SHRI VENKATESHWARA UNIVERSITY

SYLLABUS

B.TECH
CIVIL ENGINEERING
V^TH SEMESTER
(FOUR YEARS DEGREE 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*	*CT*	*TA*	*Total*	*PS*	*TE*	*PE*		
1	*SCE-501*	*Geotechnical Engineering*	*2*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*2*
2	*SCE-502*	*Transportation Engineering*	*2*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*2*
3	*SCE-503*	*Hydraulic Engineering*	*2*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*2*
4	*SCE-504*	*Hydrology & Water Resources Engineering*	*3*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*3*
5	*SCE-505*	*Environmental Engineering*	*3*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*3*
6	*SCE-506*	*Structural Engineering*	*2*	*1*	*0*	*20*	*10*	*30*		*70*		*100*	*3*
7	*SCE-507*	*Mechanics of Materials*	*3*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*3*
8	*SCE-511*	*Geotechnical Engineering Lab*	*0*	*0*	*2*				*25*		*25*	*50*	*1*
9	*SCE-512*	*Transportation Engineering Lab*	*0*	*0*	*2*				*25*		*25*	*50*	*1*
10	*SCE-513*	*Hydraulic Engineering Lab*	*0*	*0*	*2*				*25*		*25*	*50*	*1*
11	*SOE-051*	*Applications of Psychology*	*2*	*0*	*0*	*20*	*10*	*30*		*70*		*100*	*2*
12	*SNM-501*	*Essence of Indian Knowledge Tradition*	*2*	*0*	*0*								*0*
		Total										*950*	*23*

SCE-501	***Geotechnical Engineering***	***2L:0T:0P***	***2 credits***

Module 1*: Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison*

and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation-moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

On completion of this module, the students must be able to:

- *Understand the different types of soil based on their formation mechanism;*
- *Understand the various phase diagrams and derive various phase relationships of the soil;*
- *Perform various laboratory experiments to determine moisture content, specific gravity;*
- *Perform field experiments to estimate the field density of the soil mass.*

***Module 2**: Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.*

On completion of this module, the students must be able to:

- *Understand the behaviour of soils based on their moisture contents;*
- *Perform laboratory experiments to estimate various Atterberg limits and evaluate index properties of soils;*
- *Classify any soils based on their particle size distribution and index properties;*

***Module 3:** Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.*
On completion of this module, the student must be able to:

- *Determine the permeability of soils through various laboratory and field tests;*
- *Analytically calculate the effective permeability of anisotropic soil mass;*
- *Determine the seepage quantities and pore water pressures below the ground;*
- *Graphically plot the equipotential lines and flow lines in a seepage flow.*

***Module 4:** Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.*
On completion of this module, the student must be able to:

- *Understand the physical significance of effective stress and its relation with pore pressure;*
- *Plot various stress distribution diagrams along the depth of the soil mass;*
- *Understand the effect of capillary action and seepage flow direction on the effective stress at a point in the soil mass.*

***Module 5:** Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.*

On completion of this module, the student must be able to:

- *Perform laboratory test to determine the maximum dry density and optimum moisture content of the soil;*
- *Variation in compaction curve with compaction effort and soil type;*
- *Determine the compactive effort required to obtain necessary degree of compaction in-situ;*
- *Differentiate among various field methods of compaction and their usage based on the type of soil.*

Module 6: *Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.*

On completion of this module, the student must be able to:

- *Analytically compute the vertical stress in a semi-infinite soil mass due to various loading conditions;*
- *Plot isobars due various loading conditions.*

Module 7: *Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretationof consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.*

On completion of this module, the student must be able to:

- *Understand the basic mechanism of consolidation of soil;*
- *Determine various consolidation parameters of soil through laboratory test;*
- *Evaluate ground settlements against time.*

Module 8: *Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses,Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters.unconfined compression test, vane shear test*

On completion of this module, the student must be able to:

