

# **SHRI VENKATESHWARA UNIVERSITY**



## **Syllabus**

### **DIPLOMA**

**(Civil Engineering)**

**V SEMESTER**

**(Three Years Programme)**

**(w.e.f. 2019-20)**

**SCHOOL OF ENGINEERING &  
TECHNOLOGY**

**Civil Engineering  
SEMESTER- V**

Sl No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	C T	T A	Tot al	P S	TE	P E		
1	PCE -501	Design of Steel and RCC structure	3	0	0	20	10	30		70		100	3
2	PCE-502	Estimating, Costing and valuation	2	0	0	20	10	30		70		100	2
3	PCE-503	Advanced Construction Technology	3	0	0	20	10	30		70		100	3
4	PCE-504	Green Building and Energy Conservation	3	0	0	20	10	30		70		100	3
5	POE-051	Operations Research	3	0	0	20	10	30		70		100	3
6	PCE-511	Design of Steel and RCC structure Lab	0	0	2				10		15	25	1
7	PCE - 512	Estimating, Costing and valuation Lab	0	0	2				10		15	25	1
8	PCE-513	Project Phase-I	0	0	4				50		50	100	2
9	PCE-514	Summer Internship-II	0	0	0				50			50	3
		Summer Internship-II (6 weeks) after IV Sem										700	21

Course Code	:	PCE-501
Course Title	:	Design of Steel and RCC Structures
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

Following are the objectives of this course:

- To learn the concept of limit state design for tension and compression steel members.
- To learn the concept of limit state design of steel beams.
- To understand design of RCC elements.
- To know the design of short and long RCC columns.

Course Content:

**Unit – I Design of Steel Tension and Compression Members (Limit State Method)**

- Types of sections used for Tension members.
- Strength of tension member by- yielding of section, rupture of net cross-section and block shear.
- Design of axially loaded single angle and double angle tension members with bolted and welded connections.
- Types of sections used as compression member, Calculation of effective length, Radius of gyration and slenderness ratio, Permissible values of slenderness ratio as per IS 800, Design compressive stress.
- Introduction to built up sections, lacing and battening (Meaning and purpose), Diagrams of single and double lacing and battening system. (No numerical problems).
- Design of axially loaded single and double angle struts connected by bolted and welded connections with gusset plate.

Unit- II Design of Steel beams (Limit State Method)

- Standard beam sections, Bending stress calculations.
- Design of simple I and channel section.
- Check for shear as per IS 800.

Unit- III Design of Reinforced Concrete Beams by Limit State Method

- Concept of Limit state, Stress block diagram, Introduction to singly and doubly reinforced sections, IS 456
- Design of singly reinforced beam, concept of under reinforced, over reinforced and balanced section, Simple numerical problem on ultimate moment of resistance and design of beam section
- Design of doubly reinforced sections, stress and strain diagrams, depth of neutral axis, simple numerical problems on ultimate

moment of resistance of reinforced beam, Calculation of  $A_{st}$  and  $A_{sc}$ .

Unit- IV Shear, Bond and Development length in Design of RCC member

- Nominal shear stress in RCC section, Design shear strength of concrete, Design of shear reinforcement, Minimum Shear Reinforcement, Provisions of IS 456, forms of shear reinforcement
  - Types of bond, Bond stress, check for bond stress, Determination of Development length in tension and compression members and check as per codal provisions, Anchorage value of 90° hook, Lapping of bars.
  - Simple numericals on: Shear reinforcement, Adequacy of section for shear.
  - Introduction to serviceability limit state check

### **Unit- V Design of axially loaded RCC Column**

- Definition and classification of column, Limit state of compression members, Effective length of column.
- Provisions of IS 456 for minimum steel, cover, maximum steel, spacing of ties etc.
- Design of axially loaded short column - Square, Rectangular, and Circular only.

Suggested learning resources:

- Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
- Dayarathnam P., Design of Steel Structures, S. Chand and Company, Delhi.
- Subramanian N., Design of Steel Structures, Oxford University Press.
- Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
- Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune, 2014.
- Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co., New Delhi.
- Krishna Raju, and N. Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
- Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill Publications, New Delhi.
- Varghese, P.C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

Course outcomes:

After completing this course, student will be able to perform:

- Design of steel tension and compression member.
- Design of steel I and Channel sections.
- Design of singly and doubly reinforced RCC beam.
- Design of RCC beam for shear and development length.
- Design of short and long RCC columns.

