FIFTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science -5	HS 501	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PC CE 502	Structural Engineering	3	0	0	3	3	100
3.	Program Core-14	PC CE 503	Design of Structures-I	3	0	0	3	3	100
4.	Program Core-15	PC CE 504	Hydrology and Water Resources Engineering	3	0	0	3	3	100
5.	Program Core-16	PC CE 505	Transportation Engineering-I	3	0	0	3	3	100
6.	Program Core-17	PC CE 506	Environmental Engineering	3	0	0	3	3	100
7.	Program Core-18	PC CE 507	Structural Engineering Lab.	0	0	2	2	1	100
8.	Program Core-19	PC CE 508	Hydrology and Water Resources Engineering Lab.	0	0	2	2	1	100
9.	Program Core-20	PC CE 509	Environmental Engineering Lab.	0	0	4	4	2	100
10.	Summer Internship-1	SI CE 510	Industry Internship – I	0	0	0	0	1	100
			Total :	17	0	8	25	**22**	**1000**

Professional Practice, Law and Ethics

Course Code	HS 501
Course Title	Professional Practice, Law & Ethics
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Humanities Science (HS)
Number of classes	26 hours

Course Outcome:- After completion of the course, students will be able to:

CO Number	CO Description	K Level
CO 1	Develop ideas of the professionalism, values and ethics in a profession	K-3
CO 2	Develop a good insight into contracts and contracts management in engineering, arbitration and dispute resolution mechanisms	K-3
CO 3	Interpret laws governing engagement of labour in construction related works and other related areas	K-2
CO 4	Demonstrate an understanding of Intellectual Property Rights and Patents	K-2

Module 1: Professionalism, Values and Ethics in Profession (6 hrs)

Professionalism: Professional characteristics, professional education, professional development in Industry.
Values and Ethics in Profession- Value system- goodness, means and ends; Ethics-ethical premises, expectation, conflicts and practices; Moral and ego, Ethics and morality
Right, virtue ethics and justice, utility and justice, privacy, challenges to privacy, privacy on the Internet.

Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Module 2: General Principles of Contracts Management and Arbitration (10 hrs)

Indian Contract Act, 1972 and amendments covering General principles of contracting; Valid & Voidable Contracts; Prime and Subcontracts Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge,

jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision.

Module 3: Engagement of Labour & other construction-related Laws (5 hrs)

Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.

Module 4: Law relating to Intellectual property (5 hrs)

Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India. Process of obtaining patent – application, examination, opposition and sealing of patents. Duration of patents – law and policy considerations, Infringement and related remedies;

References / Suggested Learning Resources:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
1 . Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
5. Avtarsingh (2002), Law of Contract, Eastern Book Co. 7. Dutt (1994), Indian Contract Act, Eastern Law House
6. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House 9. Bare text (2005), Right to Information Act
7. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
8. Ethics in Engineering- M.W. Martin& R. Schinzinger, McGraw-Hill
9. Engineering Ethics, National Institute for Engineering Ethics, USA.
11. Ethics & Mgmt and Ethos , Ghosh, VIKASH
12. Business Ethics; Concept and Cases, Velasqez, Pearson

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Structural Engineering

Course Code	PC-CE 502
Course Title	Structural Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Professional core courses (PCC)
Number of classes	36 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Apply knowledge of structural mechanics in addressing design problems of structural engineering	K-3
CO-2	Predict problems dealing with analysis and design criteria of structures	K-3
CO-3	Model Structural Elements for design purpose	K-4
CO-4	Categorize analysis and design process of structures	K-3

Module 1: Introduction (9 hrs)

Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design.

Module 2: Planning and Design Process (9 hrs)

Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads.

Module 3: Materials and Structural Design Criteria (9 hrs)

Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;

Module 4: Design of Structural Elements (9 hrs)

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

References / Suggested Learning Resources:

1. Schodek.D.L., Betchthold.M., *Structures.* 7th edition. Pearson,2014.
2. Schueller.W., *Building Support Structures- Analysis and Design using SAP2000 Software*. 2nd edition. Computers and Structures, Inc.,2008.

3.Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, Prentice Hall, 1996
4.Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWS Publishing, Boston.
5.Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, New York, 1990.
6.MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall,New Jersey, 1997.
7.Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, Prentice Hall, NewJersey.
8.Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley,New York.
9.Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ, (2003).
10. Related Codes of Practice of BIS
11. Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers, New York.
12. W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition,John Wiley and Sons, 2000.
13. NBC, *National Building Code*, BIS (2017).
14. ASCE, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-02*, AmericanSociety of Civil Engineers, Virginia, 2002.

