E.G.S.PILLAYENGINEERINGCOLLEGE

(Autonomous)

Approved byAICTE,New Delhi|Affiliated to AnnaUniversity, Chennai AccreditedbyNAAC with „A"Grade|Accredited byNBA (CSE, EEE, MECH, ECE, CIVIL, IT)

NAGAPATTINAM–611002

B.E. Civil Engineering

FullTime Curriculum and Syllabus

First Year – First Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1901MA101	Engineering Mathematics – I (Matrices andCalculus)	3	1	0	4	40	60	100
1901PH101	Introduction to Mechanics	3	0	3	4	50	50	100
1901GEX01	Basic Electrical and Electronics Engineering	3	0	0	3	40	60	100
1901GEX02	Engineering Graphics	2	0	2	3	50	50	100
Laboratory Course								
1901GEX51	CAD Lab	0	0	2	1	50	50	100
1901GEX52	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50	50	100
1901PHX51	Engineering Physics Lab	0	0	2	1	50	50	100
1901HS151	Communication Skills	0	0	2	1	100	0	100
		11	**1**	**13**	**18**	**430**	**370**	**800**

L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester

1901MA101	ENGINEERING MATHEMATICS - I (MATRICES AND CALCULUS) (for Civil Engineering)	L	T	P	C
		3	2	0	4

Aim of the course: This course focuses on developing a solid understanding of the methods used in the application of differentiation, Eigen values, and Eigen vectors and using Cayley-Hamilton theorem, transformation of quadratic form into canonical form through orthogonal transformation, becoming familiar with the ideas of vector calculus, which are necessary for problems in all engineering disciplines, and developing an understanding of the common methods of complex variable theory so as to: Additionally, it helps the learner understand how transforms may be used to establish a new domain where the issue under investigation is simpler to manage.

PREREQUISITES: Basic Knowledge In Matices And Determinants, Series, Integration And Vector Calculus.

MODULE-I MATRICES

Algebra of matrices , Inverse and rank of a matrix: Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthoganal transformation and quadratic to canonical forms.

MODULE-II SEQUENCES AND SERIES

Convergence of sequence and series - Tests for convergence - Power series - Taylor's series, Series for exponential – trigonometric and logarithm functions.

MODULE-III DIFFERENTIAL CALCULUS

Curvature in Cartesian Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes and involutes

MODULE-IV INTEGRAL CALCULUS

Double integration – Cartesian and polar cordianates – Change the order of integration – Applications: Area of a curved surface using double integral – Triple integration in Cartesian co-ordiantes – Volume as triple integral

MODULE-V VECTOR CALCULUS

Gradient , Divergene and Curl – Diretioanal derivate – Irrotational and Solendial vector fields – Vector integration: Green's Theorem in a plane, Gauss divergence theorem and Stoke's theorem(excluding proofs) – Applications of the above theorems to find surface area of a closed region and volume of cube and parallelepiped.

For further reading:

nptel.ac.in/courses/111105035, www.nptelvideos.in/2012/11/Mathematics.html

COURSE OUTCOMES

After completion of the course, the student will be able to

CO1: Apply the nature of the matrix using Orthogonal Transformation & Calculate the inverse and positive powers of a square matrix

CO2: Relate the nature of series using comparison, Ratio, Leibnitz tests

CO3: Develop the evolutes and envelopes of given curves by means of radius and centre of curvature

CO4: Solve the area and volume of a curve using double and triple integration. Skill

CO5: Make use of vector concepts to estimate the area, surface and volume of planes.

TEXT / REFERENCE BOOKS:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2018.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition,2010.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

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1901PH101	INTRODUCTION TO MECHANICS (for Civil and Mechanical Engineering)	L	T	P	C
		3	0	0	3

Aim of the course: To make students understand and apply the knowledge in mechanics for engineering applications

PREREQUISITES:

Introduction to mechanics

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates and related problems

Vector mechanics of particles

Central forces: Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits, Application: Satellite manoeuvres

Five-term acceleration formula — Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion

Rigid body mechanics

De*finition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a* coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion;

Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples; Introduction to three-dimensional rigid body motion — (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor

Statics

Free body diagrams with examples on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases.