Course Code	:	PCE-502
Course Title	:	Estimating and Costing
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.
- To use software for detailed estimate related to civil infrastructural projects.

Course Content

### **Unit – I Fundamentals of Estimating and Costing**

- Estimating and Costing – Meaning, purpose, Administrative approval, Technical Sanction and Budget provision.
- Types of estimates – Approximate and Detailed estimate.
- Types and Uses of Estimates: Revised estimate, Supplementary estimate, Repair and maintenance estimate, renovation estimate.
- Roles and responsibility of Estimator.
- Checklist of items in load bearing and framed structure.
- Standard formats of Measurement sheet, Abstract sheet, Face sheet.
- Modes of measurement and desired accuracy in measurements for different items of work as per IS:1200.
- Rules for deduction in different category of work as per IS:1200.
- Description / specification of items of building work as per PWD /DSR.

Unit- II Approximate Estimates

- Approximate estimate- Definition, Purpose.
- Methods of approximate estimate - Service unit method, Plinth area rate method, Cubical content method, Typical bay method, Approximate quantity method (with simple numericals)
- Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects.

Unit- III Detailed Estimate

- Detailed Estimate- Definition and Purpose, Data required for detailed estimate - Civil cost, GST, Contingencies, Supervision charges, Agency charges, Procedure for preparation of detailed estimate- Taking out quantities and Abstracting.
- Methods of Detailed Estimate- Unit quantity method and total quantity method (with simple numericals)
- Long wall and Short wall method, Centre line method.

- Bar bending schedule for footing, column, beam, Lintel, chajja and slab elements
- Provisions in detailed estimate: contingencies, work charged establishment, percentage charges, water supply and sanitary Charges and electrification charges etc.
- Prime cost, Provisional sum, Provisional quantities, Bill of quantities, Spot items or Site items.

#### Unit- IV Estimate for Civil Engineering Works

- Earthwork - Quantities for roads, Embankment and canal by – Mid sectional area method, mean sectional area method, Prismoidal and trapezoidal formula method.
- Detailed estimate for septic tank, Community well.
- Use of computer /softwares / programmes for detailed estimate Preparation of Civil Engi- neering Works.

#### Unit- V Rate Analysis

- Rate Analysis: Definition, purpose and importance.
- Lead (Standard and Extra), lift, overhead charges, water charges and contractors' profit,
- Procedure for rate analysis.
  - Task work- Definition, types. Task work of different skilled labour for different items.
  - Categories of labours, their daily wages, types and number of labours for different items of work.
  - Transportation charges of materials - Lead and Lift, Hire charges of machineries and equip- ments.
  - Preparing rate analysis of different items of work pertaining to buildings and roads.

#### Suggested learning resources

1. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors Pvt. Ltd. New Delhi.
2. Peurifoy, Robert L. Oberlender, Garold, Estimating construction cost (fifth edition), McGraw Hill Education, , New Delhi.
3. Rangwala, S.C., Estimating and Costing, Charotar Publishing House PVT. LTD., Anand.
4. Birdie, G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. New Delhi.
5. Patil, B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
6. Chakraborti, M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.
7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Sched- ular of Rates.

9. Manual of Specifications and Standards for DBFOT projects, EPC works.

Course outcomes:

After competing this course, student will be able to:

- Select modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Use relevant software for estimating the quantities and cost of items of works.
- Justify rate for given items of work using rate analysis techniques.
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Course Code	:	PCE-503
Course Title	:	Advanced Construction Technology
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

Following are the objectives of this course:

- To gain knowledge on different materials in advanced construction
- To know different methods in concreting.
- To know the relevance of advanced construction methods for particular site condition.
- To identify the requisite hoisting and conveying machinery for the given situation.