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Design of Structures-I

Course Code	PC CE 503
Course Title	Design of Structures-I
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	--
Course Category	Professional core courses (PCC)
Number of classes	36 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Differentiate the basic difference between working stress, limit state & ultimate load method.	K-4
CO-2	Design the various types of beams with behavior of shear and deflections.	K-5
CO-3	Design the various components of buildings like slabs, columns, footings and stairs.	K-5
CO-4	Design isolated column foundation under axial load resting directly on bearing soil.	K-5

Module 1: Introduction to RCC and Design of Rectangular Beam in Flexure (9 hrs)

Introduction- Properties of concrete and reinforcing steel, characteristic strengths, stress-strain curves,

I.S. specifications. Design philosophies- Working stress, ultimate strength and limit state method of design. Flexure of beams by working stress and limit state methods- singly and doubly reinforced rectangular beam.

Module 2: Design of RCC Beam for Shear, Bond, Deflection and Cracking (9 hrs)

Behavior of beams in shear and bond, design for shear, anchorage, splicing of reinforcement and detailing of reinforcements. Design of flanged beam and cantilever beam. Limit state of deflection and cracking, calculation of deflections.

Module 3: **Design of RCC Slab, Lintel and Staircases (9 hrs)**

Design of one way and two-way slabs; circular slabs, yield line theory for slabs, lintel and stair cases.

Module 4: Design of RCC Column, Column Foundation and Prestressed Concrete (9 hrs)

Design of Short and Long columns, eccentrically loaded columns.

Design of isolated column foundation under axial load resting directly on bearing soil, for uniform thickness of the footing slab, with solution. Introduction to prestressed concrete-problems.

References / Suggested Learning Resources:

1. Limit state Design of Reinforced Concrete, P.C Vargheese, P.H.I. Publisher.
2. Limit State Design of R.C.C Structures, A.K. Jain, Nemchand Brothers.
3. Design of Reinforced Concrete Structures, N.Krishnaraju, CBS Publishers.
4. Reinforced Concrete Design, C.K.Wang & C.G. Salman, Harpur International Edition.
5. Reinforced Concrete Design, Mallik and Gupta, Oxford and IBH Publications.

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Hydrology and Water Resources Engineering

Course Code	PC CE 504
Course Title	Hydrology and Water Resources Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Professional core (PC)
Number of classes	36 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Understand the various components of hydrologic cycle that affect the movement of water in the earth.	K-2
CO-2	Analyze and represent hydrological data.	K-4
CO-3	Measure precipitation and estimate abstractions from precipitation.	K-6

CO-4	Compute yield from a catchment and develop rainfall-runoff model.	K-6
CO-5	Formulate and solve hydrologic flood routing model.	K-6
CO-6	Understand the concept of ground water, Channel flow theories and apply in design of irrigation channels.	K-2

Course contents:-

Module 1: Introduction to Hydrology (9 hours)

Hydrology - definition & scope, Hydrologic cycle and its components, Hydrologic data variability, Hydrologic data analysis.

Precipitation- Formation and types, Forms, Measurement, Estimating missing precipitation data, Average precipitation over area, Depth-area-duration analysis, Abstractions from precipitation, Evapotranspiration and its measurement, Infiltration and its measurement, Interception process.

Module 2: Runoff and Hydrograph (9 hours)

Runoff components, Drainage basin characteristics, Factor effecting runoff, Hydrograph and its components, Base flow separation, Unit hydrograph– concept, derivation, limitations and use, S-hydrograph, Synthetic unit hydrograph, Instantaneous unit hydrograph. .

Module 3: Floods (9 hours)

Definition, Flood estimation, Rational method and unit hydrograph method, Flood routing: reservoir routing and channel routing, Flood frequency analysis.

Module 4: Ground Water Hydrology and Irrigation (9 hours)

Ground water hydrology
Occurrence of ground water, Aquifers, Movement of ground water, Darcy's law, Porosity, specific yield and specific retention, Yield from wells for confined and unconfined aquifers, Yield of an open well.

Irrigation- Water requirement of crops, duty and delta, soil- water relationships, root zone soil water, irrigation requirement and types of irrigation. Water distribution system, canal system, design of irrigation channels – Kennedy's theory and Lacey's theory of regime channels.

