

Technical College / Al-Najaf
Department : Building & Construction Technology Engineering

Subject : Systematic Training

Class : Second year

| Week | Syllabus |
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| 8 weeks | Practical training in building & construction engineering (site work) . |

Technical College / Al-Najaf
Department : Building & Construction Technology Engineering

Subject : Building Construction

Class : Second year

Hours : 2hrs (Theoretical) , 2hrs (Practical)

Objectives :

In this subject the student will learn ;Soil investigation and soil bearing capacity , foundation types , building of walls by many masonry types (brick , stone , block ,) , forms types and scaffoldings , beams and columns , roofs and floor constructions , thermal and acoustical isolations, damp proofing , finishing works .

| Week | Syllabus |
|-------------|--|
| 1 | Site investigation , phases of site and soil investigation . |
| 2 | Methods of soil investigation , open-pit , boring and auger , standard and cone test methods . |
| 3 | Bearing capacity , calculation and determination in filed and laboratory , increasing of bearing capacity and its relation with foundation design . |
| 4 | Excavation and filling work , cut and fill , shoring system , angle of repose ,failure of embankment , layers of filling . |

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| 5&6 | Types of foundations , excavation , shoring system , reinforcing and concrete casting , drying of site work . |
| 7 | Pile foundations ,bored and driven piles , sheet piles , capping of piles. |
| 8 | Masonry stone work , stone building types and specifications , building under ground level , above ground level , preparation of stone building . |
| 9 | Brick and block works ,British and Flemish arrangements , procedure to construct walls, connections between old and new walls . |
| 10 | Hollow cavity walls , their specifications and components , reinforced walls. |
| 11 | Thermal insulation materials , specification and types ,thermal transmittance factor , resistance concept . |
| 12 | Acoustical insulation and fire resistance for building |
| 13 | Concrete Forms, timber forms(specification and components), bracing for roofs and columns . |
| 14 | Slip and travel forms , components and operation . |
| 15 | Scaffolding ,types ,components ,uses . |
| 16 | Columns classification , reinforcement , shape of their failures ,spiral reinforcement . |
| 17&18 | Beams ,types ,timber ,steel , and concert beams pre-cast pre- stress beams. |
| 19 | Floors and roofs , timber , jack arching |
| 20 | Concrete floors and roofs , one way , two way ,and ribbed slabs , composite , cellular , arch and shell roofs. |
| 21 | Lift slab system and space frame roofing . |
| 22 | Damp proofing materials , application and treatment of roofs , basement and walls . |
| 23 | Floor finishing , tiles and ceramics |
| 24 | Inner wall finishing by Gypsum , paints ,and Gypsum board . |
| 25 | External wall finishing by cement mortars , stone tiles and painting . |
| 26 | Modern finishing materials , specification , benefits and application system . |
| 27 | Doors and windows and upstairs rails . |
| 28 | Type of maintenances , preservation and periodical maintenances . |

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| 29 | Type of failure in building , causes and measures. |
| 30 | Treatment of building failures , special materials uses for treatment. |

References :

1. Handbook of building construction 2006
2. Building design and construction handbook 2001
3. انشاء المباني / زهير زاكو
4. Internet's references

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Computer Applications (1)

Class: Second Year

Hours : 1hrs (Theoretical) , 2hrs (Practical)

Objectives:

The student must know the use of engineering software programs related to its rules and theories has been taught to student previously.

| Week | Syllabus |
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| 1 | Introduction to Surfer v.10. |
| 2&3 | Review theories and formulas using in surveying. |
| 4&5&6 | Explain of Surfer program interface and use the program to draw the contour lines in limited area. |
| 7&8&9 | Explain of icons and description of input data. |
| 10 | Discussion of the program results based on input data. |
| 11&12 | Examples and assignments with discuss the procedure of input and output data. |
| 13&14&15 | Using the program to find the amount volumes of cut and |

