TRACER SYLLABUS

SOIL SURVEY AND SOIL CONSERVATION DEPARTMENT

CATEGORY NO.517/2015

(Mechanical Engineering)

1.Fluid Mechanics and Hydraulic Machines

Definition of density,specific volume,specific gravity,viscosity,kinematic & dynamic viscosity,compressibility,vapour pressure,cohesion,adhesion,surface tension and capillarity.

Intensity of pressure at a point-pressure head-units of pressure-Pascal's law Atmospheric pressure-Gauge pressure-Absolute pressure-vacuum pressure-problems-Measurements of atmospheric pressure-simple mercury barometers-pressure measuring devices-peizometer tubes,manometers-U-tube –simple differential and inverted tubes only-Mechanical Gauge-Bourdon tube pressure gauge.Pressure on plane surfaces immersed in liquid.

Total pressure and center of pressure on horizontal,vertical and inclined surfaces immersed in liquids.Pressure on lock,gates,sluice gate.

Kinematics and Dynamics of fluid flow

Introduction-types of fluid flow-steady and unsteady flow-uniform and non-uniform flow-laminar and turbulent flow-compressible and incompressible flow-rotational and ir-rotational flow-one,two and three dimensional flow-rate of flow or discharge-equation of continuity of a liquid flow-simple problems-energy of a liquid in motion-potential energy-kinetic energy-pressure energy-total energy-total head of liquid in motion-Euler's equation of motion-Bernoulli's equation from Euler's equation-assumptions-simple problems-practical applications of Bernoulli's equation-venturimeter-Orifice meter-pitot tube

Buoyancy and Floatation

Buoyancy-Centre of Buoyancy-Types equilibrium of floating bodies,Metacentre and metacentric height.

Flow through Orifices,Notches,Weirs and Mouth pieces

Definition of orifice,types of orifices-(based size,shape flow condition)-definition of vena contracta-hydraulic coefficients-C_v,C_c,C_d-experimental determination.Submerged and partially submerged orifices.Large rectangular orifice-expression for discharge-derivation.

Time for emptying a prismatic tank through an orifice at bottom or in the side head loss due to sudden enlargement and sudden contraction at the entrance of pipe from large vessel,at the exit of a pipe line,obstruction in pipe line derivation of expression for head loss due to enlargement & contraction-Types of notches-rectangular,triangular and trapezoidal notches

Discharge over

Rectangular,triangular and trapezoidal notches.Classifications-definition-discharge over

Rectangular weir,end contraction in weir effect of end contraction over discharge-Francis

Formula and Bazin's formula for end contraction-velocity of approach-problems broad crested

Weir-problems submerged weir description.Mouth piece-different types-external and internal-cylindrical

Flow through pipes and channels

Frictional loss in pipes-Chezy's and Darcy's formulae-Derivation and problems Hydraulic gradient and total energy line-Water hammer and its effect(description only)Syphon.

Flow through Channels Wetted perimeter Hydraulic mean depth-uniform and non-uniform flow-Chezy's formula.

Turbines and Pumps

Introduction-development of water Turbines-classification-impulse Turbine-Pelton wheelcomponents-velocity triangle and work done.Workdone-power produced efficiency-number of jets-design of Pelton wheel-governing-other impulse Turbines.

Reaction turbines-components-difference between impulse & Reaction-Classification of

Reaction Turbines-discharge-power produced-efficiencies-Francis Turbine-Kaplan Turbine-Draught tubes-other reaction turbines.

Characteristics of Turbines-Significance-specific speed-selection of Turbine-selection based on specific speed and head of water-characteristic curve for Impulse and reaction Turbines.

Centrifugal pump-Introduction-types of casing-piping system of CP-work done manometric head-efficiencies-discharge-power required to drive-multistage pumps-simple problems.Performance-specific speed of CP-selection of pumps based on specific speed and head-cavitation-priming.

Reciprocating pumps-Types-comparison of CP&RP-discharge-slip-power required-air vessels-indicator diagram of RP

Hydraulic control elements and components

Control valves—Functions-classifications-ratings-Describe the working of pressure control valves viz,relief valves-pilot operated relief valve-poppet valve-sequence valve Direction control valve-sequence valve Direction control valves-types-sliding spool type-rotary spool type-check valves-1 way,2 way,3 way directional control valves,pilot operated check valve,solenoid control valve.Flow control valve-types-gate,globe,pressure compensated butterfly valves,non return valve,application circuits of control valves.Seals-packings-materials for seals and

packings-purpose of sealing.Filters-types-necessity of filtration of fluids-intensifier-motors and accumulators-purpose of accumulators viz,shock suppressions,fluid makeup,leakage compensation,emergency power and holding-types of accumulators-weight loaded,spring loaded,gas loaded

Hydro-electric Installation

Layout-intake works,pressure tunnel,penstock,surge tank,action of surge tank anchor blocks and tailrace.

