**GOA UNIVERSITY**

SCHEME OF INSTRUCTION AND EXAMINATION

REVISED COURSE

BE (CIVIL) SEM VII

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subject  Code | Name of the  Subjects | Scheme of Instructions  Hrs/Week | | | Scheme of Examination | | | | | |
| L | T | P | Th. Dur  (Hrs) | Marks | | | | |
| Th | S | O | P | Total |
| 7.1 | Environmental Engineering II | 3 | 1 | 2 | 3 | 100 | 25 | 25 | - | 150 |
| 7.2 | Design of Reinforced and Prestressed Concrete | 3 | 1 | 2 | 3 | 100 | 25 | 25 | - | 150 |
| 7.3 | Estimation and Costing | 3 | 1 | 2 | 3 | 100 | 25 | 25 | 25 | 175 |
| 7.4 | Elective-I | 3 | 2 | - | 3 | 100 | 25 | 25 | - | 125 |
| 7.5 | Elective-II | 3 | 2 | - | 3 | 100 | 25 | 25 | - | 150 |
| 7.6 | Civil Engg Projects | - | - | 4 | - | - | 25 | 50 | - | 75 |
| **TOTAL** | | 15 | 7 | 10 | - | 500 | 150 | 200 | - | 850 |

Elective I 7.4.1 Advanced Geotechnical Engineering

7.4.2 Structural Dynamics

7.4.3 Air Pollution

7.4.4 Advanced Reinforced Concrete design

7.4.5 Low Cost Housing

Elective II 7.5.1 Rock Mechanics

7 .5.2Applied Engineering Geology

7.5.3 Finite Elements in Civil Engineering

7.5.4 Design of Hydraulic Structures

B.E. CIVIL (SEM VII)

**CE 7.1 ENVIRONMENTAL ENGINEERING-II**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **1** | **2** | **100** | **25** | **25** | **-** | **150** |

**Module-I**

1. Sewage, its origin& its physical, chemical and biochemical characteristics.

Concept of Theoritical, Biochemical and Chemical Oxygen Demands.

Determination of B.O.D. & C.O.D. & B.O.D. removal kinetics.

1. Quantity of sewage, & its variation, Sewage disposal systems, pumping of sewage.

**Module-II**

1. Methods of sewage disposal, Land disposal, sewage forming, self purification of streams.
2. Preliminary sewage treatment:-Bar screens, Grit chambers, their design and operation.
3. Primary sewage treatment: - Primary sedimentation tank, their geometry, design, operational difficulties and remedies.

**Module-III**

Secondary Sewage Treatment:-

1. Trickling filters, their geometry, design, operation, operational difficulties and remedies.
2. Activated sludge process, Batch culture curves, Factors affecting growth of biomass, Types of aerators, Design, operation, operational difficulties and remedies for A.S.P. units.
3. Tertiary sewage treatment:- Oxidation ponds, their types, geometry, loading rules, design, operation and operational difficulties, oxidation ditches, Lagoons.

**Module –IV**

1. Sludge collection, treatment and disposal methods. Sludge characteristics, Sludge drying beds.
2. Miscellaneous methods of sewage treatment:- Septic tanks, Inhoff tanks, Effluent disposal & reuse. Design, construction & layout of sewer networks.

Sewer appurtences, Environment impact assessment studies.

**TUTORIALS:**

Atleast one Assignment from each module.

**PRACTICALS:**

I. At least five laboratory experiments from the following

1. Determination of dissolved oxygen
2. Determination of BOD
3. Determination of total suspended and dissolved solids
4. Determination of settlable and non settlable solids
5. Determination of sludge volume index
6. Determination of COD
7. Determination of chlorides
8. Determination of sulphates

II Report of visit to sewage treatment plant.