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| | fill for any construction based on the design level proposed earlier, theories, procedure and examples. |
| 16&17 | Introduction to Prokon v.2.4. |
| 18&19 | Review theories and formulas using in drawing of shear and moment diagrams. |
| 20&21&22 | Explain of Prokon program interface and use the program to draw the diagrams of shear and moments and analysis of beam. |
| 23&24&25 | Explain of icons and description of input data. |
| 26 | Discussion of the program results based on input data. |
| 27&28 | Examples and assignments with discuss the procedure of input and output data. |
| 29&30 | Using the program to find the results of many problems in behavior of beams and columns and problems of strength of materials, theories, procedure and examples. |

References:

- 1- Crane, R. (1997) *A Simplified Approach to Image Processing: Classical and Modern Techniques in C*, Prentice Hall PTR, Upper Saddle River, NJ, 317 pp. ISBN: 0-13-226416-1.
- 2- Pitas, I. (2000) *Digital Image Processing Algorithms and Applications*, John Wiley and Sons, New York, 419 pp. ISBN: 0-471-37739-2.
- 3- Prokon, Ltd. 2005. User Manual, Version 2.1, (attached to software CD).
- 4- Golden Software, Inc. 2009. User Manual, Version 10, CO 80401-1866, USA.

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Concrete Technology (1)

Class : Second year

Hours : 2hrs (Theoretical), 2hrs (Practical)

Objectives :

The student must learn the physical , mechanical , & chemical characteristics of the main components used in concrete , as well as accomplishing all the related laboratories tests . The student will learn also the characteristics of the fresh concrete & the admixtures of concrete .

| Week | Theoretical Syllabus |
|--|---|
| 1 | Composition of concrete; Functions of the paste and aggregate ; General properties of ordinary concretes . |
| 2 | Concrete – making materials – Portland Cement ; basic constitutes of cement ; Chemical formulas and processes . |
| 3&4 | Manufacture of Portland cement ; Chemical analysis of Portland cement ; major compounds in Portland Cement; Influence of composition upon characteristics of Portland cement . |
| 5&6&7 | Properties of Portland cement : Fineness of cement ; Consistency of cement paste ; Hydration reactions in cement paste ; Hydration of cement ; heat of Hydration ; setting and hardening of cement : time of setting , soundness of cement , strength of cement paste , loss of ignition . |
| 8&9&10&11 | Types of Portland cement : Ordinary ; Modified ; Rapid hardening ; low heat ; Sulphate resisting . Other types : High–early strength ;Pozzolana–cement and pozzolanas;Slag cement ; Blast – Furnas - slag ; Masonry cement ; Expansive cement ; Aluminous cement ; White Portland ; Fly – ash ; Anti – bacterial ; Hydrophobic cement ; Waterproof cement ; Natural cement . |
| 12&13 &14&15&16 &17&18&19 | CONCRETE AGGREGATES : Preliminary remarks ; general characteristics ; data needed for proportioning mixtures ; sampling aggregate; particle shape and texture ; bond of aggregates ; specific gravity ;unit weight and voids ; porosity and absorption, moisture content ; Gradation ; sieve analysis ; maximum size of aggregates ; fineness modulus , practical grading ; gap – graded |

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| | aggregates; oversize and undersize ; all – in aggregates ; bulking of sand ; soundness of aggregates ; handling and storing aggregates ; Deleterious substances : organic impurities ; alkali – aggregates reaction ; alkali – carbonate reaction ; thermal properties of aggregates . |
| 20 | WATER : Mixing water ; Curing water . |
| 21&22 & 23&24 | ADMIXTURES : Accelerators : Retarders ; Water – Reducing Admixture; super plasticizers ;Workability admixtures ; Air –entraining Admixtures ; Expansion –producing Admixtures; Pozzolan materials ;Bonding admixtures; Curing aids ; Water Proofers ; Colouring agents ; Surface hardeners . |
| 25&26 & 27&28 & 29&30 | FRESH CONCRETE : Introduction ; Properties of fresh concrete :(Workability; Consistency ; Segregation ; Bleeding ; Unit weight) . Measurement of workability and Consistency . Factors affecting workability . Air – Entrainment ; Measurement of Entrained – Air : (Volumetric ; Gravimetric and Pressure methods) Unit weight ; yield ; Cement factor . Manufacture of concrete: Batching; Mixing ; Conveying ; Placing ; Compacting ; and Curing of concrete . |