- *Determine graphically and analytically the stress state in any plane of the soil mass;*
- *Perform various shear strength tests and appreciate the different field conditions which theysimulate;*
- *Understand the significance of shear strength parameters in various geotechnical analyses;*
- *Evaluate the stiffness of soil using shear strength parameters*

Module 9: *Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.*

On completion of this module, the student must be able to:

- *Differentiate various modes of slope failure;*
- *Evaluate factor of safety of infinite slopes based on different ground conditions;*
- *Understand various methods for computation of factor of safety for finite slopes.*

Module 10: *Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.*

On completion of this module, the student must be able to:

- *Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;*
- *Understand various site investigation techniques and their in-situ applications;*

- *Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, etc.*

1. (Civil and Environmental Engineering) by V.N.S. Murthy

SCE-502	***Transportation Engineering***	***2L:0T:0P***	***2 credits***

Module 1*: Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.*

Module 2*: Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems*

Module 3*: Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems*

Module 4*: Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems*

Module 5: *Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements-components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems*

Text/Reference Books:

1. *Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017*
2. *Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.*
3. *Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,*
4. *Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley*
5. *Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.*
6. *Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.*

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

- *carry out surveys involved in planning and highway alignment*
- *design the geometric elements of highways and expressways*
- *carry out traffic studies and implement traffic regulation and control measures and intersection design*
- *characterize pavement materials and*
- *dgn flexible and rigid pavements as per IRC*

SCE-503	***Hydraulic Engineering***	***2L:0T:0P***	***2 credits***

Objectives:

To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

***Module 1**: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.*

***Module 2**: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.*

***Module 3**: Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.*

***Module 4:** Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.*

***Module 5:** Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.*

***Module 6:** Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n".Most economical section of channel. Computation of Uniform flow, Normal depth.*

***Module 7:** Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.*

***Module 8:** Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types,applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation*

***Module 9:** Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem.*

***Module 10:** Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web based modeling in water resources engineering.*

Practical Work:

1. *Flow Visualization*
2. *Studies in Wind Tunnel*
3. *Boundary Layer*
4. *Flow around an Aerofoil / circular cylinder*
5. *Uniform Flow*
6. *Velocity Distribution in Open channel flow*
7. *Venturi Flume*
8. *Standing Wave Flume*
9. *Gradually Varied Flow*
10. *Hydraulic Jump*
11. *Flow under Sluice Gate*
12. *Flow through pipes*
13. *Turbulent flow through pipes*
14. *Flow visualization*
15. *Laminar flow through pipes*
16. *Major losses / Minor losses in pipe*

Text/Reference Books:

1. *Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House*
2. *Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.*
3. *Open channel Flow, K. Subramanya, Tata McGraw Hill.*
4. *Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.*
5. *Burnside, C.D., "Electromagnetic Distance Measurement," Beekman Publishers, 1971.*

Outcomes:

- *The students will be able to apply their knowledge of fluid mechanics in addressing problems in open channels.*
- *They will possess the skills to solve problems in uniform, gradually and rapidly varied flows in steady state conditions.*
- *They will have knowledge in hydraulic machineries (pumps and turbines).*
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SCE-504	*HYDROLOGY & WATER RESOURCES ENGINEERING*	***3L:0T:0P***	*3*

***Objectives**: 1. To prepare the students for a successful career as hydrologist and water resources engineers*
2. To develop the ability among students to synthesis data and technical concepts for application in hydrology and water resources engineering
3. To provide students an opportunity to work as a part of interdisciplinary team
4. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze, solve engineering problems and to prepare them for their career.
5. To promote student awareness of the life-long learning and to introduce them professional ethics and codes of professional practice in water resource engineering

Outcome:
At the end of the course, students must be in a position to
1. Understand the application of fluid mechanics model studies and computers in solving a host of problems in hydraulic engineering
2. Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for

design of hydraulic structures
3. Enable the students to understand the basic aquifer parameters and groundwater resources for different hydro-geological boundary conditions
4. The student is exposed to the application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources
5. Apply the principles and applications of remote sensing, GPS and GIS in the context to hydrological extreme flood and drought events in water resources engineering

