Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Civil Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Department of Civil Engineering

Program Objectives

Goal of the Civil Engineering at Dr. Babasaheb Ambedkar Technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve real life civil engineering problems;

c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) Professionalism: To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

Program Educational Objectives

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design various structures and systems that is safe, economical and efficient;
3. Capable of using modern tools efficiently in all aspects of professional practices;
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge;
5. Shall be engage in continuous research, development and exchange of knowledge for professional development;
6. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
7. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
8. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
9. Continue their professional development throughout their careers and provide opportunities for the professional development.

Program Outcomes

At the end of the program the student will be able to:

PO 1	Apply the knowledge of mathematics, basic sciences, and civil engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex civil engineering problems reaching substantiated conclusions.
PO 3	Design solutions for complex engineering problems and design of civil engineering structures that meet the specified needs.
PO 4	Use civil engineering research-based knowledge related to interpretation of data and provide valid conclusions.
PO 5	Create, select, and apply modern civil engineering and IT tools to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning acquired by the civil engineering knowledge to assess societal and safety issues.
PO 7	Understand the impact of engineering solutions on the environment, and demonstrate the knowledge for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO 11	Understand the engineering and management principles and apply these to the multidisciplinary environments.
PO 12	Recognize the need for life-long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

PSO 1	Make the students employable in engineering industries.
PSO 2	Motivate the students for higher studies and research.
PSO 3	Motivate the students for various competitive examinations.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam
SS:	Self Study Course

B. Tech. Civil Engineering

Course Structure for Semester VII (Fourth Year) w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVC701	**Core**	Design of Concrete Structures - II	2	1	--	20	20	60	100	3
BTCVC702	**Core**	Infrastructure Engineering	3	--	--	20	20	60	100	3
BTCVC703	**Core**	Water Resources Engineering	3	1	--	20	20	60	100	4
BTCVC704	**Core**	Professional Practices	2	1	--	20	20	60	100	3
BTCVE705A	**Elective IV**	Construction Techniques	3	--	--	20	20	60	100	3
BTCVE705B		Engineering Economics								
BTCVE705C		Finite Element Method								
BTCVE705D		Limit State Design of Steel Structures								
BTCVE705E		Plastic Analysis and Design								
BTCVE705F		Water Power Engineering								
BTCVOE706A	**Open Elective V**	Advanced Structural Mechanics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTCVOE706B		Air Pollution Control								
BTCVOE706C		Bridge Engineering								
BTCVOE706D		Introduction to Earthquake Engineering								
BTCVOE706E		Town and Urban Planning								
BTCVOE706F		Tunneling and Underground Excavations								
BTCVL707	Laboratory	Design & Drawing of RC & Steel Structures	--	--	2	30	--	20	50	1
BTCVL708	Laboratory	Professional Practices	--	--	2	30	--	20	50	1
BTCVT709	Training	Field Training /Internship/Industrial	--	--	--	--	--	50	50	1
BTCVS710	BTS	Seminar	--	--	2	--	--	50	50	1
BTCVP711	BTP	Project Stage-I**	--	--	6	--	50	50	100	3
		Total	**16**	**3**	**12**	**160**	**150**	**490**	**800**	**23**

***In case of students opting for Internship and Industry Project in the eighth semester, the Project must be industry-based.*

B. Tech. Civil Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme[$]				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVSS801A	(Self-Study Course)[#]	Characterization of Construction Materials	03[**]	--	--	20	20	60	100	3
BTCVSS801B		Geosynthetics and Reinforced Soil Structures								
BTCVSS801C		Higher Surveying								
BTCVSS801D		Maintenance and Repair of Concrete Structures								
BTCESS801E		Structural Dynamics								
BTCESS802A	(Self-Study Course)[#]	Energy Efficiency Acoustics and Daylighting in Building	03[**]	--	--	20	20	60	100	3
BTCESS802B		Environmental Remediation of Contaminated Sites								
BTCESS802C		Remote Sensing Essentials								
BTCESS802D		Mechanical Characterization of Bituminous Materials								
BTCESS802E		Soil Structure Interaction								
BTCEP803	Project Stage-II	In-house Project or Internship and Project in Industry*	--	--	30	50	--	100	150	15
		Total	04	--	30	90	40	220	350	21

[#] The subjects are to be studied on self-study mode using SWAYAM/NPTEL/any other online source approved by the University.

[**] If required Coordinator may be appointed for each Self study course and an administrative load of 03 hours per week may be considered for monitoring and assisting the students, and to conduct examination (if required), evaluation and preparation of result.

[$] If the examination schedule for the online Self study course chosen by student do not match with the University's Academic Schedule, the University/Institute have to conduct exam for such courses.

**** Six months of Internship and Project in the Industry. One Faculty guide from the Institute and one Mentor from the Industry should be identified to monitor the progress of work. During the Project/Internship period of work, a review of work should be taken twice followed by a final presentation at the end of Project period.***

Detailed Syllabus (VII Semester)

BTCVC701 Design of Concrete Structures - II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Limit State Method for RC Structures

Module 1: **(6 Lectures)**

Limit State of Collapse (Torsion) - Types of torsion, behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and Torsion

Module 2: **(6 Lectures)**

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), detailing of reinforcement, and construction of Interaction diagrams for uni-axial bending, concept of bi-axial bending Prestressed Concrete

Pre-stressed Concrete

Module 3: (5 Lectures)

Introduction to prestressed concrete, concepts, types, systems and methods of pre stressing,

Module 4: (5 Lectures)

Stress analysis for rectangular and symmetrical I sections, Pressure Line, Cable Profiles

Module 5: **(4 Lectures)**

Losses in Prestressing for Pre-tensioned & Post tensioned members

Module 6: **(6 Lectures)**

Design of Rectangular and Symmetrical I sections, Design of End Block

Structural audit of various structures such as load bearing wall type, RCC, Steel Framed, Prestressed Concrete, etc.:

conceptual introduction to elaborate necessity, implementation of audit, format of reporting, consequences