References:

1. "Properties of Concrete ", A.M.NEVILLE, 3 rd. Ed. , A pitman International Text. (1981) .
2. "Composition and properties of Concrete ", TROXELL , AVIS , and KELLY , Mc Graw - Hill book Company (1968) .
3. D.F. ORCHARD, "Concrete Technology", Vol. 1,2&3, (1978) .
4. ASTM , BRITISH , and IRAQI specifications for concrete works .
5. د.احمد علي العريان و د. عبد الكريم محمد عطا " تكنولوجيا الخرسانة : مواد الخرسانة المسلحة وصناعتها" ، الجزء الاول ، الطبعة الثانية ، عالم الكتب (١٩٧٥) .
6. د. كنانة محمد ثابت و د.رياض حامد الدباغ ويوسف عمرو " مبادئ الجيولوجيا الهندسية " ، جامعة الموصل (١٩٧٩) .

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Concrete Technology (1)

Class : Second year

Hours : 2hrs (Theoretical), 2hrs (Practical)

Objectives :

The student must learn the physical , mechanical , & chemical characteristics of the main components used in concrete , as well as

| Week | Practical Syllabus |
|---|--|
| 1 | General information about different types of balances , specifications and experiment reports . |
| 2&3& 4&5& 6&7&8 | CEMENT TESTS : Consistency of Cement paste . Initial and final setting times of cement paste . Compressive Strength of cement mortar . Tensile Strength of cement mortar . Soundness of cement (by Autoclave &Le – chatelier method) . Fineness of cement (blain method and by sieving) . Loss of ignition . Scientific visit . |
| 9&10& 11&12& 13&14& 15&16& 17&18 | AGGREGATE TESTS : Sampling of coarse and fine aggregate . Unit weight and voids of coarse aggregate . Unit weight and voids of fine aggregate . Sieve analysis of coarse aggregate . Sieve analysis of fine aggregate . Specific gravity and absorption for coarse aggregate . Specific gravity and absorption for fine aggregate . Bulking of sand . Moisture content in coarse and fine aggregate . Los –Angeles abrasion test for coarse aggregate . Materials finer than sieve No. 200 in coarse and fine aggregate . Salt and sulphate content in fine aggregate . Organic material content in fine aggregate . Chloride ion content . |
| 19 | Mixing water tests (Sulphates ; Chlorides ; Organic materials ... etc) |
| 20&21& 22&٢٣ &٢٤ | Tests related with admixtures and their effects on fresh and hardened concretes . |

accomplishing all the related laboratories tests . The student will

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| 25&26& 27&28& 29&30 | FRESH – CONCRETE TESTS : Measurement of Workability and Consistency : (Slump test ; Compacting Factor test ; Remoulding test ; Vebe test ; Flow test ; Ball –penetration test). Bleeding test ; Unit weight and Air – content tests . |
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learn also the characteristics of the fresh concrete & the admixtures of concrete .

References:

7. "Properties of Concrete " , A.M.NEVILLE, 3 rd. Ed. , A pitman International Text. (1981) .
8. "Composition and properties of Concrete " , TROXELL , DAVIS , and KELLY , Mc Graw - Hill book Company (1968) .
9. D.F. ORCHARD, "Concrete Technology", Vol. 1,2&3, (1978) .
10. ASTM , BRITISH , and IRAQI specifications for concrete works .
11. د.احمد علي العريان و د. عبد الكريم محمد عطا " تكنولوجيا الخرسانة : مواد الخرسانة المسلحة وصناعتها" ، الجزء الاول ، الطبعة الثانية ، عالم الكتب (١٩٧٥) .
12. د. كنانة محمد ثابت و د.رياض حامد الدباغ ويوسف عمرو "مبادئ الجيولوجيا الهندسية " ، جامعة الموصل (١٩٧٩) .