S.N.	***Unit number***	***Topics***	***Sub Topics***
1	***1***	***Hydrology & Infiltration***	*Hydrologic Cycle. Water Budget Equation, Hydrologic system, Precipitation : Types, measurements and analysis, error in estimation, missing data, consistency of rainfall records, Intensity during frequency (IDF) and probabilistic maximum Precipitation (PMP) curves. Evaporation and consumptive use: Process affecting factors, estimation and measurement techniques. Process affecting factors, measurement and estimation, Infiltration Indices.*
2	***2***	***Surface Runoff***	*Components and factors affecting runoff, methods of estimation of runoff volume and peak runoff, rating curve, Rainfall – runoff relationships Hydrograph analysis: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph, Unit Hydrograph: Theory and assumptions. Derivation of Unit Hydrograph, Synthetic Unit Hydrograph Introduction to computer models for rainfall runoff analysis. Irrigation: Developments in India, Necessity and types Advantages & disadvantages of irrigation. Functions of water in plant growth, Methods of Irrigation, Water requirement of crops. Irrigation frequency, Irrigation efficiencies, Principal crops and crop season, crop rotation. Canal irrigation: Classes and alignment, Parts of a canal system, Commanded area, curves in channels, channel losses.*
3	***3***	***Sediment Transportation***	*Suspended and Bed load and its estimation Irrigation channels: Types: lined and unlined, silt theories: Kennedy's and Lacey's Design procedure for irrigation channels, Longitudinal cross section, Schedule of area statistics and channel dimensions, use of Garret's Diagrams in channel design, cross sections of an Irrigation channel, Computer programes for design of channels*
4	***4***	***Regulation and control of canal system***	*Lining of Irrigation Canals: Advantages and types, factors for selection of a particular type, design of lined channels, cross section of lined channels, Economics of canal lining. Water Logging: Definition, effects, causes and anti-water logging measures, Drainage of water logged land, Types of drains open and closed, spacing of closed drains.*
5		***Types of canal regulation works and their function***	*Purpose, Types of canal regulation works and their functional aspects Irrigation Outlets: Requirements, types, non-modular, semi-module and rigid module, selection criterion River Training: Objective and need, classification of rivers, and river training works, meandering, stages, methods of river training, bank protection, Methods for measurement of discharge.*
	5	***Ground Water Hydrology***	*Zones of underground water, Aquifers and their types, important terms, Determination of discharge through unconfined and confined aquifers with steady flow conditions, Interference among wells, determination of aquifer constants, Well loss and specific capacity, efficiency of a well, types of water wells, bored and open wells, specific yield of a well, Relative merits of well and canal irrigation, type of tube wells, well surrounding and well development, Suitable site selection for a tube well, Types of open wells, Methods of lifting water. Infiltration galleries.*

SCE-505	***Environmental Engineering***	***3L:0T:0P***	***3 credits***

Module 1*: Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.*
Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2*: Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.*

Module 3*: Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations*

Module 4*: Noise- Basic concept, measurement and various control methods.*

Module 5: *Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.*

Module 6*: Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.*

Module 7: *Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.*

Practical Work: List of Experiments

1. *Physical Characterization of water: Turbidity, Electrical Conductivity, pH*
2. *Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorgani cetc.*

3. *Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness*
4. *Analysis of ions: copper, chloride and sulfate*
5. *Optimum coagulant dose*
6. *Chemical Oxygen Demand (COD)*
7. *Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)*
8. *Break point Chlorination*
9. *Bacteriological quality measurement: MPN,*
10. *Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)*
11. *Ambient noise measurement*

Text/Reference Books:

1. *Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.*
2. *Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.*
3. *Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 1985.*
4. *MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.*
5. *Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.*
6. *Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999*
7. *Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication*
8. *Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Healthand Environmental Engineering Organization, Ministry of Urban Development.*

Outcomes:

After successfully studying this course, students will:

- *Understand the impact of humans on environment and environment on humans*
- *Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.*

SCE-506	***Structural Engineering***	***3L:1T:0P***	***3 credits***

Objectives:

This course aims at providing students with a solid background on principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be held besides lectures.