Text Books

- IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
- Karve& Shah, “Limit State Theory & Design”, Structures Publications, Pune
- Lin T.Y., “Prestressed Concrete”, John Willey & Sons New York
- Jain A.K., “Reinforced Concrete Design (Limit State)”, Nemchand Brothers, Roorkee
- Sinha S.N., “Reinforced Concrete Design”, Vol. I, II, Tata Mc-Graw Hill
- Sinha& Roy, “Fundamentals of Reinforced Concrete”, S. Chand & Co. New Delhi
- Sinha& Roy, “Prestressed Concrete”, S. Chand & Co. New Delhi
- Krishnaraju N., “Prestressed Concrete”, Tata Mc-Graw Hill

Reference Books

- Punmia B.C., “Reinforced Concrete Design”, Vol. I, II, Laxmi Publications
- Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi
- Relevant Publications by Bureau of Indian Standards, New Delhi
- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Course Outcomes: On completion of the course, the students will be;

- Able to identify the behavior, analyze and design of the beam sections subjected to torsion.

- Able to analyze and design of axially and eccentrically loaded column and construct the interaction diagram for them.
- Understand various concepts, systems and losses in pre-stressing.
- Able to analyze and design the rectangular and symmetrical I-section pre-stressed beam/girders.

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BTCVC702 Infrastructure Engineering

Teaching Scheme :(4 Lectures) hours/week

Course Objectives:

a. To discuss elements of Railway Engineering, tunnel engineering, Docks &Harbours
b. To discuss elements of Bridge Engineering and Airport Engineering
c. To provide information about their processing, Construction and maintenance
d. To make students understand function of infrastructural components and their significance

Course Contents

Module 1 (5 Lectures)
Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, sub grade formation, fixtures and fastenings, Geometric Design of tracks- Horizontal Alignment, Vertical Alignment

Module 2 (5 Lectures)
Points and Crossings: Standard types, Design of simple turnout, various types of Junctions, Stations and Yards: Purpose, Location, Site selection, general layouts of Terminus and Junction, Signaling and Interlocking, Construction and Maintenance of Track, Modern trends in Railways

Module 3: (10 Lectures)
Bridge Engineering: Sub-structures

Determination of design discharge, Linear Water Way, Economical Span, Afflux, Scour depth, Indian Road Congress Bridge Code
Abutments: Definition, Functions, Dimensions, Types, Forces acting on an abutment, Conditions of stability
Piers: Definition, Function, Types, Forces acting on a pier, Conditions of stability, Dimensions, Location, Abutment pier
Wing walls: Definition, Functions, Types, Forces acting on a wing wall, Conditions of stability, Dimensions, Precautions
Materials for sub-structures: Cement concrete, Masonry, Steel

Module 4: (10 Lectures)
Bridge Engineering: Super-structures

Simple bridges or beam bridges: Deck bridges, Through bridges, Semi-through bridges

Introduction, advantages and disadvantages: Continuous bridges, Cantilever bridges, Arch bridges, Bow-string girder type bridges, Rigid frame bridges, Portal frame bridges, Suspension bridges, Cable-stayed bridges, Composite bridges

Materials for super-structures: Cement concrete, Masonry, Steel, Timber

Module 5: (10 Lectures)
Tunnel Engineering: Shape and Size of Tunnel Shafts, Pilot Tunnels, Tunneling in Hard Rock, Tunneling in Soft Materials, Drilling-Patterns, Blasting, Timbering, Mucking, Tunnel Lining, Advances In Tunneling Methods, Safety Measures, Ventilation, Lighting and Drainage of Tunnels

Module 6: (5 Lectures)

Dock and Harbor Engineering: Inland Water Transport in India, Tides, Winds and Waves Erosion, Transport of Sediments, Beach Drift, Littoral Drift, Sand Bars, Coast Protection, Classification of Ports and Harbors, Site Selection, Features of Break Waters, Jetties, Wharves, Piers, Facilities required, Dry Docks, Wet Docks, Lift Docks, Floating Docks, Spillways, Navigational Aids, Lighthouses, Terminal Buildings, and Dredging- Special Equipment

Airport Engineering: Planning, Airport Surveys, Site Selection, Zoning Laws, Runways, Geometric Design, Airport Capacity, Terminal Buildings, Parking Systems, Taxiways, Hangers, Airport Drainage, Air Traffic Control, Airport Lighting

Text Books

1. Saxena S. C. and Arora S. (2003) "A Course in Railway Engineering," DhanpatRai& Sons, Delhi
2. Quinn A. D. "Planning and Construction of Docks and Harbours", Tata McGraw Hill, New Delhi
3. Oza H. P. and Oza G. H. (2012) "Dock and Harbour Engineering", Chartor Publishing House, Anand
4. Shrinivasan R. (2016) "Dock, Harbour and Tunnel Engineering", Chartor Publishing House, Anand
5. Arora N. L. (1995) "Transportation Engineering", IPH New Delhi
6. Bindra S. P. "Bridge Tunnel and Railway Engineering", Dhanpatrai and Sons, New Delhi
7. Khanna S. K. and Arora N. L. (1999), "Airport Engineering" Nemchand& Bros., Roorkee
8. Rangawala S. C. (2012) "Airport Engineering", Charotar Publishing House Pvt. Limited, Anand
9. Rangawala S. C. "Bridge Engineering", Charotar Publishing House Pvt. Limited, Anand
10. Hariharan K. V. (2002) "Multimodal Transport & Infrastructure Development in India", Shroff Publishers, Mumbai

References

1. Publications of Bureau of Indian Standards, New Delhi, Relevant To the Syl Laboratories
2. Cormick H. F. (1975) "Dock and Harbour Engineering" Giffin Publishers
3. Raina V K. (2012) "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
4. Horonjeff R. (2012) "Planning and Design of Airports", Tata McGraw Hill, New Delhi

Course Outcomes: On completion of the course, the students will be able to:

- Know about the basics and design of various components of railway engineering
- Understand the types and functions of tracks, junctions and railway stations.
- Know about the aircraft characteristics, planning and components of airport
- Understand the types and components of docks and harbors.