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Technology of Construction Materials Industry

Class : Second year

Hours : 2hrs (Theoretical)

Objectives :

The student must know the industry & production operation for almost materials used in construction , materials employed in production , choosing site of factory planning , & productivity .

| Week | Syllabus |
|------------------|--|
| 1 | Factory , Factors affecting choose site , Planning device & equipment. |
| 2&3 | Production & industry operations for several types of clay bricks. |
| 4 | Production of sand-lime brick. |
| 5 | Concrete brick & block. |
| 6 | Production of cellular concrete block. |
| 7&8 | Manufacturing of gypsum (Ordinary gypsum , Plaster of Paris , Keen's cement). |
| 9 | Lime production. |
| 10&11 | Manufacturing of ordinary & Terrazzo tiles , Concrete tiles. |
| 12 | Ceramic tile & veneer. |
| 13&14 | Production of floor structural clay tile , Backed brick. |
| 15&16 | Production of bituminous materials. |
| 17 | Manufacturing of epoxy. |
| 18&19 | Production of ferrous metals (steel). |
| 20&21 | Production of non-ferrous metals (aluminum , copper , etc.,.....). |
| 22&23 | Production of pipes with several materials. |
| 24&25 | Industrialized wood , Production. |
| 26&27 | Manufacturing of paints. |
| 28 | Production of glass. |
| 29 | Manufacturing of plastics. |
| 30 | Building papers production. |

References :

- 1- Building Construction Metric Volume / J.K. McKay .
- 2- Materials of Construction / R.C. Smith .
- 3- Chemical Process Industries / R. Norris Shreve .
- 4- Construction Materials & Processes / Dor. A. Wacton .
- 5- Pipind Handbook / Crocker & King.
- 6- Metals Production / ASME Handbook.
- 7- Manufacturing Processes / B.H. Amstead.

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject: Advanced Mathematics

Class: Second year

Hours : 2 hrs (Theoretical) , 2hrs (Practical)

Objectives :

The student must know the advanced theories in mathematics needed in construction engineering .

| Week | Syllabus |
|-------|---|
| 1&2 | Multiple integrals ,double integrals , area by double integration , triple integrals , volume by double and triple integrations. |
| 3&4 | Polar coordinates , curves by polar coordinates ,area by polar double integrations , cylindrical and spherical coordinates, equations of solids |
| 5&6&7 | Ordinary differential equations of first order ,separable , homogeneous , exact and not exact , linear and Bernoulli first order equations , general and condition solutions , applications |
| 8&9 | Linear differential equations with constant coefficients, homogeneous and non-homogeneous equations , equation of higher order , general and condition solutions , applications. |
| 10&11 | Partial derivatives with two and more two variables , higher- order partial derivatives , chain rule for partial derivatives , maxima & minima of function of two |

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| | variables , saddle point and relative extrema. |
| 12&13 | Vector analysis , dot and cross product of vector functions , velocity and acceleration ,gradient of vector fields,divergance and curl of vector fields . |
| 14&15 | Equations of the lines and surfaces in space , intersection of lines and surfaces using vectors , lagrange multipliers with two and more constraints. |
| 16&17 | Complex numbers and functions , demoivres theorem, roots ,argand diagram, cauchy – rehmann equations. |
| 18&19 | Limits , Infinite sequences , convergence and divergence , infinite series , geometric and ordinary series , positive and alternative series , test of convergences |
| 20&21 | Power series , maclaurin series taylor and trigonometric series . |
| 22&23 | Fourier series for periodic function , euler coefficients , applications |
| 24&25 | Green's theorem for enclosed curves , line integral |
| 26&27&28 | Matrices , Adjoins & inverses , solving linear equations using the inverse of matrix , determinants and cramer method to solve linear equations , Gaussian elimination and gauss-seidel elimination. |
| 29&30 | Improper integration and Laplace transform of some common functions , properties of Laplace transform. |

References:

1. Advanced Engineering Mathematics /C. Ray Wylie
2. Engineering mathematics / G. S . Sharma &I . J. S . Sarna
3. Applied Mathematics for Engineers & physicists / Pipes & Harvill .

