DR. A.P.J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. SECOND YEAR

(ENVIRONMENTAL ENGINEERING)

(Effective from session 2019-20)

B.Tech. (ENVIRONMRNTAL ENGINEERING) SESSION 2019-20

SEMESTER – III

S.No	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031-38/KAS303	Engineering Science Course/ Maths III	3	1	0	30	20	50		100		150	4
2	KAS301/ KVE301	Technical Communication/ Universal Human Values	2 3	1 0	0 0	30	20	50		100		150	3
3	KCE301	Engg. Mechanics	3	1	0	30	20	50		100		150	4
4	KNE301	Environmental Chemistry & Microbiology	3	1	0	30	20	50		100		150	4
5	KCE303	Fluid Mechanics	3	0	0	30	20	50		100		150	3
6	KNE351	Environmental Sampling and Analysis Lab	0	0	2				25		25	50	1
7	KNE352	Microbiology Lab	0	0	2				25		25	50	1
8	KCE353	Fluid Mechanics Lab	0	0	2				25		25	50	1
9	KNE354	Mini Project or Internship Assessment*	0	0	2			50				50	1
10	KNC301/ KNC302	Computer System Security/ Python Programming	2	0	2	15	10	25		50			0
11		MOOCs (Essential for Hons. Degree)											
		Total										950	22

*The Mini Project or Internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

SEMESTER - IV

S.No	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS403/ KOE041-48	Maths III/ Engg. Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS401	Universal Human Values/ Technical Communication	3 2	0 1	0 0	30	20	50		100		150	3
3	KCE401	Materials, Testing & Construction Practices	3	0	0	30	20	50		100		150	3
4	KNE401	Geoinformatics	3	1	0	30	20	50		100		150	4
5	KNE402	Water Supply and Treatment Engineering	3	1	0	30	20	50		100		150	4
6	KNE451	Geoinformatics Lab	0	0	2				25		25	50	1
7	KNE452	Water Supply & Treatment Lab	0	0	2				25		25	50	1
8	KCE451	Material Testing Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming/Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										900	21

Semester-III

Engineering Mechanics (L-T-P 3-1-0) Credit – 4

Course Outcomes: At the end of this course the student will be able to-

1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of mathematics and physics to solve real-world problems.
4. Understand basic dynamics concepts – force, momentum, work and energy;
5. Understand and be able to apply Newton's laws of motion;

UNIT - I Introduction to Engineering Mechanics*:* Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant-Moment of Forces and its Applications; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems.

Friction*:* Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; [8 Hours]

UNIT- II Centroid and Centre of Gravity*,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. [8 Hours]

UNIT - III Basic Structural Analysis*,* Equilibrium in three dimensions; Analysis of simple trusses by method of sections & method of joints, Zero force members, Simple beams and support reactions. [8 Hours]

UNIT - IV Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). [8 Hours]

UNIT - V Introduction to Kinetics of Rigid Bodies*,* Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, Applications of energy method for equilibrium, Stability of equilibrium. [8 Hours]

Books and References

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall

2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press

5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,

6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics

8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications

9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

11. Strength of Materials by Timoshenko and Yσungs, East West Press.

12. Textbook of Applied Mechanics-Dynamics and Statics by Prasad I.B, Khanna Publications.

Fluid Mechanics (L-T-P 3-1-0) Credit – 4

Course Outcomes: At the end of this course the student will be able to-

1. Understand the broad principles of fluid statics, kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Apply the continuity, momentum and energy principles
5. Apply dimensional analysis

UNIT I Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. [8 Hours]

UNIT II Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, path lines, streak lines, stream tube, continuity equation for 1-D, 2-D and 3-D flows, circulation, stream function and velocity potential function. [8 Hours]

UNIT III Potential Flow: source, sink, doublet and half-body. Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks. [8 Hours]

UNIT IV Equation of motion for laminar flow through pipes, Stokes' law, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary

layer thickness, boundary layer over a flat plate, displacement, momentum and energy thickness. Application of momentum equation. Laminar boundary layer, turbulent boundary layer, laminar sub-layer, separation and its control. Vortex Flow: Free & Forced. [8 Hours]