Course Content:

**Unit – I Advanced Construction Materials**

- Fibres: Use and properties of steel, polypropylene, carbon and glass fibres.
- Plastics: Use and properties of PVC, RPVC, HDPE, FRP, GRP.
- Miscellaneous Materials: Properties and uses of acoustics materials, wall claddings, plaster boards, micro-silica, waterproofing materials, adhesives.
- Use of waste products and industrial by products in bricks, blocks, concrete and mortar.

#### Unit- II Advanced Concreting Methods and Equipments

- Ready Mix Concrete: Necessity and use of ready mix concrete. Products and equipments for ready mix concrete plant. Conveying of ready mix concrete, transit mixers.
- Vibrators for concrete consolidation: Internal, needle, surface, platform and form vibrators.
- Underwater Concreting: Procedure and equipments required for Tremie method, Drop bucket method. Properties, workability and water cement ratio of the concrete.
- Special concrete: procedure and uses of special concretes: Roller compacted concrete, Self-compacting concrete (SCC), Steel fibre reinforced concrete, Foam concrete, shotcreting.

#### Unit- III Advanced Technology in Constructions

- Construction of bridges and flyovers: Equipments and machineries required for foundation and super structure.
- Construction of multi-storeyed Building: Equipments and machinery required for construction of multi-storeyed building such as use of lifts, belt conveyers, pumping of concrete.
- Prefabricated construction: Methods of prefabrication, Plant fabrication and site fabrication, All prefabricated building elements such as wall panels, slab panels, beams, columns, door and window frames etc. Equipments and machineries used for placing and Jointing of prefabricated elements.
- Strengthening of embankments by soil reinforcing techniques using geosynthetics

#### Unit- IV Hoisting and Conveying Equipments

- Hoisting Equipments: Principles and working of Derrick-Pole, Gin Pole, Crane, Power driven scotch derrick crane, Hand operated crane, Locomotive crane, Tower crane, Lattice Girder, Winches, Elevators, ladders. Crawler cranes, Truck mounted cranes, Gantry cranes, Mast cranes.
- Conveying Equipments: Working of belt conveyers, types of belts and conveying mechanism. Capacity and use of dumpers, tractors and trucks.

#### Unit- V Miscellaneous Machineries and Equipments

- Excavation Equipments: Use, working and output of following machinery – bull dozers, scrapers, graders, Clam Shell, trenching equipment, Tunnel boring machine, Wheel mounted belt loaders, power shovels, JCB, and drag lines.
- Compacting Equipments: Output of different types of rollers such as plain rollers, ship footed rollers, vibratory, pneumatic rollers rammers.



- Miscellaneous Equipments: Working and selection of equipments: Pile driving equipments, Pile hammers, Hot mix bitumen plant, bitumen paver, grouting equipment, guniting equipments, floor polishing and cutting machine selection of drilling pattern for blasting, Bentonite/mud slurry in drilling, Explosives for blasting, Dynamite, process of using explosives.

Suggested learning resources:

1. Sharma S C and Deodhar S V, Construction Engineering and Management, Khanna Book Publishing, New Delhi
2. Chudly, R., Construction Technology Vol. I to II, ELBS-Longman Group.
3. Peurifoy, R. L., Construction Planning Equipment and Methods, McGraw Hill Co. Ltd. New York.
  4. Seetharaman, S., Construction Engineering and Management, Umesh Publication, New Delhi.
  5. Sengupta, B. and Guha., Construction Management and Planning, McGraw Hill Education, New Delhi.
  6. Smith, R. C., Materials of Construction, McGraw Hill Co. Ltd.
  7. Satyanarayana, R Saxena, S. C., Construction Planning and Equipment, Standard Publication, New Delhi.
  8. Rangawala, S. C., Construction of Structures and Management of works, Charotar Publication, Anand.
  9. Ghose, D. N., Materials of Construction, McGraw Hill Publishing Co, New Delhi.

Course outcomes:

After competing this course, student will be able to:

- Use relevant materials in advanced construction of structures.
- Use relevant method of concreting and equipment according to type of construction.
- Apply advanced construction methods for given site condition.
- Select suitable hoisting and conveying equipment for a given situation.
- Identify advanced equipment required for a particular site condition

Course Code	:	PCE-504
Course Title	:	Green Building and Energy Conservation
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

Following are the objectives of this course:

- To know various aspects of green buildings
- To use different steps involved in measuring environmental impact assessment.
- To relate the construction of green building with prevailing energy conservation policy and regulations.
- To know and identify different green building construction materials.
- To learn different rating systems and their criteria.