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Applied Surveying

Class : Second Year

Hours : 2hrs (Theoretical) , 3hrs (Practical)

Objectives:

Introducing the fundamentals, purposes & the required calculations of the applied surveying to the students as well as qualifying him to use the different kinds of surveying instruments in design & execution of civil engineering projects.

| Week | Practical syllabus |
|-------------------------|--|
| 1&2 | Measuring horizontal & vertical angles by using different kinds of theodolites. |
| 3&4 | Construct close connected & close circle traverses to survey small area. |
| 5&6&7 | Computations of the coordinates of stations traverse & plotting a traverse , Problems in inverse computation. |
| 8&9 | Measuring H. distances & vertical distances by using tachometer , By using theodolite with sub tense-bar. |
| 10&11 | Measuring slope , Horizontal & vertical distances by using EDM instrument. |
| 12&13 | Measuring area by using total station , Solve problems , Standard deviation. |
| 14&15 | Setting out curves & calculation , Curves field work surveying. |
| 16&17 | Setting out small building & roadway. |
| 18 | Practical problems in tunnel surveying. |
| 19&20 | Practical problems in hydrographic surveying. |
| 21&22&23 | Applying exercises in computer lab. |
| 24&25 | Basic measurements of photograph using pocket stereoscope , Using mirror stereoscope. |
| 26&27 | Applying measuring on Arial photographs by using plotters such as Wild B8S & Wild ALO autograph. |
| 28&29&30 | Field measurements or lab calculation for certain project. |

References :

- 1- Surveying for construction / William Irvine , FRICS.**
- 2- Text book of surveying / S.K. Husain , M.S. Naga. Raj.**
- 3- Elements of photogrammetry / Wolf , Pual R.**

- 4- المساحة المستوية / د . فوزي الخالصي
- 5- المساحة المستوية والمائية / د . علي شكري

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject : Applied Surveying

Class : Second Year

Hours : 2hrs (Theoretical) , 3hrs (Practical)

Objectives:

Introducing the fundamentals, purposes & the required calculations of the applied surveying to the students as well as qualifying him to use the different kinds of surveying instruments in design & execution of civil engineering projects.

| Week | Theoretical syllabus |
|------------------|---|
| 1 | Theodolites , Principle of construction |
| 2 | Measuring Horizontal angles |
| 3 | Measuring angles in vertical plane |
| 4&5 | Directions , Whole circle bearing , Reduce Bearing |
| 6 | Traverse Surveys , Bearings , forward & Back bearing |
| 7 | Close circle traverse, coordinates calculations |
| 8 | Close connected traverse , coordinates calculations |
| 9 | Tacheometry , stadia tacheometry , Inclined sights |
| 10 | Electromagnetic distance measurement(EDM), basic concept, systems |
| 11 | Total station, Field Techniques, point location, missing line measurements |
| 12 | Resection , Azimuth, elevation , Layout Positions and area computation |
| 13 | Motorized Total stations, Automatic ,remote control, computerized |
| 14&15 | Horizontal Curves , Kinds , computations |
| 16&17 | Vertical Curves , Kinds , Computations |
| 18 | Setting out construction , small & large building |
| 19 | Balancing thermal furnaces |

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| 20 | Tunnel surveying |
| 21 | Aerial photogrammetric surveying |
| 22 | Photogrammetric traditional surveying |
| 23 | Photogrammetric Instruments & Flight design |
| 24 | Computer Programs |
| 25&26 | Global Positioning System (GPS) |
| 27 | Geographic Information system (GIS) |
| 28&29&30 | Field measurements by using total station and calculation for certain projects |