**ORALS**: will be based on the practicals and tutorials

**TEXT BOOKS:**

1. Water and Waste Water treatment by Mark J. Hammer

2. Sewage and Waste Disposal by S.K. Garg

**REFERENCE BOOKS:**

3. Water supply and Waste Water Engineering by E.N.Steel.

4. Waste Water Engineering by Metaalf and Eddy

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**CE 7.2 DESIGN OF REINFORCED AND PRESTRESSED CONCRETE**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **1** | **2** | **100** | **25** | **25** | **-** | **150** |

**Module No. I**

1 .Design of multistoried Buildings: Design of all building components viz :

Beams, slabs, columns, footings and staircases subjected to seismic forces also.

**Module No. II**

2. Yield line analysis of slabs: Introduction, basic concepts, location of yield lines for standard cases for uniformly distributed & point loads. Methods of Analysis -Virtual & equilibrium

**Module No. III**

3. Redistribution of moments for frames: Concepts , plastic hinge, advantages & analysis of

portal frames . Design of flat slabs.

**Module No. IV**

Prestressed Concrete : Concept of prestressing , materials used , analysis of sections, Methods of prestressing, Load balancing concept. Losses of prestress. Design of simply supported prestressed member.

**TUTORIALS :**

Analysis and design of building components using application softwares

**PRACTICALS**

At least one RCC drawings for each of the above modules

**ORALS** : will be based on the practicals and tutorials

**TEXT BOOKS:**

Reinforced concrete structures - by Sinha, S.K.Roy

Reinforced concrete - by B.C.Punmia , A.K.Jain & A.K. Jain

Reinforced concrete by Menon & Pillai-Tata McGraw Hill

Prestressed Concrete - by Krishna Raju

Reinforced concrete by S.K .Mallick & A. P .Gupta

Advanced Reinforced Concrete design by P.C. Varghese

**REFERENCES: All relevant IS codes**

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CE 7.3 ESTIMATION AND COSTING

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **1** | **2** | **100** | **25** | **25** | **25** | **175** |

**Module – I**

**I. Preparation of specifications** for common materials of construction and items of work with reference to Indian standard specifications - analysis of rates and preparation of abstract of items of construction

**Module – II**

**II. Quantity surveying** - preparation of approximate estimates- preparation of detailed estimates for buildings - reinforced concrete structures and steel structures - roads - irrigation structures - sanitary and water supply works

**Module – III**

**III. Contracts –** Legal aspects of Civil Engineering Contracts, pre-requisites, Contract documents, Earnest money deposit, Security deposit, modes of termination of Contracts, Arbitration and liquidated damages. PWD procedures for execution of works.

**Module – IV**

**IV. Valuation** – Definitions, Methods of Valuation, Book value, Market value, Single and Dual rates year’s purchase. Depriciation, Sinking fund, rent fixation, Valuation for various purposes, Numericals on valuation

**TUTORIALS :** Atleast one assignment from each module

**PRACTICALS** : shall consist of minimum of 4 assignments involving estimation of buildings, roads ,sanitary and water supply works, structural steel works, culverts and irrigation works and valuation.

**PRACTICAL EXAMINATION** : will be based on assignments from the syllabus

**TEXT BOOKS:**

Estimating and Costing – by Chakraborty

Verma L.C., Standardisation - A New Discipline

Rangawala- Valuation of real properties

Rangawala, Valuation of Real Properties, Charotar publishing

Civil engineering Contracts and Estimates by B. S. Patil

**REFERENCE BOOKS:**

Dutta B.N., Estimation & Costing in Civil Engg, UBS

Chakrabarthi, Estimation, Costing, Specification in Civil Engg,

Shah N.A., Quantity Surveying & Specification in Civil Engg**.,**

I**.**S 1200 (1968), Methods of Measurement of Building & Civil Engg. Works

Mahajan S.P., Civil Estimating & Costing, Satya Prakashan

Goa Schedule of rates for PWD

B.E. CIVIL (SEM VII)

**Elective I**

# CE 7.4.1 ADVANCED GEOTECHNICAL ENGINEERING

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module I

1. Introduction to special geotechnical aspects:

Shell foundations; floating foundations; foundations for special structures such as power transmission lines, communication towers, etc.; Elements of Centrifuge Modelling – case studies.