Course Content:

#### **Unit I : Introduction to Green Building and Design Features**

- Definition of Green Building, Benefits of Green building, Components/features of Green Building, Site selection, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.
- Site selection strategies, Landscaping, building form, orientation, building envelope and fen- estration, material and construction techniques, roofs, walls, fenestration and shaded finish- es, advanced passive heating and cooling techniques, waste reduction during construction

#### **Unit-II Energy Audit and Environmental Impact Assessment (EIA)**

- Energy Audit: Meaning, Necessity, Procedures, Types, Energy Management Programs
- Environmental Impact Assessment(EIA): Introduction, EIA regulations, Steps in environ- mental impact assessment process, Benefits of EIA, Limitations of EIA, Environmental clear- ance for the civil engineering projects.

#### **Unit- III Energy and Energy conservation**

- Renewable Energy Resources: Solar Energy, Wind Energy, Ocean Energy, Hydro Energy, Bio- mass Energy
- Non-renewable Energy Resources: Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical Sources of Energy, Fuel Cells, Hydrogen, Biofuels.
- Energy conservation: Introduction, Specific objectives, present scenario, Need of energy conservation, LEED India Rating System and Energy Efficiency.

#### Unit- IV Green Building

- Introduction: Definition of Green building, Benefits of Green building,
- Principles: Principles and planning of Green building
- Features: Salient features of Green Building, Environmental design (ED) strategies for building construction.
- Process: Improvement in environmental quality in civil structure
- Materials: Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, Green roofing

#### Unit V Rating System

- Introduction to (LEED) criteria,
- Indian Green Building council (IGBC) Green rating,
- Green Rating for Integrated Habitat Assessment. (GRIHA) criteria
- Heating Ventilation Air Conditioning (HVAC) unit in green Building
- Functions of Government organization working for Energy conservation and Audit(ECA)-
- National Productivity council(NPC)
- Ministry of New and Renewable *Energy* (MNRE)
- Bureau of Energy efficiency (BEE)

#### Suggested learning resources:

- 1 Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hoboken, New Jersey.
- 2 Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, New Delhi.
- 3 O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
- 4 Jagadeesh, K S, Reddy Venkatta Rama & Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers, Delhi.
- 5 Sam Kubba., Handbook of Green Building Design and Construction, Butterworth-Heinemann.
- 6 Means R S, Green Building - Project Planning and Cost Estimating, John Wiley & Sons
- 7 Sharma K V, Venkataseshaiyah P., Energy Management and Conservation, IK International.

#### Course outcomes:

After completing this course, student will be able to:

- Identify various requirements for green building.
- Use different steps in environmental impact assessment.
- Relate the construction of green building with prevailing energy conservation policy and regulations.
- Supervise the construction of green building construction using green materials.

- Focus on criteria related to particular rating system for assessment of particular Green building.

Course Code	:	
Course Title	:	OPERATIONS RESEARCH
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

**Course Learning Objectives:**

- To provide a broad and in depth knowledge of a range of operation research models and tech- niques, which can be applied to a variety of industrial applications.

Course Content:

**UNIT-I:** Development, Definition, Characteristics and phase of Scientific Method, Types of models;

General methods for solving operations research models.

**UNIT-II:** Allocation: Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.

**UNIT-III:** Transportation Problem Formulation optimal solution. Unbalanced transportation prob- lems, Degeneracy. Assignment problem, Formulation optimal solution.

**UNIT-IV:** Sequencing: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines.

**UNIT-V:** Theory of games: introduction, Two-person zero-sum games, The Maximum –Minimax prin- ciple, Games without saddle points – Mixed Strategies, 2 x n and m x 2 Games – Graphical solutions, Dominance property, Use of L.P. to games.