References :

- 6- Surveying for construction / William Irvine , FRICS.
- 7- Text book of surveying / S.K. Husain , M.S. Naga. Raj.
- 8- Elements of photogrammetry / Wolf , Pual R.
- 9- المساحة المستوية / د . فوزي الخالصي
- 10- المساحة المستوية والمائية / د . علي شكري

Technical College / Al-Najaf

Department : Building & Construction Technology Engineering

Subject: Strength of Materials

Class: Second year

Hours: 2 hrs

(Theoretical) , 2 hrs (Practical)

Objectives:

The student must know the relations between externally applied loads and their internal effects on bodies (Strains, Deformations , and Stresses).

| Week | Syllabus |
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| 1&2&3 | Simple stress: Analysis of internal forces , Simple stress , Shearing stress , Bearing stress. |
| 4&5&6 | Riveted & Welded Connections: |

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| | Types of riveted joints , Strength of a simple lap joint , Structural riveted joints , Welded constructions. |
| 7&8&9&10 | Simple Strain: Stress-strain diagram , Hooke's law , Axial axial -deformation , Poisson's ratio , Biaxial & Tri deformations , Statically indeterminate members , Thermal stresses. |
| 11& 12 | Torsion: Derivation of torsion formulas , Longitudinal shearing stress , Shear flow. |
| 13&14&15 | Shear and Moment in Beams: Shear & moment , Shear & moment diagrams , Relations between load ; shear & moment. |
| 16&17&18&19 | Stresses in Beams: Derivation of flexure formulas , Economic sections , Unsymmetrical beams , Analysis of flexure action , Formula for horizontal shear stress. |
| 20&21&22&23 | Beams Deflections: Theorem of area-moment method , Double integration method. |
| 24&25&26&27 | Combined Stresses: Combined axial & flexural loads , Kern of a section , Loads applied off axes of symmetry , Stress at a point , Mohr's circle , Transformation of strain components. |
| 28&29&30 | Columns: Critical loads , Long columns by Euler's formula , Intermediate columns , Empirical formulas. |

References:

- 1. Strength of Materials / Ferdinand L. Singer & Andrew Pytel.**
- 2. Strength of Materials / R. S. Khurmi.**
- 3. Solution of Problems in Strength of Materials and Mechanics of Solids / S. A. Urry & P.J. Turner.**

Technical College / Al-Najaf

Department: Building & Construction Technology Engineering

Subject: Fluid Mechanics

Class: Second Year

Hours: 1 hour (Theoretical) , 2Hours (Practical)

Objectives:

This subject will introduce fluid mechanics and establish its relevance in civil engineering. Develop the fundamental principles underlying the subject. Demonstrate how these are used for the design the pipe network and related apparatus and the simple hydraulic components.

| Week | Practical Syllabus |
|--------------|--|
| 1 | General looking for the instruments in the fluid laboratory ; How to write the practical report. |
| 2-7 | Properties of fluid; a- density measurement b- viscosity measurement c- surface tension d- capillarity |
| 8-10 | Pressure measurement devices ; a- barometers b- Manometers; 1.piezometers, 2.open U-tube manometer, 3.inclined manometer, 4. Differential manometer. c- Balancing of the force; 1.piston type, 2.bell type, 3.ring type. d- Borden gauge. |
| 11-12 | Calibration of pressure gauges |
| 13-14 | Center of pressure of submerged surface in liquid |
| 15-17 | Hydrostatic forces on submerged surfaces; a- hydrostatic force on a horizontal plane b- hydrostatic force on a vertical plane c- hydrostatic force on inclined plane. |
| 18-20 | Flow measurements; a- Pitot-Static tube b- Venture meter c- orifice meter |
| 21-23 | Reynolds number and type of flow; Laminar flow, Turbulent flow. |
| | Losses in pipes; |

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| 24--30 | a- Major losses in pipes (frictional losses) b- Minor losses in pipes (elbows and valves). |
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References :

1. Douglas, J.F. et al; 2011 (Fluid Mechanics). Prentice Hall.
2. Durgaiyah D. R.; 2002 (Fluid Mechanics and Machinery). New Age international publishers.
3. White, F. M.; 1994 (Fluid Mechanics).3rd ed. McGraw-Hill, New York.
4. Khurmi, R.S.; 1994 (Hydraulics, Fluid Mechanics and Hydraulic Machines). S. Chand and Co. Ltd.