UNIT V Drag and lift, drag on a sphere, aerofoil, Magnus effect, Similarity Laws; geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance. Introduction to Computational Fluid Dynamics (CFD). [8 Hours]

Books and References

1. Hibbler, "Fluid Mechanics in SI Units" 1/e Pearson Education, Noida.
2. Fox & Donald, "Introduction to Fluid Mechanics" John Wiley &Sons Pvt Ltd,
3. Cengel & Cimbala, "Fluid Mechanics" TMH, New Delhi.
4. Katz, "Introductory Fluid Mechanics" Cambridge University Press
5. Pnueli & Gutfinger, "Fluid Mechanics" Cambridge University Press
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. Gupta, "Fluid Mechanics & Hydraulic Machines" Pearson Education, Noida
8. Graebel, "Engineering Fluid Mechanics", CRC Press Taylor & Francis Group.
9. Janna, "Introduction to Fluid Mechanics" 4/e, CRC Press Taylor & Francis Group.
10. AK Jain "Fluid Mechanics" Khanna Publication.
11. White,F.M. "Fluid Mechanics" TMH, New Delhi.
12. Munsen et al , "Fundamental of Fluid Mechanics" Wiley Newyork Ltd
13. Garde, R.J., " Fluid Mechanics", SciTech Publications Pvt. Ltd
14. I.H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student.
15. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication
16. Jagdish Lal "Fluid Mechanics"
17. N Narayan Pillai " Principles of Fluid Mechanics & Fluid Machines" Universities Press.
18. Esposito, Fluid Power & Applications" 7/e Pearson Education, Noida.
19. DR Malhotra & Malhotra, "Fluid Mechanics Hydraulics & Hydraulic Machines" Satya Prakashan, New Delhi.

Environmental Chemistry and Microbiology (L-T-P 3-1-0) Credit – 4

Course Outcomes: At the end of this course the student will be able to-

1. Understand basic principles of environmental chemistry.
2. Apply previous knowledge of analytical chemistry in environmental processes.
3. Understand the effect of human activities on the natural chemical processes.
4. Understand about microbial processes and their significance.

Unit-I

Introduction to environmental chemistry-concept and scope of environmental chemistry, components of environment, structure and composition of atmosphere, natural cycles of matter in the environment.

Introduction to microbiology: Concept and scope of microbiology, kinds of microorganisms, major characteristics and the role of microorganisms, interaction between biological and chemical components. [8 Hours]

Unit II:
Chemistry of water and waste water-Hydrological cycle, principles of equilibrium chemistry, pH, oxidation - reduction and the applications of principles of chemistry for solving Environmental Engineering Problems, Colloidal Chemistry, catalysis and Photo catalysis, Corrosion and its control . [8 Hours]

Unit III:
Chemistry of the air environment- combustion related air pollution, global environmental problems - chemistry of CFC, ozone depletion, greenhouse effect, acid rain, La Nino etc. Chemistry of pollution due to detergents, pesticides, polymers, trace organics, metals, petroleum and radioactive compounds. [8 Hours]

Unit IV:
Environmental Microbiology-Basic principles of microbial transformation of organic matter, microbial inhibition mechanisms, Structure and function of cell constituents, biomass – classification, nutrients and microorganisms – environmental factors, Indicator organisms, - coliforms – MPN index, M.F. technique. [8 Hours]

Unit V:
Pure and mixed cultures, Aerobic and anaerobic metabolism, microbial growth and dynamics, Microbial taxonomy, classification and morphological aspects of bacteria, fungi, protozoa, algae and other higher aquatic life forms, Bioassay tests for toxicity evaluation, Role of microorganisms in water and waste water engineering, Microbiology applied to air pollution control (Bio scrubbers and bio-filters). [8 Hours]

Books and References :