2.Engineering materials and properties

Metallic and non-metallic properties such as-Mechanical,strength,hardness,toughness,brittleness,creep,fatigue,stiffness,ductility,malleability,elasticity and plasticity.Electrical Properties-Resistance and Resistivity,conductance and conductivity,capacitance.Magnetic properties-Magnomotive force,rellectance,permeance,hysteresis Thermal properties-Specific heat,thermal conductivity,thermal resistance,and thermal diffusivity.Chemical properties:Corrosion resistance,acidity and alkalinity.Physical properties:-density,viscosity,colour,finish,porosity.

Testing of Engineering Materials-

Destructive testing-tension and compression test

Hardness test:-Brinell,rock well,Vickers-impact test,fatigue test and creep test,Nondestructive testing-Radio graphic,ultrasonic inspection,

Organic and ceramic materials-Introduction,classification of rubber:natural and synthetic rubber,Plastic-thermosetting and thermoplastic with examples-requirements of plastic and elastimers and their uses.Classification of ceramics-properties and uses-glass building stone,refractory materials,abrasive-materials,concrete

3.Basic Mechanical Engineering

Fundamentals of I.C.Engines

Definition,Classification,Two stroke engines,Two stroke petrol engines,Four stroke engines,Four stroke diesel engines(construction and working using simple line sketches),Four stroke petrol engines,Functions of different parts of I.C.Engines(No sketch required),Comparison between-Two stroke and four stroke engines,Petrol and diesel engines,Testing of IC engines-determination of indicated power-brake power-mechanical efficiency-indicated thermal efficiency brake thermal efficiency-specifc fuel consumption-heat balance sheet.

Air Standard Cycles

Assumption,Air standard efficiency Brief explanation with P.V.diagrams and derivation with P.V.diagrams and derivation of air standard efficiency of Carnot Cycle,Otto cycle,Diesel cycle,Joule cycle,Brief explanation of dual combustion cycle with P.V.diagram(No derivation of air standard efficiency),Simple and direct problems using standard expressions.

Air Compressors

a.Introduction Function of air compressors-uses of compressed air .Classification of compressors.Working of reciprocating(single stage and two stage)compressors,Rotary compressors(fans,blowers),centrifugal compressors and axial flow compressors P-V diagram of single stage and two stage compressors-derivation of work done-power required to drive the compressor(simple problems)-inter coolers-advantages of multistage compressors.Efficiencies of air compressor-mechanical efficiency,isothermal efficiency,isentropic efficiency,volumetric efficiency,derivation of volumetric efficiency in terms of clearance volume and stroke volume,effect of clearance on volumetric efficiency

Modes of heat transfer-conduction,convection and radiation.Fields of applications of heat transfer.Thermal conduction,Fourier's law of thermal conduction,thermal conductivity,conduction through a plane wall,simple problems.Thermal radiation-Reflection,absorption,and transmission of radiation,absorptivity,reflectivity and transmissivity.Convept of black body.

Stefan's Boltzman's law of total radiation,concept of grey body,Thermal convection-Newton-Rikhman-equation Q=hAt,Free convection,forced convection.

Heat exchangers-Function of heat exchangers,types of heat exchangers-Recuperator type and regenerative type,parallel flow,counter flow and cross flow.Concept of Logarithmic mean temperature difference(LMTD)and AMTD.LMTD for parallel flow and counter flow heat exchangers(no derivation).Simple problems to calculate heat transfer by LMTD method.

Types of Fuels-its value in engineering-classification of fuels-soild fuels-liquid fuels-gaseous fuels requirements of a good fuel.Calorific value of fuels-Gross or higher calorific value –net calorific value-(simple problems)Determination of calorific values-bomb calorimeter-Gas calorimeter.Combustion of fuels-Atomic theory-structure-Combustion equation of solid fuels-Minimum mass of air required for combustion-Mass of carbon in flue gases-Mass of flue gas per kg of fuel burnt-Flue gas analysis-Orsat apparatus

PART –II

Basic Civil Engineering

1.Building Materials and Construction-Stone-Classification-geological,Physical and chemical classification-characteristics of good building stone-varieties of stones-granite-trap-basalt-sand stone-Laterite.Values of load bearing capacity of stones.Quarrying of stones-methods-wedging and blasting-explosives used.Dressing of stones.

Bricks: Raw materials used-Composition of brick earth,manufacturing methods(Description only)-IS specification of bricks-characteristics of good brick used for building purpose.Tiles:Types of tiles characteristics-uses-Porcelain and glazed tiles Earthenware and stoneware pipes-uses-qualities.

Lime: Sources of lime-Classification –methods of manufacturing(Description only)Cements:Composition,Compounds present,Manufacturing methods-characteristics of cement,Types of cement-Properties of

each-characteristics of cement-Tests on cement-Consistency test,fineness test,Sp.gravity test,Setting time test,Soundness test.

Sand: Sources of sand-River sand,Sea sand and pit sand-Limitations of mining of sand from rivers and sea shore-M-sand,alternatives of sand.