References / Suggested Learning Resources:

1. V. T. Chow, D. R. Maidment and L. W. Mays, "Applied Hydrology", McGraw Hill, 1st Edition, 1988.
2. K. Subramanya, "Engineering hydrology", McGraw Hill, 2nd Edition, 1994.
3. S K Jain, P K Agarwal and V P Singh, "Springer Hydrology and Water resources of India", 1st edition, 2007
4. V. P. Singh, "Elementary Hydrology", Englewood Cliffs, NJ : Prentice Hall, 1stEdition, 1992.

5. D. K. Tood and L. W. Mays, "Ground Water Hydrology", Wiley India Pvt. Ltd, 3rdEdition, 2004.
6. T Davie, Taylor and Francis, Fundamentals of Hydrology 2nd edition, 2008

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Transportation Engineering-I

Course Code	PC CE 505
Course Title	Transportation Engineering-I
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Professional core (PC)
Number of classes	36 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Build up surveys involved in planning and highway alignment and design the geometric elements of highway.	K-3 & K-6
CO-2	Examine and characterize the various pavement materials.	K-4
CO-3	Design flexible and rigid pavements as per IRC.	K-6
CO-4	Identify the various problem related to traffic studies with traffic control systems.	K-3

Course Contents:-

Module- 1: Highway development and planning (10 hours)

Classification of roads, road development in India, current road projects in India; highway alignment and project preparation, geometric design of highways with cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Module- 2: Pavement Materials (8 hours)

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

Module- 3: **Pavement Design (10 hours)**

Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems; pavement failures; highway drainage.

Module- 4: Traffic Engineering & Control (10 hours)

Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, introduction to shockwaves and delay studies, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems; traffic signs and marking:

References / Suggested learning Resources:-

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. L R Kadiyali, N B Lal, Principles and practice of highway engineering, Khanna Publications, 2005
3. Principles of Transportation Engineering, Partha Chakraborty, PHI Learning, 1st edition
4. Principles of Highway Engineering and Traffic Analysis, 4th Edition, Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, John Wiley

Reference Books:

1. Morlok, E.R., An Introduction to Transportation Engineering and Planning, McGraw Hill, NY, 1970
2. Hay W.W., Introduction to transportation Engineering, John Wiley & Sons, NY, 1988.
3. Papacostas C.S., Fundamentals of transportation Engineering, Prentice Hall of India, 1987.
4. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.

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Environmental Engineering

Course Code	PC CE 506
Course Title	Environmental Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Environmental Science
Course Category	Professional core (PC)
Number of classes	36 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Explain air pollution, noise pollution, solid waste management.	K-5
CO-2	Elaborate water demand and water quality, design water treatment plant and explain the distribution of treated water.	K-5, K-6
CO-3	Explain the characteristics of sewage and sewerage system	K-5
CO-4	Design the sewage treatment plant and explain the disposal of waste water.	K-5, K-6

Course Contents:-

Module 1: Air Pollution, Municipal Solid Waste and Noise Pollution (9 hours)

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid wastes management (reuse/ recycle energy recovery, treatment and disposal).
Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution. Water Demand: Design flows, design Hours, and design population, factors affecting water consumption, water demand, and design capacities for various water supply components.

Module 2: Quantity of Water and Distribution of Water (9 hours)

Quality of Water: The hydrological cycle and water quality, physical, chemical and biological water quality, water quality parameters, water quality requirements, Indian standards. Treatment of Water: Historical overview of water treatment, water treatment process, water treatment process (Theory and Application): Aeration, solid separation, settling operations, coagulation, softening, filtration, disinfections, other treatment process: dissolved solid removal, treatment design, preparation of hydraulic profiles.
Distribution of Water: Methods of distribution of water, distribution reservoirs, distribution systems, distribution system components, capacity and pressure requirements, design of distribution system, hydraulic analysis of distribution systems, Storage capacity of distribution reservoir, pumping required for water supply systems.

Module 3: Water and Waste Water (9 hours)

General Terms: Sewerage, domestic Sewage, Sewage treatment, Disposal, Scope, role of an Environmental Engineer. Historical overview Sewage Characteristics Quality parameters: BOD, COD, TOC, Solids, DO, Nitrogen, Phosphorus, Standards of disposal into natural water courses and on land, Indian standards.
Collection of Sewage System of sewerage: Separate, combined and partially separate, components of sewerage systems, systems of layout, Quantity of sanitary sewage and variations, quantity of storm water, rational method, shapes of sewer, circular and egg shaped, Hydraulic design of sewers: diameter, self-cleansing velocity and slopes, Construction and testing of sewer lines, Sewer materials, joints and appurtenances, sewage pumping and pumping stations, Maintenance of Sewerage system.