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1: Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems

Skill

CO2: Extend all of concepts of linear kinetics to systems in general plane motion

CO3: Apply basic dynamics concepts of force, momentum, work and energy to apply in Newton's laws of motion

CO4: Apply Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces

CO5: Apply the concepts of friction and conditions of equilibrium in two and three dimensions.

REFERENCES (BOOKS):

(i) Engineering Mechanics, 2nd ed. — MK Harbola
(ii) Introduction to Mechanics — MK Verma
(iii) An Introduction to Mechanics — D Kleppner & R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Gri_*ths*
(v) Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii) Mechanical Vibrations — JP Den Hartog
(viii) Theory of Vibrations with Applications — WT Thomson
(ix) An Introduction to the Mechanics of Solids, 2nd ed. with SI Units — SH Crandall, NC Dahl & TJ Lardner
(x) Engineering Mechanics: Statics, 7th ed. — JL Meriam
(xi)Engineering Mechanics of Solids — EP Popov

REFERENCES (WEBSITES):

1. https://www.edx.org/course/introduction-mechanics-part-1-ricex-phys-101-1x
2. https://learn.saylor.org/course/PHYS101
3. https://www.slideshare.net/KhanSaif2/1-introduction-to-mechanics-71503843

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1901GEX01	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common for all UG programmes, except BE- EEE)	L	T	P	C
		3	0	0	3

Aim of the course: To study about the fundamentals of Electrical, Electronics and Communication Engineering

PREREQUISITES:

COURSE CONTENTS

Introduction to DC and AC circuits: Ohms law - Kirchhoff's laws - Mesh analysis - Nodal analysis - Generation of AC waveforms - Analysis of R-L, R-C, R-L-C circuits - Introduction to three phase systems - Types of connections.

Electrical Machines: DC Generator, DC Motor, Transformer, Induction Motor: Working principle, construction and applications.

Measuring instruments: Classification of instruments; Voltmeter, Ammeter, Wattmeter, Energy meter, Multimeter, CRO: Principles and operation.

Semiconductor devices: V-I characteristics of PN junction diode and Zener diode; Rectifiers - Half wave and full wave rectifiers; BJT - configurations; Amplifiers & Oscillators: classification, operation and applications; SCR: Construction and V-I characteristics; Basic power converters (Block diagram approach only).

Digital systems: Boolean algebra - Reduction of Boolean expressions - De-Morgan's theorem - Logic gates - Implementation of Boolean expressions.

Communication Systems: Model of communication system - Analog and digital, Wired and wireless channel - Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system.

Electrical safety and wiring: Safety measures in electrical system - Safety devices - types of wiring - Wiring accessories-staircase, fluorescent lamps and corridor wiring - Basic principles of earthing - Types of earthing - layout of generation, transmission and distribution of power (Single line diagram).

COURSE OUTCOMES

Upon completion of this course, students will be able to

1.Solve very simple problems in DC and AC circuits
2.Explain the construction and principle of operation of DC and AC machines
3.Describe the operation of simple electrical measuring instruments
4.Elucidate the characteristics of diode, Zener diode, BJT, SCR and their applications
5.Implement Boolean expressions using logic gates
6.Explain the operation of functional blocks of various communication systems
7.Summarize the electrical safety systems and electrical wiring procedures

REFERENCES (BOOKS):

1. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, PHI Learning, 2010.
2. R. Muthusubramaniam, S. Salaivahanan and K.A. Mureleedharan, "Basic Electrical Electronics and Computer Engineering", Tata McGraw Hill, 2004.
3. D.P. Kothari and I.J. Nagrath, "Theory and Problems of Basic Electrical Engineering", PHI learning, New Delhi, 2004.
4. J.B. Gupta, "Fundamentals of Electrical Engineering and Electronics", S.K. Kataria and Sons, Reprint 2012 Edition.
5. R.L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson, 11th Edition, 2013.
6. George Kennedy and Bernard Davis, "Kennedy's Electronic communication Systems", McGraw Hill Education, 5th Edition, 2011.
7. Donald P. Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications", McGraw-Hill Education, 8th Edition, 2014.