1. Reinforced Earth and Geosynthetics :

Introduction Material Application areas and construction; modern consolidation techniques such as use of band wicks and band drains along with surcharge.

### Module II

1. Underpinning: Concept, reasons, different Methods; relocation of structures
2. Laterally loaded piles; pile testing- static and dynamic tests.
3. Soil structure interaction:

Concept and introduction. Importance of interaction complexities involved in interactive Analysis and Designs.

### Module III

1. Geotechnical Earthquake Engineering:

Earthquakes, Ground shaking. Liquefaction, Surface Rupture, Other Deformations, I.S. code provisions. Principles of geotechnical earthquake Engineering.

1. Landslides – types and mitigation techniques.
2. Foundation problems in Expansive soils, Floating Foundations.

### Module IV

1. Flexible and Rigid Earth Retaining Structures:

Braced cofferdams, cantilever sheet pile walls. Anchored Bulkheads common sheet piling section. Types of Retaining walls. Forces on Retaining walls, stability Analysis, Design Aspects. Aspects of Soil nailing and rock bolts.

1. Geo-Environmental Engineering:

Types and sources of underground contaminations. Transport of underground contaminants, Geo-environmental site characterizations, remedial measures, Landfills.

**TERMWORK** : will consist of atleast one assignments from each module

**ORALS :** will be based on tutorials

**TEXT BOOKS :**

Geotechnical Engg – Principles and Practice by D. P. Coduto

Engineering with Geosynthetics by G V Rao and G V S Raju

Earth Reinforcement and Soil Structures by C J F P Jones

Foundation Engg by S P Brahma

Geotechnical Earthquake Engineeringby Steven L Kramer

**REFERENCE BOOKS:**

Foundation Design and Construction by M Tomlinson

Handbook of Foundation Engg by Kamraj

Principles of Foundation Engineering by Braja M Das

Foundation Engg Handbook by Winterkorn and Fang

Research Papers & Conference Volumes

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**Elective I**

**CE 7.4.2 STRUCTURAL DYNAMICS**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

**Module I**

1. Single degree freedom system, free vibrations, damped free vibrations, critical damping, and response, periodic loading expressed in harmonics, dynamic load factor.
2. Single degree freedom system, response to impulsive loading, rectangular, triangular pulses, Duhamel Integral. Response to general dynamic loading, Numerical schemes such as Wilson-Theta, Newmark-Beta, constant linear acceleration, time domain and frequency domain analysis.

**Module II**

1. Multi-degree freedom system, stiffness and flexibility approaches, Lumped-mass matrix, free vibrations fundamental, Frequencies and mode shapes, orthogonality of modes, numerical schemes to find mode shapes and frequencies.

**Module III**

1. Multi degree freedom systems, response to dynamic loading, Formulations of equations of motion, normal coordinates mode superposition method, Modal matrix, numerical scheme of Wilson and Newmark.

**Module IV**

1. Structural response to earthquake, wind and ground motion characteristics Response spectrum design earth quake, IS code provisions for multistory frames.

**TUTORIALS** : will consist of assignments based on the following:

1. Free vibration test on SDOF system OR equivalent analytical analysis
2. Free vibration test on MDOF system OR equivalent analytical analysis.
3. Dynamics of a multi storied building frame subjected to harmonic base motion OR equivalent analytical analysis
4. Dynamics of a one-storied building frame with planar asymmetry subjected to harmonic base motions. OR equivalent analytical analysis

5. Dynamics of a Multi- storied building frame subjected to periodic (non-harmonic) base motion OR equivalent analytical analysis

**TEXT BOOKS:**

1. Anil. K. chopra: Dynamics of Structures-Theory and Applications to Earthquake Engineering

2. R.W.Clough:, J.Penzian: Dynamics of Structures

3. J.M.Biggs: Structural Dynamics

**REFERANCE BOOKS:**

1. L.S.Jacobsen & R.S.Arye: Engineering Vibrations

2. S.P.Timoshenkoo: Vibration Problems in Engineering

3. G.B.Warburden: The Dynamical Behaviour of Structures

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**Elective I**

**CE 7.4.3 AIR POLLUTION**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module I

Introduction, definition. Air pollution past, present & future. Episodes &Global implications, units of measurement, sources of pollution & its classification. Effects of Oxides of Nitrogen, Sulphur dioxide, Carbon monoxide, SPM, Photochemical Smog etc. on metals, materials, human health & injury to vegetation.

