

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



EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. SECOND YEAR

(CIVIL ENGINEERING)

(Effective from session 2019-20)

THIRD SEMESTER

CIVIL ENGINEERING

SESSION 2019-20

S.No	Subject	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
	Codes		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	1	0	30	20	50		100		150	3
			3	0	0								
3	KCE301	Engg. Mechanics	3	1	0	30	20	50		100		150	4
4	KCE302	Surveying and Geomatics	3	1	0	30	20	50		100		150	4
5	KCE303	Fluid Mechanics	3	0	0	30	20	50		100		150	3
6	KCE351	Building Planning & Drawing Lab	0	0	2				25		25	50	1
7	KCE352	Surveying and Geomatics Lab	0	0	2				25		25	50	1
8	KCE353	Fluid Mechanics Lab	0	0	2				25		25	50	1
9	KCE354	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	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
	Codes		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	0	0	30	20	50		100		150	3
			2	1	0								
3	KCE401	Materials, Testing & Construction Practices	3	0	0	30	20	50		100		150	3
4	KCE402	Introduction to Solid Mechanics	3	1	0	30	20	50		100		150	4
5	KCE403	Hydraulic Engineering and Machines	3	1	0	30	20	50		100		150	4
6	KCE451	Material Testing Lab	0	0	2				25		25	50	1
7	KCE452	Solid Mechanics Lab	0	0	2				25		25	50	1
8	KCE453	Hydraulics & Hydraulic Machine 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

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. Shames 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 Youngs, East West Press.
12. Textbook of Applied Mechanics-Dynamics and Statics by Prasad I.B, Khanna Publications.

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

1. Describe the function of surveying and work with survey instruments, take observations, and prepare plan, profile, and cross-section and perform calculations.
2. Calculate, design and layout horizontal and vertical curves.
3. Operate a total station and GPS to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system.
4. Relate and apply principles of photogrammetry for surveying.
5. Apply principles of Remote Sensing and Digital Image Processing for Civil Engineering problems.

UNIT - I

Introduction to Surveying: Definition, Classification, Principles, Survey stations and Survey lines; Introduction to measurement of distance, direction and elevation; Ranging and its methods, Meridians and Bearings, Methods of leveling, Booking and reducing levels, Reciprocal leveling, distance of visible horizon, Profile leveling and cross sectioning, Errors in leveling; Introduction to methods of plane table surveying; *Contouring:* Characteristics, methods, uses, computation of areas and volumes. *Theodolite survey:* Instruments, Measurement of horizontal and vertical angle; Methods of horizontal and vertical control, *Triangulation:* Figures or systems, Signals, Satellite station, Baseline and its importance, corrections, *Trigonometric leveling:* Accessible and inaccessible objects. [8 Hours]

UNIT - II

Curves: Elements of simple circular curves, Theory and methods of setting out simple circular curves, Transition curves- types, characteristics and equations of various transition curves; Introduction to vertical curves. [8 Hours]

UNIT - III

Modern Field Survey Systems: Principle and types of Electronic Distance Measurement systems and instruments, Total Station- its advantages and applications; Global Positioning Systems- Segments, working principle, errors and biases. *Geographic Information System:* Concepts and data types, data models, data acquisition. GIS applications in civil engineering. [8 Hours]

UNIT - IV

Photogrammetric Survey: basic principles, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement, flight planning for aerial photography, selection of altitude, interval between exposures, crab and drift, stereoscope and stereoscopic views, parallax equations. Introduction to digital photogrammetry. [8 Hours]

UNIT - V

Remote Sensing: Concepts and physical basis of Remote Sensing, Electromagnetic spectrum, atmospheric effects, image characteristics. Remote sensing systems, spectral signatures and characteristics spectral reflectance curves. Salient features of some of Remote Sensing satellites missions. *Digital image processing:* Introduction, image rectification and restoration, image

enhancement, image transformation, image classification. Applications of remote sensing to civil engineering. [8 Hours]

Books and References:

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House.
7. Punmia BC et al: Surveying Vol. I, II, Laxmi Publication
8. Chandra AM and Ghosh SK: Remote Sensing and Geographical Information System, Alpha Science
9. Ghosh SK: Digital Image Processing, Alpha Science
10. Lillesand T M et al: Remote Sensing & Image Interpretation, John Wiley & Sons
11. Bhatta B: Remote Sensing and GIS, Oxford University Press, 2008

FLUID MECHANICS (L-T-P 3-0-0) Credit – 3

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.

BUILDING PLANNING & DRAWING LAB (L-T-P 0-0-2)

Credit – 1

Drawing and drafting of following with CAD/BIM software

1. Introduction to the tools and commands of drafting software.
2. Working in layers, blocks, x-ref, drawing layout and print setup.
3. 3D drafting and rendering
4. Planning and drafting of elevation and cross section of door and window
5. Planning and drafting of plan and cross section of Dog legged and open well staircase.
6. Planning and Drawings of Residential building of 1 room set (plan and section).
7. Planning and drawing of 3 room residential building with staircase.
8. Preparation of details general arrangement drawing of 4 room duplex house including planning and drafting

SURVEYING & GEOMATICS LAB**(L-T-P 0-0-2) Credit – 1**

1. To measure bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method.
2. To find out reduced levels of given points using Auto/dumpy level.
3. To study parts of a Vernier and electronic theodolite and measurement of horizontal and vertical angle.
4. To measure horizontal angle between two objects by repetition/reiteration method.
5. To determine the height of a vertical structure (e.g. chimney/ water tank etc.) using trigonometrical leveling by taking observations in single vertical plane.
6. To set out a simple circular curve by Rankine's method.
7. Demonstration and working on Electronic Total Station. Measurement of distances, horizontal & vertical angles, coordinates and area of a land parcel.
8. Demonstration and working with Mirror stereoscopes, Parallax bar and Aerial photographs.
9. Visual Interpretation of standard FCC (False colour composite).
10. Digitization of physical features on a map/image using GIS software.
11. Coordinates measurement using GPS.