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BTCVC703 Water Resources Engineering

Teaching Scheme :(3 Lectures+ 1 Tutorial) hours/week

Course objectives:

1) To study occurrence movement and distribution of water that is a prime resource for development of a civilization.

2) To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.

3) To know the basic principles and movement of ground water and properties of ground water flow.

Course Contents

Module 1: Introduction (10 Lectures)

Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, difference between weir, barrage and dam, methods of distribution of water, development of irrigation in India Introduction to hydrology: hydrologic cycle, rain, surface and ground water

Water Requirement of Crops

Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

Module 2: Reservoirs and Dams (10 Lecturers)

Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam,

Module 3: Spillway Weirs and Canals (8 Lectures)

Spillway, Necessity and Different Types, Location of Spill Ways, Selection Criterion, Gates for Spillways,

Weirs on Permeable Foundations: Theories of Seepage, Bligh's Creep Theory, Limitations of Bligh's Creep Theory, Khosla's Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy's and Lacey's Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

Module 4: Lift Irrigation (8 Lectures)

Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy's law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).

Module 5: Hydrology (6 Lectures)

Hydrology, measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

Module 6: Water logging and drainage (6 Lectures)

Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures

Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara.

Text Books

1. Varshney R. S., Gupta & Gupta, 1987, "Theory and Design of Irrigation Structures", Vol. I & II
2. Punamia B. C. Pandey B. B. and Lal, 1992, "Irrigation and Water Power Engineering", Standard Publishers, New Delhi
3. Garg S. K., 1976, "Irrigation Engineering & Hydraulic Structures",Khanna Publishers, N. Delhi,
4. Priyani, 1982, "Irrigation and Water Power", Charotar Publishing House, Anand
5. Bharat Singh,1979, "Irrigation", Nemchand Brothers, Roorkee
6. Subramanya K., 1984, "Engineering Hydrology", Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

1. USBR, "Design of Small Dam", OXFORD & IBH, Publishing Company
2. Justinn, 1961, "Engineering for Dam" Vol. I, II, III, Creager and Hinds
3. Leliavsky, "Design of Hydraulic Structures" Vol. I & II,

4. C B I & P “River Behaviour, Management and Training”
5. Circular of Government of Maharashtra, 18 February 1995, “Design of Canals”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.

CO2: Understand various irrigation structures and schemes.

CO3: Develop basis for design of irrigation schemes.

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BTCVC704 Professional Practices

Teaching Scheme :(2 Lectures + 1 Tutorial) hours/week

Pre Requisites: Building Construction

Course Objectives:

1. To discuss introduce methods of quantity surveying, costing, and valuation
2. To facilitate students with concepts of costing involved in infrastructures
3. To make students familiar with process involved during tendering & contracting

Course Contents

Module 1: Introduction (04 Lectures)

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates

Module 2: Quantity Surveying (06 Lectures)

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates, specifications: purpose general and detailed specifications for various items of work, prime cost, provisional sums and provisional quantities, taking out quantity, P.W.D. method, recording of measurements

Module 3: Costing (10 Lectures)

Analysis of rates for various items of construction of civil engineering works, standard schedule of rate, price escalation, detailed and approximate estimates for buildings, R.C.C works, culverts, earthwork for canals, roads including hill roads and other civil engineering works

Module 4: Tendering (6 Lectures)

Types, preparation of tender papers, conditions of contracts, competitive bidding, types of bids, invitation of tenders, scrutiny and acceptance of tenders, award of jobs, introduction to B.O.T. and similar other basis of execution,

Module 5: Contracts (8 Lectures)

Essentials of legally valid contract, types and forms of contract between various agencies, organizational set up of P.W.D. classification of works, method of carrying out work in P.W.D. mode of payment, bill forms, introduction to arbitration

Module 6: Valuation (6 Lectures)

Principles, types, price and cost, attributes of value, valuer and his duties, factors affecting the valuation of properties, methods of valuation, different types of lease

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

Text Books

1. Dutta B. N. (2012) “Estimating and Costing”, UBS Publishers Distributors, New Delhi

2. Namavati R. H. (2016) “Professional Practice Estimating and Valuation”, Lakhani book Depot, Mumbai
3. Patil B. S. (2015) “Civil Engineering Contracts and Estimates”, Universities Press, Hyderabad
4. Bhasin P. L. (1987) “Quantity Surveying”, S. Chand & Co. Ltd., Mumbai
5. Rangwala S. C. (1990), “Elements of Estimating and Costing”, Charotar Publication, Anand
6. Birdi G. S. (2014) “Estimating and Costing”, DhanpatRai& Sons, N. Delhi
7. Chakroborty M. (2010) “Estimating, Costing & Specification in Civil Engineering”, M.Chakraborty Publication, Nepal
8. Rangwala S. C. (2011) “Valuation of real Properties”, Charotar Publication, Anand

References

1. Govt. of Maharashtra P.W. and Housing Department Publication edition 1979 and 1981
2. P. W. D. Maharashtra, “Standard Specifications”, Volumes I & II
3. C.P.W.D. Specifications
4. C.P.W.D. Schedule of Rates
5. P.W.D. Maharashtra Schedule of Rates
6. Publications of Bureau of Indian Standards: IS 1200 all parts, and other relevant

Course Outcomes: On completion of the course, the students will be able to:

Understand the importance of preparing the types of estimates under different conditions for various structures.

Know about the rate analysis and bill preparations and to study about the specification writing.

Know the various types of contract, accounts in PWD, methods for initiating the works in PWD and tendering.

Understand the valuation of land and buildings, various methods and factors affecting valuation.

BTCVE705A Construction Techniques

Course Objectives:

The main objectives of the course are:

1. To study different methods of construction to successfully achieve the structural design with recommended specifications.
2. To involve the application of scientific and technological principles of planning, analysis, design and management to construction technology.