### Module II

Meteorology – Composition &Structure of the atmosphere, wind circulation, windrose diagram, solar radiation, ALR, ELR, atmospheric stability condition ,wind velocity profile, Max. mixing depth (MMD) , Temp Inversion, plume behaviour, heat island effects. Laboratory analytical methods of particulate concentration. Hydrocarbon in atmospheric photochemistry & Oxidant in Photochemical Smog.

### Module III

Pollutant dispersion in the atmosphere. Gaussian dispersion model, plume rise, stack design max G.L. Pollutant concentration, conc. along line. Calculation of effective stack height. Air Quality Standards, criteria and indices Ringelmanns charts.Global phenomenon like green house effect, ozone depletion, acid rains.

### Module IV

Air Pollution control equipments – Principles, design, operation & maintenance of following devices – Gravitational setting chamber, cyclone separator, wet collector, fabric filter, Electrostatic Precipitator etc. Air Pollution Acts- definition of terms used, constitution of Central Pollution Control Board and State Pollution Control Board, Functions of Boards, Power of Boards.

**TUTORIALS:** shall consist of the following:

1. Atleast one assignments based on the syllabus which consists of four theory and two laboratory experiments i.e.
2. Determination of concentration of SPM using High Volume Samplers.
3. Determination of CO, SC concentrations of motor vehicles using Gas Analysers.
4. Report of atleast two field visit of any two industries possibly where air pollution control equipments are in use.

**ORALS :** will be based on tutorials

**TEXT BOOKS:**

Air Pollution by M. N. Rao,

Air Pollution by Rao & Rao

**REFERENCE BOOKS:**

Air Pollution by Muralikrishna.

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**Elective I**

**CE 7.4.4 ADVANCED REINFORCED CONCRETE DESIGN**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module No. I

Redistribution of Moments – Concepts, plastic hinge.Advantages& Analysis of Portal Frames

Design of Folded Plates

### Module No. II

### Yield Line analysis of slabs: Characteristic features, Virtual & Equilibrium methods. Design of Grid Floors & Flat Slabs

### Module No. III

General Classification of Shells, Membrane Theory of Cylindrical Shells. Applications to Sphericals Domes ,Conical Shells & Conical Water Tanks

### Module No. IV

Design of Bunkers & Silos. Design of Pile Foundations

**TUTORIALS**

1. Problems using softwares – STAADPRO
2. RCC drawings – 3NOS FOR ABOVE MODULES except module II

# ORALS : Will be based on tutorials

# TEXT BOOKS:

Reinforced Concrete – S.K Mallick & A.P Gupta Sinha, S.K.Roy

Advanced Reinforced Concrete Design - P.C. Varghese

Design & Construction of Concrete Shell Roof – G.S Ramaswamy

Design of Reinforced Concrete Structures –N. Krishna Raju

**REFERENCES :**

Advanced Reinforced Concrete Design – N. Krishna Raju

Theory & Design of Concrete Shells – B.K Chatterjee

Design of Roof Shells – J.E Gibson

Stresses in Shells – Wilhelm & Flugge

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**Elective I**

**CE 7.4.5 LOW COST HOUSING**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module No. I

Introduction- Need for low cost housing - Housing Scenario.

Requirements of Low Cost Housing: Quantitative requirements and Qualitative requirements.

Introduction to work by national and international organisations dealing with low cost housing and by research organisations. Role of Nirmithi Kendras. Techniques promoted by Building Centres.

### Module II

Financial assistance/subsidies/loans for low cost housing.