Module 4: Sewage Treatment and Waste Water Disposal (9 hours)

Sewage Treatment Various units: Their purposes sequence and efficiencies, Preliminary treatment: Screening and grit removal units oil and grease removal, Primary treatment, Secondary Treatment: activated sludge process, trickling filter, Sludge digestion and drying beds. Stabilization pond, Septic tank, soakage systems, Imhoff tank, Recent trends in sewage treatment, advanced wastewater treatment: nutrient removal, solids removal.
Wastewater Disposal and Reuse Disposal of sewage by dilution, self-purification of streams, sewage disposal by irrigation & sewage farming, wastewater reuse. Plumbing for Drainage of Buildings Various systems of plumbing- one pipe, two pipe, single stack, traps, Layout of house drainage.

References / Suggested learning Resources:-

1. Environmental Engineering Peavy, H.S.,Rowe,D.R and Tchobanoglous McGraw Hill Book Company,1985.

2. Water and waste water Engineering fair,G.M.,Geyer,J.C and Okun,D.S fair,G.M.,Geyer,J.Cand Okun,D.S
3. Water supply and Pollution Control Viessman,Jr.andHammer,M.J Harper Collins College publishers,1985.
4 Water supply, Waste Disposal A.K.ChatterjeeKhanna Publishers and Environmental Pollution Engineering.
5.Water supply and sanitary S.C.Rangawala, Engineering K.S.RangawalaCharotar publishing P.S.Rangawala housing
6. Water supply and sanitryG.S.Birdie& J.S. Birdie DhanpatRai Engineering publishing
Company, New Delhi.
7. Environmental Engineering Peavy H.S., McGraw Hill Book Row D.R. and Company, 1985 Tchobanoglous G
8. Environmental Engineering (Vol. I) Water Supply Engineering ,S K Garg, Khanna Publishers
9. Sewage Disposal and Air Pollution Engineering S.K.Garg, Khanna Publishers, Pollution Control Engineering 1979. Environmental Engineering Vol.II.

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Structural Engineering Lab.

Course Code	PC CE 507
Course Title	Structural Engineering Lab.
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Professional core (PC)
Number of classes	20 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Review the physical behavior of cement and concrete	K-2
CO-2	Predict the behavior arches and frame structures	K-3
CO-3	Compute the bond strength between steel bar and concrete	K-3
CO-4	Analyze the behavior of RCC structures,	K-4

Course Contents:-

List of Experiments (*Minimum 6 or more experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Water content for standard consistency of cement.
2. Initial and final setting times of cement
3. Soundness of Cement by Le-Chatalier's Apparatus &Autoclave test method.
4. Compressive strength & tensile strength of cement.
5. Water absorption, compressive strength of Bricks.

6. Behaviour of pre-stressed concrete beams in flexure.
7. Ultimate strength and deflection of R.C.C. slab.
8. Behaviour of under reinforced and over reinforced R.C. beams in flexure.
9. Behaviour of R.C. beams, with and without shear reinforcement in shear.
10. Bond strength between steel bar and concrete (a) in a beam specimen and (b) by pull-out test.
11. Two and Three hinged arch.
12. Verification of Muller-Breslau principle-Arch / continuous beam / frame models.
13. Fineness of cement by sieving & air permeability method.
14. Tensile and bend test of M.S and HYSD bar.

References / Suggested learning Resources:-

1. Basic Structural Analysis, Reddy, C. S., Tata McGraw Hill.
2. Elementary Structural Analysis, Norris and Wilbur, Tata McGraw Hill.
3. Theory & Analysis of Structures, Jain, O. P.and Jain B. K, Nem Chand &Vol.I & II Bros .
4. Theory of Structures, Vol. II Jain, O.P. &Arya A. S em Chand &Bors.,
5. Indeterminate Structural Analysis Wang, C. K, McGraw Hill Book Company
6. Matrix Analysis of framed Structures, Weaver, W. & Gere, J. M., CBS Publishers & Distributors, Delhi.
7. Structural Dynamics, Mario Paz, CBS publishers and Distributors
8. Dynamics of Structurs, A. K. Chopra

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Hydrology and Water Resources Engineering Lab.