Teaching Scheme: (3 Lectures+1Tutorials) hours/week

Course Contents

Module 1: (8 Lectures)

Introduction, planning of a new project, site access and services, mechanical and manual construction, excavation in earth: Understanding basics and functions of equipment, earthmoving equipment - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates, drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities

Module 2:(8 Lectures)

Excavation in hard rock, Rippers, jack hammers, drills, compressors and pneumatic equipment, blasting explosives, detonators, fuses, drainage in excavation – necessity and methods of dewatering

Module 3:(8Lectures)

RMC Plant, layout and production capacity, type of concrete mixers, machinery for vertical and horizontal transportation of concrete, grouting, Shotcreting, under water concreting, Type of formwork, Slip formwork, equipment for placing of concrete in normal and difficult situations

Module 4: (8 Lectures)

Prefabricated construction: Relative economy, steel construction: planning and field operations, erection equipment, cranes of various types such as tower, crawler, luffing jib tower crane, floating and dredging equipment

Module 5: (4 Lectures)
Road construction aspects, asphalt mixing and batching plant (Hot Mix Plant), sensor paver for rigid roads, crushing plants belt conveyers, cableway, construction of a new railway track, aspects of bridge construction

Module 6: (4 Lectures)
Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

Text Books

1. Peurifoy R.L. (2010). *Construction, Planning, Equipment & Methods*, McGraw hill Book Co. N. Delhi
2. Verma Mahesh, (1975). *Construction Equipment*, Metropolitan book Co., New York
3. Singh J., (2006). *Heavy Construction - Planning, Equipment & Methods*, Oxford & IBH Pub., N. Delhi

Reference Books

1. Quin A. (1961), Planning and Construction of Docks and Harbors, Mc-Graw Hill Company, New York.
2. Stubbs F. W., (1971). Hand Book of Heavy Construction, Mc-Graw Hill Inc, US 2nd edition.
3. Boyes R.G.H, (1975). Structural & cut off Diaphragm Walls, Applied Science Publishers Ltd. London.
4. Ataev S. S., (1999). Construction Technology, Mir Publishers, Mascow.

Course Outcomes: On completion of the course, the students will be able to:

1. Understand the planning of new project with site accessibility and services required.
2. Comprehend the various civil construction equipment's.
3. Familiar with layout of RMC plant, production, capacity and operation process.
4. Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.

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BTCVE705B Engineering Economics

Course Objectives:

The main objectives of the course are:

1. To learn the economics behind any constructional activities.
2. To Emphasis upon develop interest in investment evaluation and financing projects.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(04 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation,

Module 2 **(06 Lectures)**

Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 3 **(06 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 4 **(06 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 5 **(08 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Module 6 **(06 Lectures)**

PPP in Projects Public Private Participation in Projects- PPP Models, BOOT, BOT, Joint Ventures, BOOT, BOT, Annuity, DBFO, External Commercial Borrowings, International Finance, FIDIC.

Text Books

1. Blank, L.T., and Tarquin, A. J., (1988). *Engineering Economy*, Mc-Graw Hill Book Co.
2. Collier C. and GlaGola C. (1998). *Engineering Economics & Cost Analysis*, Addison Wesley Education Publishers,
3. Patel, B. M., (2000). *Project management- strategic Financial Planning, Evaluation and Control,*Vikas Publishing House Pvt. Ltd. New Delhi,
4. Shrivastava, U. K., (2000). *Construction Planning and Management*, Galgotia Publications Pvt. Ltd. New Delhi.

References

1. Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
2. Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
3. Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
4. Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
5. Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
6. Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing

CO2: Analyze available alternatives and propose best suitable among them

CO3: Apply various models of financial management and accounting

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BTCVE705C Finite Element Method

Course Objectives:

The main objectives of the course are:

1. To solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.
2. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to FEM & Approximate Methods **(06 Lectures)**

Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's

Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure.

Module 2: One Dimensional FE Analysis (06 Lectures)

Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C^0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses)

Module 3: FE Analysis by Direct Approach (06 Lectures)

C^1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Simple applications to Beams.

Module 4: Two Dimensional FE Analysis (06 Lectures)

Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems

Module 5: Three Dimensional FE Analysis (04 Lectures)

3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, FEA of Axi-symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (all contents at introductory level)

Module 6: Applications of FEA (04 Lectures)

Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to software's, elementary problem-solving using freeware

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class test shall cover syllabus of any three consecutive Modules.

References:

1. Mukhopdhyay, M., (1984). *Concept and Application of Finite Element Analysis*, Oxford and IBH Publishing Co. Pvt. Ltd.
2. Zienkiewicz, O.C and Taylor R.L., (2000). *The Finite Element Method*, Vol 1 & 2; 5th Ed, Butterworth-Heinemann,
3. Reddy J. N. (2005). *An Introduction to Finite Element Method*, McGraw Hill , 3rd Ed,
4. Cook R.D., Malcus D.S. and Plesha, (1997). *Concepts and Applications of Finite Element Analysis*,4th Ed, Wiley.
5. Hutton D.V., (2004). *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Pub.
6. Desai C. S. & Abel J. F., (1974). *Introduction to the Finite Element Method*, CBS Pub.
7. Krishnamoorthy C. S, (1994). *Programming in the Finite Element Method*, Tata McGraw Hill.

8. Chandrupatla T. R. and Belegundu,(2002). *Introduction to the Finite Element in Engineering*, Pearson Education.
9. Bathe K.J., (1996). *Finite Element Procedures*, PHI learning pvt.ltd
10. Desai Y.M., and Eldho T.I, (2011). *Finite Element Method with application in Engineering*, Pearson, Delhi
11. Bhavikatti S. S. (2015). *Finite Element Analysis*, New Age International Publication.

Course Outcomes: Upon completion of the course the students will be able to:

1. Understand the different energy methods in structural analysis and basic concepts of finite element method.
2. Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
3. Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
4. Solve 2-D problems using knowledge of theory of elasticity.
5. Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics.
6. Analyze 1D, 2D, and 3D structures using different software packages based on FEM.

BTCVE705D Limit State Design of Steel Structures

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Design of Steel structures

Course Objectives:

- To introduce the design loads and the stresses developed in the steel member
- To discuss the various connections and identify the potential failure modes
- To provide guidelines for various tension, compression and flexural members.
- To make students aware of various guidelines set by Standards & Codes

Course Contents

Module 1: Introduction **(4 Lectures)**

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Module 2: Connections **(4 Lectures)**

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 3: Axially Loaded Members **(6 Lectures)**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice

Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Module 4: Beams **(6 Lectures)**

Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections

Module 5: Industrial Roofing **(6 Lectures)**

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details

Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Module6: Columns and Column Bases **(8 Lectures)**

Simple and built up section; lacing, battening, column subjected to axial force and bending moment, column splices. Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt.