Materials: Use of locally available materials, Low cost materials for roofing, walling, doors, windows etc. Stabilised soil block. I.S Code specifications. The concept of cheaper materials/or better comfort Use of mine rejects and other rejects. Substitute materials for Timber. Use of Industrial wastes. Use of Agricultural wastes in low cost Housing.

### Module III

Precast Technology - Introduction to Partial and Total prefabrication Techniques.

Basics of Green buildings Technology – Concept of Energy Audit in a Building

Design concepts: Row housing, community housing complexes. Advantages and disadvantages.

New design concepts for housing - harmonising with the surroundings. Housing Pattern. Low cost . Housing in Earthquake prone areas.

### Module IV

Construction techniques: Block making machines. Typical hand operated and power operated machines for soil and concrete blocks in national and international field. Do it yourself techniques. Concept of involvement of end users in construction. Low cost Infrastructure services

Rural Housing - Mud Housing Technology, Soil Stabilisation, Rural Housing programmes,

Social Housing programmes- Implementing Agencies, performance of Social Housing programmes.

**TUTORIALS:**

1. Study of an existing house constructed using low cost housing Technique
2. Design and estimate a typical self contained low cost house
3. Make 3D detailed drawings of any 6 low cost techniques.

**ORALS :** Will be based on tutorials

**TEXT BOOKS:**

Handbook of low cost Housing by G.K Lal

**REFERENCES BOOKS:**

Relevant reports and conference/ Seminar Volumes of CBRI, NBO etc.

IS Codes. IS 2185-1979 (Part I)

IS 456-2000

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**Elective II**

**CE 7.5.1 ROCK MECHANICS**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module I

1. **Introduction:** Definition, Development of rock mechanics, Objectives of rock mechanics, Application of rock mechanics, Similarities and difference between soil mechanics and rock mechanics, discontinuities in rocks
2. **Physical Properties:** Specific gravity, porosity, void index, unit weight, water absorption, Degree of saturation, slake durability index, rock sampling.

### Module II

1. **Compressive Strength Of Rock:** Stress distribution in specimens under compression, Modes of failure in compression, Failure mechanism of specimens in compression, Factors affecting compressive strength – End friction, specimen geometry, rate of loading, moisture and confining pressure.
2. **Elastic Constants:** Static and dynamic elastic constants, Significance and application, Determination of static and dynamic elastic constants, Typical stress-strain curves for rocks, Complete stress-strain curve,

### Module III

1. **Tensile Strength:** Significance and application of tensile strength, Laboratory determination of tensile strength - Direct methods, Indirect methods-Bending tests, Hydraulic extension tests, Diametral compression tests, other methods, Factors affecting tensile strength of rock.
2. **Shear Strength:** Significance and application, Various methods of estimating shear strength – single shear test, double shear test, punch shear test, oblique shear test, rock core direct shear test, Concept of shear strength of jointed rock.

### Module IV

1. **Engineering Classification Of Rocks:** Necessity, aim, and process of classification, Classification of intact rocks- ISRM and Deere and Miller classification, Engineering Classification of rock mass- RQD, BGD and RMR systems of classifications.
2. **Insitu-Tests:** Necessity, plate bearing test, pressure tunnel test, pressure meter test and direct shear test and field permeability tests.

**TUTORIALS** : will consist of atleast one assignments from each module

**ORALS :** will be based on tutorials

**TEXT BOOKS**

Rock Mechanics-Verma B. P.

Introduction to rock mechanics – Jumikies

Engineering in Rocks-Ramamurthy

**REFERENCE BOOKS**

Hand book on rock mechanics(Vol I to IV) – Lama and Vutukuri

Rock mechanics – Stack and Zienkiwize

Relevant IS Codes

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**Elective II**

**CE 7.5.2 APPLIED ENGINEERING GEOLOGY**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module I

1. **Indian stratigraphy**. Geological history of Peninsula. Study of different geological formations of the peninsula. Occurrence of important economic minerals, building stones and construction materials of India. Geology and stratigraphy of Goa.
2. **Coastal Engineering.**

