFERENCE BOOKS:

1. Roshan Namavathi, "**Professional Practice**"

2. Gajaria GT, "**Law Relating to Building & Civil Engg. Contracts in India**"

3. Collier, Kieth, "**Managing Construction Contracts**"

III SEMESTER

MAJOR PROJECT (PHASE - I)

Course Name	MAJOR PROJECT (PHASE - I)	Course Code	18CVCTPJP1		
Credits	18	L-T-P	0-0-18	SEE +CIE	50+50

Course Outcomes: At the end of the course, students will be able to:

CO1: Exhibit application of knowledge, critical thinking and formulate problem in the field of construction materials/ technology and demonstrate skills on research literature.

CO2: Demonstrate skills in developing research methodologies and designing and conduction of experiments.

IV SEMESTER
MAJOR PROJECT (PHASE– 2) (DISSERTATION AND VIVA-VOCE)

Course Name	**MAJOR PROJECT (PHASE– 2) (DISSERTATION AND VIVA-VOCE)**	**Course Code**	**18CVCTPJP2**	**SEE Duration**	**03 Hrs**
Credits	**12**	**L-T-P**	**0-0-12**	**CIE+SEE**	**50+50**

Course Outcomes: At the end of the course, students will be able to:

CO1: Analyse and interpret the analytical and experimental data effectively.

CO2: Communicate confidently and comprehend and write reports effectively.

INDUSTRIAL TRAINING

Course Name	**INDUSTRIAL TRAINING**	**Course Code**	**18CVCTPCIT**	**SEE Duration**	**03 Hrs**
Credits	**10**	**L-T-P**	**0-0-10**	**CIE+SEE**	**50+50**

Note: Students shall undergo an intensive Internship/ training for a minimum period of 12 weeks and submit a report after completion of the training.

Course Outcomes: At the end of the course, students will be able to:

CO1: Comprehend construction company organizational/financial structure.

CO2: Demonstrate professional skills relevant to construction technology.

CO3: Apply and correlate theory and practice and to communicate effectively regarding complex Engineering activities.

CO4: Engage in life-long learning by observing and examining critically and make corrections cautiously.