Note: Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic design **concept and shall be taught with reference to IS 800 2007**

Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

1. Duggal S. K. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Gambhir M. L. (2017) "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Negi L. S. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Chandra Ram (2016) "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
5. Subramanian N. (2010) "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
6. Sai Ram K. S. (2015) "Design of Steel Structures", Pearson Education, Delhi

Reference Books

1. Arya A. S. and Ajamani J.L. (2014) "Design of Steel Structures", Nemchand and Brothers, Roorkee
2. Vazirani V.N. and Ratwani M.M. (1988) "Design of Steel Structures", Standard Book House, New Delhi
3. Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
4. Gaylord E.H. and Gaylord C.N. (1991) "Design of Steel Structures" McGraw Hill, New York
5. Salmon C. G. and Johnson J. E. (2008) "Steel Structures: Design and Behaviour", Harper and Row, New York
6. Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.

CO4: Understand provisions in relevant BIS Codes.

BTCVE705E Plastic Analysis and Design

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Structural Mechanics I, Structural Mechanics-II, Design of Steel Structures

Course Objectives:

1. To introduce plasticity in various materials & components and their behavior.

2. To understand analysis of determinate and indeterminate members for collapse load
3. To understand philosophy of limit state design
4. To introduce potential design considerations for design calculations

Course Contents

Module 1 **(8 Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

Module 2: **(8 Lectures)**

Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms. Bending moment diagram at collapse

Module 3: **(6 Lectures)**

Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Module 4: **(6 Lectures)**

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force

Module 5 **(4 Lectures)**

Design of portal frames, design of corner connection with and without haunches.

Module 6 **(4 Lectures)**

Consideration of deformations, calculation of deflections for plastically deformed structures

Text Books:

- Bureau of Indian Standards, "Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)".
- Bureau of Indian Standards, "IS: 800 Code of Practice for General Construction in Steel"
- Arya A.S. and Ajmani J.L., "Design of Steel Structures", Nemchand& Bros., Roorkee
- Ramchandra, "Design of Steel Structures Vol – II", Standard Book House, Delhi
- Neal B.G., "Plastic Method of Structural Analysis", Chapman & Hall
- Beedle L.S., "Plastic Design of Steel Frames", John Wiley & Sons

References:

- Bureau of Indian Standards, "Handbook for Structural Engineers SP 6"
- INSDAG Kolkata, "Teaching Resource for Structural Steel Design"
- "Steel Designers Manual" ELBS

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand modes of structural collapse

CO2: Perform the plastic analysis and design of various determinant and in-determinant structures.

CO3: Adapt plastic theory of design for various structures

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BTCVE705F Water Power Engineering

Teaching Schemes: Lectures: 3 Hours/Week

Course Objectives:

1. To introduce hydraulic energy sources and methods of generation'
2. To provide information of components, layout, and arrangements of power station
3. To inculcate the knowledge of essential collateral components and their practical significance.

Course Contents

Module 1 **(08 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

Module 2 **(08 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

Module 3 **(06 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

Module 4 **(06 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

Module 5 **(04 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants

Module 6 **(04 Lectures)**

Tidal Power Stations: Necessity, Advantages, Classification, Limitations

Text Books

1. Dandekar and Sharma, "Water Power Engineering", Vikas Pub. House Pvt. Ltd.

2. Bhattacharya P. K., "Water Power Engineering", Khanna Publications, New Delhi

3. Deshmukh M. M. "Water Power Engineering", Dhanapatrai and Sons N. Delhi

References

1. Creager and Justin, "Hydro – Electric Hand Book"

2. Brown G., "Hydro-electric Engineering Practice", Vol. I to III

3. Mosonvi, "Water Power Development"

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify potential energy sources and adapt as per the requirement

CO2: inculcate basics of electricity generation and power plants

CO3: propose suitable energy source for running a project optimistically.

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BTCVOE706 A Advanced Structural Mechanics

Teaching Schemes: Lectures: 3 Hours/Week

Course Contents

Module 1:Review of basic concepts in structural analysis (06 Lectures)
structure, loads, response, statically determinate structures, principle of virtual work and displacement-based and force-based energy principlesderiving stiffness and flexibilitycoefficients,Force method, Displacement Methods

Module 2: Matrix concepts and Matrix analysis of structures (06 Lectures)
Matrix; vector; basic matrix operations;rank; solution of linear simultaneousequations; eigenvalues andeigenvectors.Introduction; coordinate systems;displacement and force transformationmatrices;Contra-gradient principle; element andstructure stiffness matrices;Element and structure flexibilitymatrices; equivalent joint loads;stiffness and flexibility approaches

Module 3:Matrix analysis of structures with axialelements: (08 Lectures)
Introduction:Axial stiffness and flexibility; stiffnessmatrices for an axial element (two dof),plane truss element (four dof) andspace truss element (six dof);One-dimensional axial structures:Analysis by conventional stiffnessmethod (two dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Plane trusses:Analysis by conventional stiffness, method (four dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Space trusses:Analysis by conventional stiffnessmethod (six dof per element) andreduced element stiffness method(single dof).