Waves and tides.- wave motion, Force and height of waves , beach zones , wave refraction, tides , changes in sea level

Coastal erosion and deposition- coastal erosion, beaches , longshore drift, Offshore bars

Shoreline Investigation and data acquisition- Recording devices, topographic and hydrographic surveys. Measurement of water levels , movement of sediments

Methods of Shoreline protection.; Sea Walls, Embankments, revetments, bulkheads

Methods of Stabilization of long shore drift- Groynes , Beach Replenishment

**Module-II**

1. **Geology of dam and reservoir sites**. A) Dams**: Geological** investigation, Types dams. Influence of strength, stability, water tightness, physical characteristics and geological structures on dams. Suitable and unsuitable conditions. Precautions and Treatments.
2. **Groundwater-I:** Water table. Storage and circulation. Porosity and Permeability. Geological work of groundwater. Springs, wells and artesian wells. Cone of Exhaustion. Occurrence of groundwater in different rocks. Water quality, safe yield and contamination. Groundwater exploration.

**Module-III**

1. **Tunneling:** Geological investigations for selecting tunnel routes. Influence of lithology, geological characters and structures of rocks and soils in tunneling. Tunnels in soft ground. Effect of groundwater, gasses and temperature variations in tunnels. Excavations of tunnels. Tunnel support analysis.
2. **Landslides:** Causes .Classification. Influence of geological characters, structures of rocks and groundwater on landslides. Safe and unsafe slopes. Controlling of landslides. Precautions while making cut in hill sites.

**Module-IV**

1. **Building stones and aggregates:** Requirements of good building stones, aggregates and other construction materials. Suitability of common rocks as building stones.
2. **Engineering properties of rocks:**

1. Physical properties, porosity, density, moisture content, degree of saturation, Permeability, durability

2. Strength characteristics: Compressive strength, tensile strength, shear strength, point load strength, elasticity, plasticity and deformability

**TUTORIALS**

1. Identification and study of natural construction materials, building stones and decorative stones.
2. Problems on water quality.
3. Problems on structural geology (thickness of strata, strike and dip).
4. Toposheet map reading.
5. Use of Brunten compass and Clinometer compass

**ORALS :** will be based on tutorials

**TEXTBOOKS**

1. Engineering geology and Geotechincs: B.P.Krynine and W.R.Judd
2. Geology for Engineers: Blyth and others.
3. Text book of Engineering geology: Dr.R.B.Gupte
4. Engineering and General geology: Parbin Singh

**REFERENCE BOOKS:**

1. Geology for Engineering: Legget
2. Mining Geology: Mckinstry.
3. Principles of Engineering geology R. Johnson and J.Graff.

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**Elective II**

**CE 7.5.3 FINITE ELEMENTS IN CIVIL ENGINEERING**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

###### **Module I**

1. **FUNDAMENTAL CONCEPTS OF FEM:** General, Historical background, stresses and equilibrium, Basic steps in FEA, boundary conditions, strain-displacement relations, stress-strain relations, Potential energy approach, Rayleish-Ritz method, Galerkin’s method. Advantages of FEM, Matrix algebra and Gaussian elimination
2. **FEA FOR 1-D STRESS-DEFORMATION PROBLEMS:** Introduction, FE modelling, Co-ordinate and shape functions, Potential energy and Galarkian approach, Assembly of global stiffness matrix and load vector, treatment of boundary conditions, Quadratic shape functions.

###### **Module II**

1. **2-D STRESS-DEFORMATION FEA USING CST:** Introduction, plane strain and plane stress problems, finite element modelling, Problem modelling, boundary conditions and solution.
2. **FEA FOR 2-D STRES-DEFORMATION WITH QUADRILATERAL:** Introduction, Four nodded quadrilateral element, Finite element formulation, Derivation of element equation, Problem solution.