Technical College / Al-Najaf

Department: Building &Construction Technology Engineering

Subject: Fluid Mechanics

Class: Second Year

Hours: 1 hour (Theoretical) , 2Hours (Practical)

Objectives:

This subject will introduce fluid mechanics and establish its relevance in civil engineering. Develop the fundamental principles underlying the subject. Demonstrate how these are used for the design the pipe network and related apparatus and the simple hydraulic components.

| Week | Theoretical Syllabus |
|-------------|---|
| 1 | SI Units, dimensions , symbols , abbreviations |
| 2-3 | Development of fluid mechanics, properties of fluids; density, specific weight, viscosity, compressibility, surface tension, capillarity etc. Characteristics of flow; discharge, velocity, pressure, shear etc. |
| 4-5 | Fluid static's; absolute and gauge pressure, pressure measurement; Bourdon gauge, piezometer column, |

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| | simple manometer, differential manometers. Hydrostatic forces on plane and curved surfaces, center of pressure. |
| 6-7 | Kinematics of fluid flow; classification of types of flow; streamlines, stream tube, path lines, flow net; continuity equation. |
| 8-10 | Energy equation for steady flow; potential, kinetic and flow energy; hydraulic grade line and energy line; cavitations; power; solution of flow problems; jet trajectory. |
| 11- 13 | Momentum in fluid flow; impulse momentum principle; momentum correction factor ; forces on pressure conduits ; forces on stationary blades ; forces on moving blades ;jet reaction ; application of momentum equation to fluid flow problems . |
| 14 -16 | Steady flow in pressure conduits ; laminar and turbulent flow; critical flow ; general equation for conduit friction ;friction for laminar flow ; friction for turbulent flow ; pipe roughness ; friction factor charts ; empirical equations for pipe flow; economical diameter of pipes. |
| 17-18 | Minor head losses; loss at entrance, losses due to contraction; losses due to expansion ; loss in pipe fittings ; loss in bend and elbows, etc . |
| 19-20 | Solution of practical pipeline problems; pipeline with pumps. |
| 21-22 | Equivalent pipes; branching pipes; pipes in series; pipes in parallel. Hazen- Williams's formula. |
| 23-24 | Pipe networks; Hardy cross method; computer aided pipe - network analysis. |
| 25-26 | Fluid measurements ; measurement of fluid properties ; measurement of static pressure ; velocity measurement by different methods ; measurements of discharge ; nozzles ; coefficients of contraction ; coefficients of velocity; coefficients of discharge; Venture tube ;nozzle meter ; elbow meter; rote meter. |
| 27-28 | Hydraulic similitude; geometric similarity; kinematics similarity ; dynamic similarity; Reynolds number , Froude number , Mach number , Weber number, Euler number; scale ratios ; models ; dimensional analysis . |
| 29- 30 | Unsteady flow problems; discharge with varying head. Unsteady flow in pipes. Water hammer. Surge tanks. |

References :

- 1. Douglas, J.F. et al; 2011 (Fluid Mechanics). Prentice Hall.**
- 2. Durgaiah D. R.; 2002 (Fluid Mechanics and Machinery). New Age international publishers.**
- 3. White, F. M.; 1994 (Fluid Mechanics).3rd ed. McGraw-Hill, New York.**
- 4. Khurmi, R.S.; 1994 (Hydraulics, Fluid Mechanics and Hydraulic Machines). S. Chand and Co. Ltd.**