Module 4:Matrix analysis of beams and grids (10 Lectures)

Conventional stiffness method forbeams:Beam element stiffness (four dof);generation of stiffness matrix forcontinuous beam; dealing with internalhinges, hinged and guided-fixed endsupports; accounting for sheardeformations;

Reduced stiffness method for beams:Beam element stiffness (two dof);dealing with moment releases, hingedand guided-fixed end supports;

Flexibility method for fixed andcontinuous beams:Force transformation matrix; elementflexibility matrix; solution procedure (including support movements);Stiffness method for grids:Introduction; torsional stiffness of gridelement and advantage of torsionrelease; analysis by conventionalstiffness method using grid elementwith six dof; analysis by reducedstiffness method (three dof perelement);

Module 5:Matrix analysis of planeframes: (06 Lectures)
Conventional stiffness method for planeframes:Element stiffness (six dof); generationof structure stiffness matrix andsolution procedure; dealing withinternal hinges and various endconditions;

Reduced stiffness method for planeframes:Element stiffness (three dof); ignoringaxial deformations; dealing withmoment releases, hinged and guidedfixedend supports;

Flexibility method for plane frames:Force transformation matrix; elementflexibility matrix; solution

procedure(including support movements);Ignoring axial deformations;

Module 6:Matrix analysis of spaceframes: (04 Lectures)

Stiffness method for space frames:Introduction; element stiffness matrixof space frame element with 12 dofand 6 dof; coordinate transformations;analysis by reduced stiffness method(six dof per element);

References

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.

BTCVOE706B Air Pollution Control

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

a. To discuss the sources of air pollutants and their effect on human, plants and materials
b. To get the knowledge of meteorology for controlling air pollution
c. To facilitate students with design methodologies of air pollution control equipment
d. To make aware of legislation for prevention and control of air pollution

Course Contents

Module 1: Introduction to Air Pollution (04 Lectures)

The Structure of the atmosphere, Composition of dry ambient air and properties of air. BIS Definition and scope of Air Pollution, Scales of air pollution, Types of exposures.Air Pollutants,

Module 1: Classification (04 Lectures)

Classifications, Natural and Artificial, Primary and Secondary, point and Non-Point, Line and Area Sources of air pollution. Stationary and mobile sources, composition of particulate& gaseous pollutant, units of measurement.Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, air pollution episodes. Global effects of air pollution- global warming, ozonedepletion, acid rain and heat island effect.

Module3: Meteorology and Air pollution (06 Lectures)

Solar radiation, wind circulation, factors affecting dispersion of pollutants, Lapse rate, stabilityconditions, wind velocity profile, Maximum mixing depth (MMD), visibility, Windrosediagram,General characteristics of stack plume (Plume behaviour). Gaussion diffusion modelfor finding groundlevel concentration. Plume rise. Formulae for stack height and determinationof minimum stack height.

Module4: Air Sampling and Analysis (06 Lectures)

Air pollution survey, basis and statistical considerations of sampling sites. Devices and methods used for sampling gases and particulates. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Module5: Photochemical Smog, Odour Pollution & Indoor Pollution (08 Lectures)

Chemistry of air pollution, Chain reactions of hydrocarbons, nitrogen oxide, Sulphuric oxidesand intermediates, photochemical smog formation, air pollution indices -aerosols, fog, smog index. Odour pollution: Theory, sources, measurement and methods of control of odour pollution. Indoor air pollution: Causes of air pollution, sources and

effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.

Module6: Control of Air Pollution (08 Lectures)

By process modification, change of raw materials, fuels, process equipment and process operation by use of air pollution control equipment for particulate and gaseous pollutants. Design of control equipment as Settling chamber, cyclone, fabric filter, Electrostatic precipitator and Wet scrubber. Principles of removal of gaseous pollutants, design of incineration, absorption adsorption systems. Control of air pollution from automobiles.Vehicular pollution, composition, quantityandcontrol.Air (Prevention and Control) Pollution Act, 1981.Emission standards for stationary and mobile sources.National Ambient air quality standards, 2009 (NAAQS).

Text Books

1. Wark K. and Warner C. F. (1997) "Air pollution: Its Origin and Control" Pearson Education, Delhi
2. Rao M. and Rao H. V. N. (2017) "Air Pollution" Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Peavy S. H. and Rowe D. R. (2017) "Environmental Engineering" Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Muralio Krishna K. V. S. G. (2017) "Air Pollution and Control" Jain Brothers, Mumbai

Reference Books

1. Crawford M. (1984) "Air pollution Control Theory" McGraw Hill, New York
2. Anjaneyulu Y. (2002) "Air Pollution and Control Technologies" Allied Publishers, Mumbai
3. Raju B. S. N. (2018) "Fundamentals of Air Pollution" CBS Publishers and Distributors Pvt. Ltd., N. Delhi

Course Outcomes:On successful completion of this course the students will be able to

- Identify the sources of air pollutants and their effect on human, plants and materials.
- Apply knowledge of meteorology for controlling air pollution
- Design air pollution controlling equipment.
- Apply knowledge of legislation for prevention and control of air pollution.

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BTCVOE706C Bridge Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction (4 Lectures)

History of bridges, components and definitions, classification of road bridges, span length, classical examples of each type, people involved in the total process, history of analysis

Module 2: Selection of site and initial decision process (8 Lectures)

Survey and alignment, geotechnical investigations and interpretations

River Bridge: Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard.

Road Bridge: Selection of bridge site and planning, collection of bridge design data, vertical clearance.

Module 3: Standard loading for bridge design as per different codes (6 Lectures)

Road Bridges: IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept, equivalent loads, trafficload, width of roadway and footway, use of influence lines for maximum forces

in members, transverse distribution of live loads among deck longitudinal,load combinations for different working state and limit state designs.

Railway Bridges: Loadings for railway bridges, rail road data, pre-design considerations, rail road v/s highway bridges.

Module 4: Superstructures (6 Lectures)

Selection of main bridge parameters, design methodologies, choices of superstructure types: orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis (Preferable), different types of superstructure (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge.

Transverse analysis of bridge: Slab bridge and voided slab bridge, beam-slab bridge, box girder bridge, temperature analysis, distortional analysis, effects of differential settlement of supports, reinforced earth structures.

Typical details: Slab bridge, slab-girder bridge (straight/skew), box girder bridge (straight/skew).

Module 5: Substructure (4 Lectures)

Pier, abutment, wing walls, importance of soil structure interaction

Foundations:open foundation, pile foundation, well foundation, examples - simply supported bridge, continuous bridge.

Module 6: Bearings and deck joints (6 Lectures)

Different types of bridge bearings and expansion joints, Design of bearings and joints.