###### **Module III**

1. **FEA FOR PLANE TRUSS STRUCTURES:** Introduction, Plane trusses, Formulation of problem, Temperature effects, introduction to three-dimensional trusses.
2. **FEA FOR BEAMS AND FRAMES:** Beams: Introduction, Potential energy, Finite element formulation, Load vector, Boundary conditions, Shear force and bending moment, Problem solution. Frames: Introduction, Plane frames, Finite element formulation, Load vector, Boundary conditions, Problem solution.

###### **Module IV**

1. **DYNAMIC CONSIDERATIONS IN FEA:** Introduction, Formulation, Solid body with distributed mass, Element mass matrix for various types of elements, Evaluation of Eigenvalues and eigenvectors, Vector iteration method and Inverse iteration method.
2. **PREPROCESSING, PROCESSING AND POSTPROCESSING IN FEA:** Introduction, Mesh generation, Region and block representation, Block corner nodes, sides and subdivisions, Generation of node numbers, Co-ordinates and connectivity, Examples of mesh generation, Data handling and editing, Post processing.

**TUTORIALS** : will consist of atleast one assignments from each module

**ORALS :** will be based on tutorials

**TEXT BOOKS:**

Introduction to Finite Elements in Engineering – Chandrupatla and Belegundu

Finite Element Method – Desai

Introduction to Finite Element Method – Desai and Abel

**REFERENCE BOOKS:**

Finite Element Procedures – Bathe

The Finite Element Method – Zienkiewicz

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**Elective II**

# CE 7.5.4 DESIGN OF HYDRAULIC STRUCTURES

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **3** | **2** | **0** | **100** | **25** | **25** | **0** | **150** |

### Module No. I

Design & Construction of Dams – Site investigation,engg surveys,geological & hydrological investigations,Storage capacity, Reservoir- Operation , losses & sedimentation .

Gravity dams- Selection criteria of dam site,construction materials,joints,keys & water stops,temperature control,galleries.Types of loads, stability & gravity analysis , safety. Design of overflow & non overflow section by single & multi step method . Stress analysis & stress contours.Composite dams & Cofferdams

### Module No. II

### Arch & Buttress Dams- types,spillway works.Design principles of Arch dam-constant angle & constant radius types.Appurtenant works

Earth & Rockfill dams-Advantages & limitations,Foundation for earth dams,causes & failure ,design criteria, seepage line, stability analysis, Swedish circle methods with pore pressure,construction details & maintenance, Rockfill Dams-Different types& stability analysis

### Module No. III

Spillway types , Design of principles of Ogee & bucket type Spillways ,Energy dissipater stilling basin design .Chute, siphon & shaft spillway desugn .

Crest gate- types, choice & advantages.Design of radial gates. Intake structures

### Module No. IV

Design of small bridge and culverts: Data collection. High flood discharge Linear water way. scour depth, principles of hydraulic design of causeways and box culverts.

River Training works: River pattern, regime flow, Guide Banks, Flood levels, Design of guide bunds, launching aprons and spurs. Bridge piers.

Hydro Electric Development: Types of power plants, principles of planning of Hydro electric project - choice of turbines. tail race channel ,penstocks , Forebay ,pressure shafts.

**TUTORIALS**:

Atleast one design problems on each module

**ORALS :** will be based on above tutorials

# TEXT BOOKS:

Theory and Design of irrigation Structures - Varshney and Gupta.

Engineering for Dams Vol. I to III - Creager, Justin, Hinds

**REFERENCES :**

Goodman,A.S.,Principles of water resource planning .Prentice Hall Publication, 1954.

Hydroelectric Hand Book - Guthrie Brown.

B.E. CIVIL (SEM VII)

**CE 7.6 CIVIL ENGINEERING PROJECT**

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| **Scheme of Instruction** | | | **Scheme of Examination** | | | | |
| **L** | **T** | **P** | **Theory** | **Int. Asst.** | **Orals** | **Pract** | **Total** |
| **-** | **-** | **4** | **-** | **25** | **50** | **-** | **75** |

**The project will include experimental or analytical studies or a combination of both on any of the civil engineering topics. A hard copy of progress report shall be submitted at the end of the semester.**