1. A.K. De: Environmental Chemistry
2. Benefield, L.D, Judkins, J.F and Weand, B.L Process Chemistry for Water and Waste water treatment, Prientice-Hall, Inc. Eaglewood Cliffs, New Jersey, 1982.
3. Krueger and Johansson: Microbiology
4. Larinzar – General Biochemistry
5. Manahan: Environmental Chemistry
6. McKinney: Microbiology for Sanitary Engineers
7. Pelczar, Chan, and Krieg: General Microbiology
8. Pelczar, M.J., Chan E.C.S. and Krieg, N.R. Microbiology, Tata McGraw Hill, New Delhi, 1993.
9. Sawyer, C.N., McCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering, Tata McGraw-Hill, New Delhi, 2003.
10. Sawyer, McCarty, and Parkin: Chemistry for Environmental Engineering
11. Sharma: Microbiology
12. Tortora, Funke and Case: Microbiology

Environmental Sampling and Analysis Lab (L-T-P 0-0-2) Credit – 1

1. Collection of grab and composite sample from a water/ wastewater stream
2. Flow measurement in a wastewater drain in field.
3. Determination of moisture content and pH of soil.
4. Digestion of samples for metal analysis.
5. Determination of Na and K by flame photometer.
6. Vehicle counting and classification on a highway.
7. Measurement of noise.
8. Determination of metals in samples.
9. Study of chromatography.

Microbiology Lab (L-T-P 0-0-2) Credit – 1

1. Use of microscope: Bacterial morphology and staining methods.
2. Biological examination of water: Algae, bacteria and Protozoa.
3. Quantitative plating method.
4. Bacterial water quality: Measuring quality of water by using coli form organisms (MPN method and membrane filter).
5. Indicator and Indices: Fecal streptococci, anaerobic bacteria
6. Estimation of sugars, proteins, lipids.
7. Biochemical activities of bacteria: hydrolysis of polysaccharides,
8. Determination of Biodiversity index.

Reference:
Sirockin and Cullimore: Practical Microbiology

Fluid Mechanics Lab (L-T-P 0-0-2) Credit – 1

Note: Students will perform minimum 10 experiments from the following:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. Verification of Bernoulli's Theorem

7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.

9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.

10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

11. To determine Meta-centric height of a given ship model.

12. To determine the head loss for a sudden enlargement, sudden contraction and losses in bend.

13. Flow Visualization -Ideal Flow

14. To make studies in Wind Tunnel (Aerofoil and circular cylinder)

Semester-IV

Materials, Testing & Construction Practices (L-T-P 3-0-0) Credit – 3

Course Outcomes: At the end of this course the student will be able to-

1. Identify various building materials and to understand their basic properties.
2. Understand the use of non-conventional civil engineering materials.
3. Study suitable type of flooring and roofing in the construction process.
4. Characterize the concept of plastering, pointing and various other building services.
5. Exemplify the various fire protection, sound and thermal insulation techniques, maintenance and repair of buildings.

UNIT I Scope of Study of building Materials: building materials and their performance, economics of the building materials.

Stones: Requirement of good building stone, characteristics of building stone sand their testing. Common building stones.

Bricks: Manufacturing process of clay bricks, classification of clay bricks. Properties of clay bricks, testing methods for clay bricks. Problems of efflorescence & lime bursting in bricks & tiles. Different types of bricks.

Gypsum: properties of gypsum plaster, building products made of gypsum and their uses.

Cement: Raw materials used, Process of Manufacturing, Chemical composition, compounds formed and their effect on strength, Types of cement, Testing of cement properties, Uses of cement.

Cement Concrete: Constituent materials and their properties, Grades of concrete, Factors affecting strength, Properties of concrete at fresh and hardened stage, Testing of concrete, Methods of Curing of concrete.

Pozzolona: Chemical composition and requirements for uses, Natural and Artificial flyash, Surkhi(burnt clay pozzolona), rice husk and ash pozzolona, properties and specifications for use in construction. Timber: Classification and identification of timber, Fundamental Engineering Properties of timber, Defects in timber, Factor affecting strength of timber, Methods of seasoning and preservation of timber. Wood based products.