Module 1: *Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design*

Module 2: *Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads*

Module 3: *Materials and Structural Design Criteria: Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and designphilosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;*

Module 4: *Design of Structural Elements; Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems*

Module 5: *System Design Concepts; Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection*

Text/Reference Books:

1. *Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004*
2. *McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J.,2003.*
3. *Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996*
4. *Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.*
5. *Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper &Row, Publishers, New York, 1990.*
6. *MacGregor, J. G., Reinforced Concrete: Mechanics and Design, 3rd Edition, Prentice Hall,New Jersey, 1997.*
7. *Nawy, E. G., Reinforced Concrete: A Fundamental Approach, 5th Edition, Prentice Hall, New Jersey.*
8. *Wang C-K. and Salmon, C. G., Reinforced Concrete Design, 6th Edition, Addison Wesley, New York.*
9. *Nawy, E. G. Prestressed Concrete: A Fundamental Approach, Prentice Hall, NJ, (2003).*
10. *Related Codes of Practice of BIS*

11. *Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.*
12. *W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition,John Wiley and Sons, 2000.*
13. *NBC, National Building Code, BIS (2017).*
14. *ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.*

Outcomes:

- *The students will be able to apply their knowledge of structural mechanics in addressing design problems of structural engineering*
- *They will possess the skills to solve problems dealing with different loads and concrete and steel*
- *They will have knowledge in structural engineering*

SCE-507	***Mechanics of Materials***	***3L:0T:0P***	***3 credits***

The objective of this Course is to introduce to continuum mechanics and material modeling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behavior of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behavior is carefully observed and measured (learnt in the previous course on Materials, Testing & Evaluation). For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

What will I learn?

- *Understand the deformation and strains under different load action and response in terms offorces and moments*
- *Understand the behaviour under different loading actions*
- *Application of engineering principles to calculate the reactions, forces and moments*
- *Understand the energy methods used to derive the equations to solve engineering problems*
- *Make use of the capabilities to determine the forces and moments for design*

Proposed Syllabus

Module 1: *Deformation and Strain covering description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder;*

Module 2: *Generalized state of stress and strain: Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.*

Module 3:*Momentum Balance and Stresses covering Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion*

Module 4:*Mechanics of Deformable Bodies covering Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses,*

Module 5: *Force-Stress-Equilibrium covering Multiaxial Stress and Strain*

Module 6: *Displacement – Strain covering Multiaxial Strain and Multiaxial Stress-strain Relationships*

Module 7: *Elasticity and Elasticity Bounds covering Stress-strain-temperature Relationships and Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure of Materials,*

Module 8: *Bending: Stress and Strains; Deflections and Torsion covering Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.*

Module 9: *Structural stability; Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design*

Text/Reference Books:

1. *Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.*
2. *Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.*
3. *Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India.*
4. *Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004*
5. *Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979*
6. *Gere, J. M., and S. P. Timoshenko. Mechanics of Materials. 5th ed. Boston: PWS Kent Publishing, 1970.*
7. *Ashby, M. F., and D. R. H. Jones. Engineering Materials, An Introduction to their Properties and Applications. 2nd ed. Butterworth Heinemann.*
8. *Collins, J. A. Failure of Materials in Mechanical Design. 2nd ed. John Wiley & Sons, 1993.*
9. *Courtney, T. H. Mechanical Behavior of Materials. McGraw-Hill, 1990.*
10. *Hertzberg, R. W. Deformation and Fracture Mechanics of Engineering Materials. 4th ed. John Wiley & Sons, 1996.*
11. *Nash, W. A. Strength of Materials. 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.*

Text/Reference Books:

12. *Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.*
13. *Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.*
14. *Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India.*
15. *Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004*

16. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
17. Gere, J. M., and S. P. Timoshenko. Mechanics of Materials. 5th ed. Boston: PWS Kent Publishing, 1970.
18 .Ashby, M. F., and D. R. H. Jones. Engineering Materials, An Introduction to their Properties and Applications. 2nd ed. Butterworth Heinemann.
19 .Collins, J. A. Failure of Materials in Mechanical Design. 2nd ed. John Wiley & Sons, 1993.
20. Courtney, T. H. Mechanical Behavior of Materials. McGraw-Hill, 1990.
21. Hertzberg, R. W. Deformation and Fracture Mechanics of Engineering Materials. 4th ed. John Wiley & Sons, 1996.
22. Nash, W. A. Strength of Materials. 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.