Parapets for highway bridges: Definitions, classification of bridge parapets, various details

Text/Reference Books

- Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.
- Raju N. K., Design of Bridges, Oxford & IBH.
- Ponnuswamy S., Bridge Engineering, Tata McGraw Hill
- Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4th Edition, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation),, 2nd Edition, Shroff Publishers,
- Raina V. K., Field Manual for Highway and Bridge Engineers", 3rd Edition, Shroff Publishers, Mumbai
- Raina V. K., "World of Bridges", Shroff Publishers, Mumbai

Course Outcomes: On completion of the course, the students will be able to:

1. Understand components of bridges and its various types.
2. Understand site selection criteria and comprehend various forces acting on bridges.
3. Analyze bridge structures using different analysis techniques.
4. Understand the importance of different types of bridge bearings.

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BTCVOE706D Introduction to Earthquake Engineering

Course Objectives:

The main objectives of the course are:

1. To provide a coherent development to the students for the courses in sector of earthquake engineering.
2. To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Teaching Scheme: (3 Lectures) hours/week

Pre-Requisites: Structural Mechanics I & II

Course Contents

Module 1 **(6 Lectures)**

Elements of seismology: Terminology, structure of the earth, causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquakes, Accelerogram, prominent earthquakes of India.

Module 2 **(6 Lectures)**

Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral.

Module 3:(6 Lectures)

Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads.

Module 4 **(6 Lectures)**

Principles of Earthquake Resistant Design (EQRD), planning aspects, resistance of structural elements and structures for dynamic load, design criteria, ductile detailing of RCC members, energy absorption, provisions of IS 13920.

Module 5 **(6 Lectures)**

Construction aspects of masonry and timber structures, retrofitting and strengthening techniques of low cost and low-rise buildings, provisions of IS 4326.

Module 6 (6 Lectures)

Dynamic properties of soils, field and Laboratory tests, site evaluation, behavior under dynamic loads, effect on bearing capacity, settlement, liquefaction.

Text Books

1. IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of Indian Standards, New Delhi.
2. Chopra A.K. (2001). *Dynamics of Structures*, 2nd Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.
3. Mario Paz,(1985). *Structural Dynamics*, CBS Publication.
4. Arya A.S., (1987). *Elements of Earthquake Engineering*, South Asian Pub., New Delhi.

Reference Books

1. Clough R.W. and Penzien J.(1993), Dynamics of Structures, McGraw Hill New York
2. Humar J. L., (2002). Dynamics of Structures, 2nd Edition Swets and Zeitlinger, Netherlands.
3. FarzadNaiem, (2001). The Seismic Design Handbook, Kluwer Academic Pub. Massachusetts, ISBN: 0-7923-7301-4.

4. Dowrick D. J., (1977). Earthquake Resistant Design for Engineers & Architects, John Wiley and Sons Ltd.

5. Pauley T. and Priestley M.J.N., (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.

6. Nayak N. V., (1985). Foundation Design Manual, Dhanpatrai and Sons, Delhi.

7. Housner G.W. & Hudson D. E., (1950). Applied Mechanics- Dynamics, East-West Edition, N. Delhi.

8. Kramer S. L., (2003). Geotechnical Earthquake Engineering, Pearson Education.

Course Outcomes: On completion of the course, the students will be able to:

CO1 Capture complexities in earthquake resistant design of structures

CO2 Grasp Nature of earthquake vibration and associated forces on structures

CO3 Understand importance of designing the building to targeted seismic performance.

BTCVOE706E Town and Urban Planning

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

1. To discuss town and Urban planning with essential attributes
2. To provide information of various aspects involved town and Urban planning
3. To make students familiar with various standards, acts, laws and guidelines

Course Contents

Module 1: **(06 Lectures)**

Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

Module 2: **(06 Lectures)**

Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

Module 3: **(06 Lectures)**

Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

Module 4: **(08 Lectures)**

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

Module 5: **(04 Lectures)**

Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module6: **(04 Lectures)**

Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books:

1. Hiraskar G.K. (2018) "Town and country Planning"DhanpatRai Publication, N. Delhi
2. Rangawala S.C. (2015) "Town Planning", Charotar Publications, Anand
3. Sundaram K.V. (1978) "Urban and Regional Planning in India", Vikash Publishing House Pvt. Ltd.
4. MRTP Act 1966 & 2002
5. Land Acquisition Act - 1894
6. Misra S. N. (1984) "Rural Development Planning-Design and Method", Satvahan Publications, N. Delhi

Reference Books

1. Eisner S. and Gallion A. (1993) "The Urban Pattern", John Wiley & Sons, N. Delhi

Outcomes: Upon completion of the course the students will be able to:

1. Understand town and Urban planning and their essential attributes
2. Identify elements of planning and regulations of the same
3. Implement guidelines provided by standard authorities

BTCVOE706F Tunneling and Underground Excavations

Course Objectives:

The main objectives of the course are:

1. To understand the need of utilization of Underground Space for various applications.
2. To develop the plan for infrastructure for transport.

Teaching Scheme: Lectures: 3 hours/week

Course Contents

Module 1 **(06 Lectures)**

Tunneling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Module 2 **(08 Lectures)**

Tunneling by Drilling and Blasting: Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, specific drilling; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

Module 3 **(06 Lectures)**

Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems.Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

Module 4 **(06 Lectures)**

Excavation of large and deep tunnels Introduction; purpose and use of large and deep tunnels; excavation issues governing large and deep tunnels; excavation methods of large and deep tunnels - unit operations, different equipment, types of rock

pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels.

Module 5 **(6 Lectures)**

Shield Tunneling: Introduction; advantages of shield tunneling; classification; different types of shield tunneling techniques – open shield, close shield, half shield; conventional shields, special features in shield tunneling; factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields, other shield development methods, problems encountered with possible remedies.

Module 6 **(4 Lectures)**

Submerged and Floating Tunnels; Micro-tunneling; Trenchless excavation. Novel Excavation Techniques: Penetrating Cone Fracture, Bottom-hole pressurization, expanding cements, Diamond wire saw.