Asphalt: Bitumen and Tar: Terminology, specifications and uses, Bituminous materials. [8 Hours]

UNIT II Plastics: classification, advantages of plastics, Mechanical properties and use of plastic in construction. Paints, varnishes and distempers: Common constituents, types and desirable properties, Cement paints. Ferrous metals: Desirable characteristics of reinforcing steel. Principles of cold working. Strength ,Telemechanical, physical Properties and chemical composition. Brief discussion on properties and uses of Aluminum and lead. Glass: Ingredients, properties types and use in construction. Insulating Materials: Thermal and sound insulating material, desirable properties and types. [8 Hours]

UNIT III Building Construction: Components of building area considerations, Construction Principle and Methods for layout, Damp proofing, anti termite treatment in buildings, Vertical circulation: stair cases and their types and planning. Different types of floors, and flooring

materials .Bricks and stone masonry construction. Cavity wall & hollow block construction. [8 Hours]

UNIT IV Doors and Windows: Construction details, types of doors and windows and their relative advantages & disadvantages. Types of roof and roof treatments, Lintel sand Chhajja, Principles of building Planning. [8 Hours]

UNIT V Natural Ventilation, Water Supply and Sanitary fittings (Plumbing), Electric Fittings. Heating Ventilation & Air conditioning (HVAC), Mechanical Lifts and Escalators, Fire Fighting and Fire Protection of Buildings. Acoustics. Plastering and its types, pointing, Distempering, Colour washing, Painting etc. Principles & Methods of building maintenance. [8 Hours]

Books and References

1. SK Duggal, "Building Materials" New Age International

2. Purushothama Raj, "Building Construction Materials & Techniques" Pearson Edu.

3. PC Varghese, "Building Materials" PHI

4. Rangwala, "Building Materials" Charotar Publishing House.

5. Sushil Kumar, "Building Construction" Standard Publisher.

6. Domone, "Construction Materials" 4/e, CRC Press Taylor & Francis Group.

7. Adams, "Adams' Building Construction Adams" CRC Press Taylor & Francis Group.

8. BC Punmia, "Building Construction" Laxmi Publication.

9. Jha & Sinha, "Building Construction" Khanna Publishers

10. Sahu, "Building Materials and Construction" Mc Grew Hill Education

11. Deodhar, "Civil Engineering Materials" Khanna Publishers

12. Mehta, "Building Construction Principles, Materials & Systems" 2/e, Pearson Education Noida.

13. Sandeep Mantri, "Practical building Construction and its Management" Satya Publisher, New Delhi.

14. Khanna S. K., Justo C.E.G, & Veeraragavan A., "Highway Materials and Pavement Testing", Nem Chand and Bros.

15. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO etc.

16. Chudley, R. Greeno, Building Construction Handbook, Butterworth

Geoinformatics (L-T-P 3-1-0) Credit – 4

Course Outcomes: At the end of this course the student will be able to-

1. Improve decision making in the field environmental engineering.
2. Apply integration of information from multiple sources.
3. Understand elimination of redundant data.
4. Minimize duplication in the data

Unit - I

Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation, Introduction to Digital Photogrammetry. [8 Hours]

Unit - II

Remote Sensing: Physics of remote sensing, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC [8 Hours]

Unit - III

Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing. [8 Hours]

Unit - IV

Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications [8 Hours]

Unit - V

Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Datum, coordinate sytem and map projection, Static, Kinematic and Differential GPS, GPS Applications. [8 Hours

Books and References

1. Sateesh Gopi, R Sathkumar & N Madhu "Advanced Surveying GIS & Remote Sensing" Pearson Education.
2. Kang Tshung Chang "Introduction of Geographic Information Systems" TMH.
3. A M Chandra: Higher Surveying Narosa Pub.
4. B C Punamia: Higher Surveying Laxmi Publication
5. T M Lillesand et al: Remote Sensing & Image Interpretation
6. B. Bhatta: Remote Sensing & GIS
7. M Anjireddy: Remote Sensing & GIS, BS Publications
8. Narayan Panigrahi "Geographical Information Science" Universities Press.
9. N K Agarwal: Essentials of GPS, Spatial Networks: Hyderabad.
10. George Joseph "Fundamental of Remote Sensing" Universities press.
11. GS Srivastava "An Introduction to Geoinformatics" TMH.