Outcomes:

At the end of the course, the student will have

- *an ability to apply knowledge of mathematics, science, and engineering*
- *an ability to design a system, component, or process to meet desired needs*
- *an ability to identify, formulate, and solve engineering problems*
- *the broad education necessary to understand the impact of engineering solutions in a globaland societal context*
- *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*
- *an ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes*

APPLICATIONS OF PSYCHOLOGY
Course code: SOE-051

Credits: 2-0-0

1. OBJECTIVES:

The objectives of this course are to make students:

1) *aware of the different applications of psychology to everyday issues of life,*
2) *aware of the different social issues, workplace issues, and behavioural issues, and*
3) *understand how the knowledge gained from this course can be used in their own personal and professional work life.*

2. COURSE TOPICS:

2.1 Unit 1: *Introduction: Nature and fields. (6)*

2.2 Unit 2: *Psychology in industries and organizations: Job analysis; fatigue and accidents; consumer behavior. (8)*

2.3 Unit 3: *Psychology and mental health: Abnormality, symptoms and causes psychological disorders.(10)*

2.4 Unit 4: *Psychology and Counseling: Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling. (6)*

2.5 Unit 5: *Psychology and social behavior: Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation. (10)*

Text

1. *Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall.*
2. *Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson*
3. *Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education*
4. *Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall.*

SCE-511	***Geotechnical Engineering lab***	***0L:0T:2P***	***1 credits***

Practical Work: *List of tests on-*

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Vane shear test
19. Direct Shear Test
20. Unconfined Compression Strength Test.

Text/Reference Books:

2. *Soil Mechanics by Craig R.F., Chapman & Hall*
3. *Fundamentals of Soil Engineering by Taylor, John Wiley & Sons*
4. *An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ*
5. *Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning*
6. *Principles of Foundation Engineering, by Braja M. Das, Cengage Learning*
7. *Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy*
8. *Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.*
9. *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering(Civil and Environmental Engineering) by V.N.S. Murthy*

SNM-501 Essence of Indian Knowledge Tradition

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Course objective*: The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in*

modern society with rapid technological advancements and societal disruptions.
Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.
Course Contents *– Basic structure of Indian Knowledge System: अ□□□□□Ę□ -□□□□,□□□□□□ (□□□□őद, □□□□őद, गūवŊ□□□, ཱ□□□r̈ □□□) □□□□□□□ (□□Ɨ□, क्क, □□Ŝb, ƒŋ□□□□, Ȕ□□□□, □□□) ४ □□□□□□ (धमŊ□□‹, □□□□□□□, □□□□□, तकŊ□□‹) – Modern Science and Indian Knowledge System – Yoga and Holistic Health care – Case studies*

Philosophical Tradition (सवŊदशŊन)-Ɋ□□, □□□□□□□, □□□ß, □□□, □□□□□□□, □□□□□□, □□□□Ŋक, □□□, □□Ɲ – Indian Linguistic Tradition (Phonology, morphology, syntax and semantics) – Indian Artistic Tradition - □□ũ□□□, □□□□Ŋ□□□, □□·□□□□, ཱ□□□r̈, □□□□□, □□r̈□□□□□□□□□□ – Case studies

References

• V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
• Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan • Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
• Fritzof Capra, Tao of Physics
• Fritzof Capra, The Wave of life
• VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam
• Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
• GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016
• RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi Prakashan, Delhi 2016 • P B Sharma (English translation), Shodashang Hridayan

Pedagogy: *Problem based learning, group discussions, collaborative mini projects.*
Outcome: *Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.*