Text Books:

1. Srinivasan R., (2016). *Harbour, Docks and Tunnel Engineering*, Charotar Pub. House.
2. Saxena S. C. (2015). *Tunnel Engineering*, DhanpatRai Publications.
3. Tatiya R. R., (2013), *Surface and Underground Excavation*, CRC Press.

References:

2. Stack, B. (1982). Handbook of Mining and Tunnelling Machinery, Wiley, New York.
3. Chugh, C.P., (1977). Drilling Technology Handbook, Oxford & IBH Publication.
4. Bickel J.O. and. Kuesel T.R, (2018). Tunnel Engineering Handbook, CBS Publishers and Distributors Pvt. Ltd.
5. Brebbia C.A., Kaliampakos D., Prochazka P., (2008). Underground Spaces Design, Engineering and EnvironmentalAspects, WIT Press,

Web links:

1. https://www.isrm.net
2. www.nirm.in
3. http://umich.edu/~gs265/tunnel.html
4. http://se.sze.hu/images/ngm_se108_1/Tunnels_2015-03-20_Toth_1-Excavation.pdf
5. https://www.usbr.gov/ssle/safety/RSHS/sec23.pdf
6. https://www.osha.gov/Publications/osha3115.html

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand types of tunnels and tunneling methods conforming to site conditions

CO2: Investigate various tunneling operations and relevant machinery required

CO3: Understand methods and operations of excavating large and deep tunnels

CO4: Propose suitable tunneling and excavations methods to optimize the same.

BTCVL707 Design Drawing of RC & Steel Structures

Practical: 2 Hours / Week Term Work: 50 Marks

Part A -Design and Drawing of Steel Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures. Student may use IS 800 1984 or 2007.

1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases

2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases

3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases

4) G + 3 Building Structure

Part B - Design and Drawing of RC Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following RC structures:

1) G + 2 Building

2) Elevated water tank: analysis and design of staging and tank body.

Course Outcomes: On completion of the course, student will be able to simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.

BTCVL708 Professional Practices Laboratory

Practical:2 Hours / Week

Term work include detailed study and working of following set of assignments
1) Detailed estimate for a two storied RCC or load bearing wall building
2) Preparing detailed estimate for any four of the following:
   a) A small culvert
   b) A stretch of a road about 1 Km. long including earthwork
   c) A reach of canal about 1 Km. long
   d) A percolation tank
   e) A factory shed of steel frame

f) Water supply scheme
g) Drainage scheme
h) Water Treatment plants.

3) Valuation report including valuation certificate for any one of the following:
a) A building for residential purpose or commercial purpose
b) A hotel
c) A theatre
d) Any one construction machine.

4) Drafting of Detailed specification for any five civil engineering items. This shall include at least one item each from Roads, Irrigation works, Water Supply, Sanitation and buildings

Assignment (1) and (2) shall include Rate Analysis of at least two items.

BTCVT709 Field Training /Internship/Industrial

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of field training shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVS710 Seminar

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVP711 Project Stage I

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project must be industry-based.

Detailed Syllabus (VIII Semester)

BTCVSS801 Characterization of Construction Materials

By Prof. Manu Santhanam, Prof. PiyushChaunsali IIT Madras

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these

materials. The course will be focused primarily on cement and concrete, and include the following techniques; the physics of the techniques and their application to cement science, including lab demonstrations and experiments will be covered.

Week 1: Introduction to course; Structure of Construction Materials – An Overview
Week 2: Calorimetry
Week 3: X-ray diffraction
Week 4: X-ray diffraction
Week 5: Thermal analysis
Week 6: Surface area measurement
Week 7: Optical microscopy
Week 8: Scanning electron microscopy
Week 9: Image analysis
Week 10: Spectroscopic techniques
Week 11: Mercury intrusion porosimetry
Week 12: Impedance analysis and ultrasonic methods

1. Karen Scrivener, Ruben Snellings, Barbara Lothenbach, A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2015.
2. V. S. Ramachandran and James J. Beaudoin, Eds., Handbook of Analytical Techniques in Concrete Science and Technology, William Andrew Publishing, New York, 2001.
3. D A St. John, A. W. Poole, and I. Sims, Concrete Petrography – A Handbook of Investigative Techniques, Arnold Publishing.London, 1998.
4. William D. Callister, Materials Science and Engineering: An Introduction, Sixth Edition, John Wiley and Sons, 2003.
6. J. M. Illston and P. L. J. Domone, Construction Materials – Their Nature and Behaviour, Third Edition, Spon Press, 2001.
5. Jan Skalny, Editor, Materials Science of Concrete, Volumes I – VII, American Ceramic Society, 1989 – 2005.
7. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.

Link - https://swayam.gov.in/nd1_noc20_ce01/preview

BTCVSS801B Geosynthetics and Reinforced Soil Structures

Link - https://nptel.ac.in/content/syllabus_pdf/105106052.pdf

BTCVSS801C Higher Surveying

Link - https://swayam.gov.in/nd1_noc20_ce16/preview

BTCVSS801D Maintenance and Repair of Concrete Structures

Link-https://nptel.ac.in/content/syllabus_pdf/105106202.pdf

BTCVSS801E Structural Dynamics

Link- https://swayam.gov.in/nd1_noc20_ce21/preview

BTCVSS802A Energy Efficiency Acoustics & Daylighting in Building

Link-https://swayam.gov.in/nd1_noc20_ce08/preview

BTCVSS802B Environmental Remediation of Contaminated Sites

Link-https://swayam.gov.in/nd1_noc20_ce31/preview

BTCVSS802C Remote Sensing Essentials

Link-https://swayam.gov.in/nd1_noc20_ce29/preview

BTCVSS802D Mechanical characterization of Bituminous Materials

Link- https://swayam.gov.in/nd1_noc20_ce04/preview

BTCVSS802E Soil Structure Interaction

Link-https://swayam.gov.in/nd1_noc20_ce22/preview

BTCVC803 Project Stage II or Internship

Term work shall consist of detailed report for chosen topic and output of final working proposed in previous semester. Report shall summarise the literature survey, spell out the scope of work, methodology and results.

Viva-voce Examination shall be based on work carried out by the student.

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