Water Supply and Treatment Engineering (L-T-P 3-1-0) Credit – 4

Course Outcomes: At the end of this course the student will be able to-

1. Understand technical aspects of drinking water treatment
2. Design water supply network.
3. Understand conventional and advanced methods for water treatment.
4. Design water supply system for rural areas.

Unit-I

Characteristics of water: Physical, chemical and biological standards. Theory, Operation and design of aeration system, sedimentation, coagulation, and clariflocculation. Design of clariflocculator. [8 Hours]

Unit-II

Filtration: Slow and rapid gravity filter, multi-media filters and pressure filters. Design of slow sand filter and rapid sand filter. Disinfection: theory and application of chlorine. Miscellaneous methods of water treatment- removal of iron and manganese, hardness, fluorides, colour, taste and odour, dissolved metals and gases. [8 Hours]

Unit-III

Adsorption, ion-exchange, membrane processes. Operation and Maintenance of water treatment plants, Industrial water treatment. [8 Hours]

Unit-IV

Water Supply Engineering: Water demand, design period, population forecasting, sources of water; hydrological concepts, ground-water and its development. [8 Hours]

Unit-V

Conveyance of water; pipe materials, corrosion, laying of pipes, pipe appurtenances, pumps for water supply, distribution system, planning of water supply projects. Design of water distribution network. Rural water supply distribution system. [8 Hours]

Books and References

1. Fair, and Geyer: Water and Wastewater Engineering, Vol-I and II, John Wiley and sons, New York.
2. Steel and McGhee: Water Supply and Sewerage.
3. Peavy, Rowe and Tchobanoglous: Environmental Engineering
4. Hammer and Hammer, Jr.: Water and Wastewater Technology.
5. Garg, SK: Water Supply Engineering (Environmental Engineering Vol.-I)
6. Raju: Water Supply and Wastewater Engineering
7. Kshirsagar: Water Supply and Treatment
8. Punmia: Water Supply and Wastewater Engineering
9. Birdie: Water Supply and Sanitary Engineering

Geoinformatics Lab (L-T-P 0-0-2) Credit – 1

1.Demonstration and working on Electronic Total Station. Measurement of distances, horizontal & vertical angle and coordinates.
2.Measurement of area of a land parcel using Total Station.
3.To layout a precise traverse in a given area and to compute the adjusted coordinates of survey stations.
4.Demonstration and working with Mirror stereoscopes, Parallax bar and Aerial photographs.
5.Visual Interpretation of standard FCC (False colour composite).
6.Digitization of physical features on a map/image using GIS software.
7.Coordinates measurement using GPS.

Water Supply and Treatment Lab (L-T-P 0-0-2) Credit – 1

1. Sampling Techniques
2. Determination of pH, conductivity.
3. Determination of colour, turbidity.
4. Determination of total solids, total dissolved solids, total suspended solids and volatile solids.
5. Determination of hardness, chloride.
6. Determination of alkalinity, acidity.
7. Determination of iron, sulphate.
8. Determination of fluoride, nitrate.
9. Determination of sulphate.
10. Determination of fluoride.
11. Jar test for coagulation studies.
12. Application of laboratory and pilot plant scale units for evaluation of design criteria of:
    Settling analysis studies.
    Water treatment by slow sand filter / rapid gravity filter.

References:

1. Sawyer, McCarty and Parkin: Chemistry for Environmental Engineering
2. Mathur: Water and Wastewater Testing
3. Standard Methods for the Examination of Water and Wastewater, A.P.H.A., New York.

Material Testing Lab (L-T-P 0-0-2) Credit – 1

Testing of various properties of following materials as per BIS specifications

I. Cement

1. Normal Consistency of cement.
2. Initial & final setting time of cement
3. Compressive strength of cement
4. Fineness of cement by air permeability and Le-chatalier's apparatus.
5. Soundness of cement.
6. Tensile strength

II. Coarse Aggregate

1. Water absorption of aggregate
2. Sieve Analysis of Aggregate
3. Specific gravity &bulk density
4. Grading of aggregates.

III Fine Aggregate:

1. Sieve analysis of sand
2. Silt content of sand
3. Bulking of sand

IV Bricks:

1. Water absorption.
2. Dimension Tolerances
3. Compressive strength
4. Efflorescence