Course Code	PC CE 507
Course Title	Hydrology and Water Resources Engineering Laboratory
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Program core (PC)
Number of classes	24 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Measure precipitation by different methods.	K-5
CO-2	Estimate abstractions from precipitation.	K-6
CO-3	Analyse rainfall data.	K-6
CO-4	Determine the velocity of water in a canal and calculate discharge.	K-5
CO-5	Demonstrate the concept of ground water storage, and its movement.	K-2

List of Experiments (*Minimum 6 or more experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

(a) Rainfall measurement using rain gauge.
(b) Rainfall measurement by Theisen polygon method.
(c) Measurement of infiltration using double ring infiltrometer.
(d) Evaporation measurement using evaporimeter.
(e) Analysis of rainfall data.
(f) Determination of velocity of water in a canal by current meter and calculation of approximate discharge of the canal.
(g) Determination of hydraulic conductivity.
(h) Steady flow into a well in unconfined aquifer.
(i) Steady flow into a well in confined aquifer.
(j) Abstractions from a single well in an unconfined aquifer.
(k) Applications of Remote sensing and GIS in Water Resources Engineering.
(l) Study on Weather Station.

References / Suggested learning Resources:-

1. V. T. Chow, D. R. Maidment and L. W. Mays, "Applied Hydrology", McGraw Hill, 1st Edition, 1988.
2. K. Subramanya, "Engineering hydrology", McGraw Hill, 2nd Edition, 1994.
3. V. P. Singh, "Elementary Hydrology", Englewood Cliffs, NJ : Prentice Hall, 1st Edition, 1992.
4. D. K. Tood and L. W. Mays, "Ground Water Hydrology", Wiley India Pvt. Ltd, 3rd Edition, 2004.
5. David R. Maidment, "Handbook of Hydrology", McGraw Hill, Ist Edition 1993

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Environmental Engineering Lab.

Course Code	PC CE 507
Course Title	Environmental Engineering Lab.
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	Nil
Course Category	Program core (PC)
Number of classes	40 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Analyze sound samples, solid waste and air sample.	K-4
CO-2	Measure Physical parameters of water	K-5
CO-3	Measure Chemical parameters of water	K-5
CO-4	Measure Physical and chemical parameters of waste water	K-5

List of Experiments (*Minimum 10 or more experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Collection and analysis of sound samples.
2. Classification of Solid wastes.
3. Air volume sampling.
4. Determination of turbidity, colour and conductivity.
5. Determination of pH, alkalinity and acidity.
6. Determination of hardness and chlorides.
7. Determination of residual chlorine and chlorine demand.
8. Determination of Dissolved Oxygen.
9. Determination of Most Probable Number (MPN) of Coliforms.
10. Determination of B.O.D of sewage
11. Determination of C.O.D of domestic and industrial sewage.
12. Determination of kjeldal nitrogen
13. Determination of volatile, mixed, filterable and dissolved solids.
14. Determination of optimum dose of coagulants.
15. Determination iron and two heavy metals.
16. Determination of SO2 in the ambient air.
17. Measurement of particulate matter in air.

References / Suggested learning Resources:-

1. Environmental Engineering Peavy, H.S.,Rowe,D.R and Tchobanoglous McGraw Hill BookCompany,1985.
2. Water and waste water Engineering fair,G.M.,Geyer,J.C and Okun,D.S fair,G.M.,Geyer,J.C and Okun,D.S
3. Water supply and Pollution Control Viessman,Jr.andHammer,M.J Harper Collins College publishers,1985.
4 Water supply, Waste Disposal A.K.ChatterjeeKhanna Publishers and Environmental Pollution Engineering.
5. Water supply and sanitary S.C.Rangawala, Engineering K.S.RangawalaCharotar publishing P.S.Rangawala housing
6. Water supply and sanitryG.S.Birdie& J.S. Birdie DhanpatRai Engineering publishing Company, New Delhi.
7. Environmental Engineering Peavy H.S., McGraw Hill Book Row D.R. and Company, 1985 Tchobanoglous G
8. Sewage Disposal and Air S.K.Garg, Khanna Publishers, Pollution Control Engineering 1979.Environmental Engineering Vol.I

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Industry Internship – I

Course Code	SI CE 503
Course Title	Industry Internship – I
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K-3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting	K-3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K-2
CO-4	Show professional ethics by displaying positive disposition during internship.	K-2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional, educational advancement and entrepreneurship;	K-5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.

2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.

3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.

4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 4^{th} and 5^{th} semester,

2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

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