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).

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

INTRODUCTION TO SOLID MECHANICS (L-T-P 3-1-0) Credit – 4

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

1. Describe the concepts and principles of stresses and strains
2. Analyze solid mechanics problems using classical methods and energy methods
3. Analyze structural members subjected to combined stresses
4. Calculate the deflections at any point on a beam subjected to a combination of loads
5. Understand the behavior of columns, springs and cylinders against loads.

UNIT I Simple stress and strains:

Concept of stress and strain, types of stresses and strains, Hook's law, stress and strain diagram for ductile and brittle metal. Lateral strain, Poission ratio, volumetric strain, elastic moduli and relation between them. Bar of varying cross section, composite bar and temperature stress. Strain energy for gradual, sudden and impact loading.

Compound stress and strains:

Normal stress and strain, shear stress and strain, stresses on inclines sections, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional state of stress & strain, equilibrium equations, generalized Hook's law-3D, Theories of failure and factor of safety.

[8 Hours]

UNIT II Shear force and bending moment diagrams

Shear force (SF) and Bending moment (BM) diagrams for simply supported, cantilevers, overhanging and fixed beams. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads. [8 Hours]

UNIT III Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.

Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections. [8 Hours]

UNIT IV Deflection of Beams: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Short Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules. [8 Hours]

UNIT V Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs.

Thin cylinders, Thick cylinders & Spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders. [8 Hours]

Books and References:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MCGRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Youngs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MCGRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
12. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.

HYDRAULIC ENGINEERING & MACHINES (L-T-P 3-1-0) Credit – 4

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

1. Apply their knowledge of fluid mechanics in addressing problems in open channels.
2. Solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
3. Have knowledge in hydraulic machineries like pumps and turbines.

UNIT I Introduction : Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels critical, sub-critical and super-critical type of flows. Critical depth, concepts of specific energy and specific force. Chezy's and Manning's equations for uniform flow in open channel, Velocity distribution, most efficient channel section, compound sections. [8 Hours]

UNIT II Energy-Depth relationship: Application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions. Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical and numerical methods. Measurements of discharge & velocity – Venturi flume, Standing wave flume, Parshall flume, Broad crested weir, Current meter and Floats. [8 Hours]

UNIT III Rapidly varied flow: Hydraulic jump; Evaluation of the jump elements in rectangular channels on horizontal and sloping beds, energy dissipater, open channel surge, celerity of the gravity wave, deep and shallow water waves. [8 Hours]

UNIT IV Impulse momentum equation- Impact of Jets-plane and curved- stationary and moving plates. Pumps: Positive displacement pumps - reciprocating pumps , centrifugal pumps, operation, velocity triangles, performance curves, Cavitation, Multi staging, Selection of pumps. [8 Hours]

UNIT V Rotodynamic Machines, Pelton Turbine, equations for jet and rotor size, efficiency, spear valve, reaction turbines, Francis and Kaplan type, Head on reaction turbine, unit quantities, similarity laws and specific speed, cavitation, characteristic curves. [8 Hours]

Books and References

1. Chow, V.T. "Open Channel hydraulics" McGraw Hill Publication
2. Subramanya, K., Flow through Open Channels, TMH, New Delhi
3. Ranga Raju, K.G., Flow through open channels, T.M.H. New Delhi
4. Rajesh Srivastava, Flow through Open Channels , Oxford University Press
5. Streeter, V.L.& White E.B., "Fluid Mechanics" McGraw Hill Publication
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication
8. AK Jain "Fluid Mechanics" Khanna Publication.
9. Houghtalen, "Fundamentals of Hydraulics Engineering Systems" 4/e Pearson Education, Noida

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

SOLID MECHANICS LAB (L-T-P 0-0-2) Credit – 1

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

1. Tension test on Mild Steel
2. Bending tests on simply supported beam and Cantilever beam.
3. Determination of torsion and deflection,
4. Measurement of forces on supports in statically determinate beam,
5. Determination of shear forces in beams,
6. Determination of bending moments in beams,
7. Measurement of deflections in statically determinate beam.
8. To determine Flexural Rigidity (EI) of a given beam
9. To find deflection of curved members.
10. To find Critical load in Struts with different end conditions.
11. Hardness Test (Brinell's and Rockwell)
12. Impact test (Charpy and IZOD)

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

1. To determine the Manning's coefficient of roughness 'n' for the bed of a given flume.
2. To study the velocity distribution in an open channel and to determine the energy and momentum correction factors.
3. To study the flow characteristics over a hump placed in an open channel.
4. To study the flow through a horizontal contraction in a rectangular channel.
5. To calibrate a broad-crested weir.
6. To study the characteristics of free hydraulic jump.
7. To study centrifugal pump and their characteristics
8. To study characteristics of Pelton Turbine.
9. To study characteristics Francis Turbine.
10. To study characteristics of Kaplan Turbine.
11. To study the free over-fall phenomenon in an open channel and to determine the end depth
12. To determine coefficient of discharge for given rectangular notch.