Reference Books:

1. Operations Research: an introduction, Hamdy A. Taha, Pearson Education.
2. Operations. Research: theory and application, J.K. Sharma, Macmillan Publishers.
3. Introduction to Operations Research: concept and cases, Frederick S. Hillier and Gerald J. Lieberman, Tata McGraw-Hill

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand the formulation of Liner Programming
CO2	Analyze and Convert the problem into a mathematical model.
CO3	Understand and implement the transportation problems at workplace
CO4	Understand sequencing to optimize the process time for n- job and m-machine
CO5	Identify and select suitable methods for various games and apply the LP

Course Code	:	PEC-511
Course Title	:	Design of Steel and RCC Structures Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

Following are the objectives of this course:

- To learn the concept of limit state design of tension and compression steel members.
- To understand design of steel beams.
- To learn the concept of limit state design of RCC beams.
- To know the limit state design of RCC columns.

List of Practical to be performed:

1	Draw any five commonly used rolled steel sections and five built up sections.
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2	Summarize the provisions of IS 800 required for the design of tension member in report form.
3	Compile relevant clauses from IS 800 required for the design of a compression member and submit it in report form.
4	Draw sketches for single & double lacing of given built up columns.
5	Draw sketches for battening of given built up columns.
6	Prepare a report on the IS 800 provisions pertaining to design of lacing & battening along with its significance.
7	Draw cross section, strain diagram & stress diagram for singly reinforced section.
8	Draw cross section, strain diagram & stress diagram for doubly reinforced section.
9	Design simply supported I section steel beam for udl.
10	Design beams section for shear as per IS 800 provisions.
11	Draw sketches of different types of column footings.
12	Interpret the actual RCC Structural Drawings used on site with reference to reinforcement details of various structural elements.
13	Prepare a checklist for reinforcement provided from actual drawings used on site for various structural elements.
14	Prepare a detailed report of site visit for reinforcement detailing of structural elements like beams, columns, staircase & footing.
15	Prepare a detailed report of site visit for study of rolled steel tension & compression members used in various structures.

Suggested learning resources:

1. Shah, V.L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.

2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.
4. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
5. Shah, V.L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune, 2014.
6. Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co., New Delhi.
7. Krishna Raju, and N.Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
8. Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill Publications, New Delhi.
9. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

Course outcomes:

After completing this course, student will be able to perform:

- Design of steel tension and compression member.
- Design of steel beams including check for shear.
- Design of singly and doubly reinforced RCC beam.
- Design of shear reinforcement in RC beams.
- Design of RCC column as per IS 456.

Course Code	:	PCE-512
Course Title	:	Estimation and Costing Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.
- To use software for detailed estimate related to civil infrastructural projects.

List of Practical to be performed:

1	Prepare the list of items to be executed with units for detailed estimate of a given structure from the given drawing.
2	Prepare a report on market rates for given material, labour wages, hire charges of tools & equipments required to construct the given structure as mentioned in at Serial number 1 above.
3	Study of items with specification given in the DSR ( for any ten item)
4	Recording in Measurement Book (MB) for any four items
5	Prepare bill of quantities of given item from actual measurements. (any four items).
6	Prepare approximate estimate for the given civil engineering works.
7	Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).
8	Prepare detailed estimate from the given set of drawings using “standard measurement and abstract format” for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart, lead statement ( G+1 Building) .
9	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)
10	Prepare rate analysis for the given five item of works.
11	Prepare detailed estimate of road of one kilometre length from the given drawing.
12	Prepare detailed estimate of small Septic tank from the given set of drawings.
13	Prepare detailed estimate of well from the given set of drawing.
14	Use the relevant software to prepare detailed estimate of a Road.
15	Use the relevant software to prepare detailed estimate of a residential building.

### Suggested learning resources:

1. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors
2. Peurifoy, Robert L. Oberlender, Garold, Estimating construction cost (fifth edition), McGraw Hill Education, , New Delhi.
3. Rangwala, S.C., Estimating and Costing, Charotar Publishing House, Anand.
4. Birdie, G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. Delhi.
5. Patil, B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
6. Chakraborti, M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.
7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.
9. Manual of Specifications and Standards for DBFOT projects, EPC works.

### Course outcomes:

After completing this course, student will be able to:

- Select modes of measurements for different items of works.

- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Use relevant software for estimating the quantities and cost of items of works.
- Justify rate for given items of work using rate analysis techniques.