Mortar: Preparation of lime and cement mortar-Proportions of mortar for various items of work-tests on cement mortar

Cement Concrete: Plain concrete-Water cement ratio-Ingredients and proportioning methods characteristics-preparation-workability-Tests on Cement concrete-Laboratory tests and field tests-Slump test,compaction factor test-Qualities of water used for mixing.Reinforced cement concrete

Timber and wood products:

Structural classification-Soft wood and hard wood –defects in timberseasoning of timber-preservation of timber-wood products-veneers,ply wood,particle boardfibre-board,hard board,etc.

Metals: Ferrous metals-Wrought iron,Cast iron,Mild steel-Special steels-High carbon steel,High tensile steel and stainless steel(Properties and uses only)-Non ferrous metals:Aluminium,Copper,Lead,Zinc and Titanium-imporant alloys-properties and uses.

Paints and Varnishes:

Types-Constituents-Preparation-Characteristics and application.

Plastics:types-characteristics and properties of P V C-uses-Limitations of using plastics.Rubber:Characteristics and properties,uses

Component parts of a building and their functions-

Masonry:Classification-Stone masonry-Brick masonry-Laterite masonry-composite masonry.Different types of stone masonry-General principles and specifications for stone masonry as per relevant codes.

Brick masonry: Different types of bonds for walls,piers and junctions of walls for equal and unequal thickness-English,Flemish(Single and Double Flemish)-Specification for brick masonry as per relevant codes.Hollow block masonry:

Types of hollow blocks used in construction and methods of construction-Advantages and Disadvantages with reference to other types of masonry.Solid block masonry and inter locking block masonry.Partition walls-Types-materials-requirements.

Mechanic of Materials

Stress and strain-types of stresses-Elasticity-Hook's law-Young's modulus-stresses and strains in uniform sections of same and composite materials Mechanical properties of materials-Elasticity,stiffness,plasticity,toughness,brittleness,ductility,malleability and hardness-Tensile test on ductile material(Mild steel bar)and stress strain curve-compression test on brittle material(cement concrete)and stress strain curve-limit of proportionality,elastic limit,yield point-ultimate stress-breaking stress working stress and factor of safety.Temperature stresses-elongation and contraction due to temperature change-temperature stress when deformation is fully or partially prevented-temperature stress in composite sections Linear strain and lateral strain-poisson's ratio-volumetric strain-volumetric strain of a bar subjected to normal forces on its faces-Bulk modulus-modulus of rigidity-relationship between elastic constants

Beams,Columns and Struts

Classification of beams-cantilever,simply supported,fixed,overhanging and continuous types of loading-concentrated,uniformly distributed and uniformly varying Shear force and bending moment-definition and sign conventions.Calculation of SF and BM for cantilever,Simply supported and overhanging beams and sketching of SF and BM diagrams(for point

load,u.d.load,uniformly varying load ,and combinations of u.d.and point loads) Relation between SF and BM.Maximum BM-point of contra flexure.

Columns-definitions-effect of axial load on columns-column,strut,slenderness ratio,buckling factor,buckling load or crippling load,safe load-types of columns-short column,medium size column,long column-Euler's equations and its assumption for crippling load for different End conditions-both end hinged-one end is fixed and other is free,one end is fixed and other is hanged,both ends fixed-limitation of Euler's equation-equivalent length-Rankin's formulae Strut,column-failure of strut,short and long columns-types of end conditions Euler's formula for columns of different end conditions-slenderness ratio-limitations of Euler's formula-applications.

Riveted and Welded joints

'Types –lap,butt,single cover,double cover,single,double,multiple,chain,zigzag,diamond-empirical proportions-diameter of rivet,plate thickness,margin,pitch-rivet materials.

Types of failure-rivets-by crushing and shearing-failure of plate by tearing-strength and efficiency of joints-design of joints-lap and butt,single and double riveted,single and double cover joint-caulking and filtering operations.Types of failures two troughs,two cylinders,hoop stress-longitudinal stress-calculation of thickness and pressure

Springs:Introduction-stiffness of a spring-types of spring-leaf spring-helical springs-closely coiled and open coiled helical spring with round wire-properties of spring materials-closely-coiled helical springs-subjected to an axial load,an axial twist-stress induced-length-number of turns pitch deflection-stiffness-diameter Torsional shear stress-torsional stress and strains-polar moment of inerta.

Introduction to Computers & Word Processing

Introduction,application of computers,generations of computers,classification of computers-analog,digital,hybrid Computers,Structure of computer-Hardware and Software components.

Input unit,Output Unit,ALU,Memory Unit,Control Unit,CPU,Microprocessor,micro,mini,supercomputers-machine languages,assembly languages,high level languages-system software,application software-assembler,compiler,operating system-Types of memory-primary memory,secondary memory,sequential access,random access memory,RAM,ROM-magnetic tape,floppy,hard disc,compact disc-input devices,out put devices.