REFERENCES (WEBSITES):

1. https://nptel.ac.in/courses/108108076/
2. https://nptel.ac.in/downloads/108105053/
3. https://nptel.ac.in/courses/117103063/
4. https://nptel.ac.in/courses/117102059/

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1901GEX02	ENGINEERING GRAPHICS (Common to all B.E./B.Tech. Programmes)	L	T	P	C
		2	0	2	3

MODULE I	**CONCEPTS AND CONVENTIONS (Not for Examination)**	
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
MODULE II	**PLANE CURVES AND FREE HAND SKETCHING**	**9 Hours**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of Objects.		
MODULE III	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**9 Hours**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
MODULE IV	**PROJECTION OF SOLIDS**	**9 Hours**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.		
MODULE V	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**9 Hours**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		
MODULE VI	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**9 Hours**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		
Stilled		**TOTAL: 45 HOURS**

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Perform free hand sketching of basic geometrical constructions and multiple views of objects.

CO2: Do orthographic projection of lines and plane surfaces.

CO3: Draw projections and solids and development of surfaces.

CO4: Prepare isometric and perspective sections of simple solids.

CO5: Demonstrate computer aided drafting

REFERENCES:

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore,2016.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2015.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2017.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2015.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2016.

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1901GEX51 CAD (COMPUTER AIDED DRAFTING) LAB L T P C

List of Experiments: **0 0 2 1**

Basics commands of a CAD software- two-dimensional drawing, editing, layering and dimensioning - coordinate Systems-Drawing practice - orthographic views of simple solids using CAD software.

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B-spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
7. Drawing isometric projection of simple objects.
8. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Total: 30 Hours

References:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014.
2. P.S. Gill, A Textbook of Machine Drawing, Katson books, 2013.
3. R.K. Dhawan, A Textbook of Machine Drawing, S. Chand,2012.
4. K.C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.,2009.

Employability.

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Subject Code	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY (Common for all UG programmes)	L	T	P	C
		-	-	2	1

Aim of the course : To apply the fundamentals of Electrical and Electronics Engineering

PREREQUISITES:

1. Experiments related to verification of Ohm's law and Kirchhoff's laws
2. Experiments involving logic gates
3. Fan and light control using regulators
4. Design of 6V regulated power supply
5. Energy conservation demonstration experiment using energy meter
6. Waveform generation and calculation of rms and average values
7. IC 555 and IC 741 based experiments
8. Experiments in earthing
9. Staircase wiring and residential building wiring
10. Speed control of DC shunt motor

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1: Design and analyze electronic circuits
CO2: Test digital logic gates
CO3: Control lights and speed of motors
CO4: Measure electrical parameters using instruments
CO5: Generate waveforms
CO6: Construct different wiring schemes.

REFERENCES (BOOKS):

1. Edward Hughes, " Electrical Technology,", Pearson Education
2. D.P. Kothari and Nagrath " Basic Electronics",MH Education 2013.
3. Paul Scherz and Simon Monk "Practical Electronics for inventors" Mc Graw Hill Publications 2013.

REFERENCES (WEBSITES):

1. https://nptel.ac.in/courses/122106025/

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1901PHX51	ENGINEERING PHYSICS LAB	L	T	P	C
		0	0	2	1

List of Experiments:

1. Determination of wavelength of various colours of mercury spectrum using Laser grating
2. Determination of velocity of liquids using ultrasonic interferometer
3. Determine the dispersive power of a prism using spectrometer
4. Determine the unknown resistance of the given wire using Carey-Foster"s Bridge
5. Determine the band gap of the given semiconductor
6. Determine the acceptance angle and particle size using Laser
7. Torsional pendulum – Rigidity modulus of a steel wire
8. Thickness of a thin wire – Air Wedge
9. Measurement of Young"s modulus – Uniform and Non-uniform bending
10. Thermal conductivity –Lee"s Disc method

Skill

Total: 30 Hours

References:

1. „Practical Physics", R.K. Shukla, Anchal Srivastava, New age international (2011)
2. „B.Sc. Practical Physics", C.L Arora, S. Chand &Co. (2012)

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1901HSX51	COMMUNICATION SKILLS LAB (Common for all B.E./B.Tech. Programme)	L	T	P	C
		0	0	2	1

Course Overview: English- being the foremost global language has its domination in internationally sensitive domains such as science and technology, business and commercial relation, education and diplomatic relationships, politics and administration and so on. It is the language of corporate India, a passport for better career, better pay, and advanced knowledge and for communication with the entire world. In higher education, English is the prevalent prestigious language. Careers in any area of business communication or within the government, or in science and technology require fluency in English

The basic idea behind offering English as a practical subject at the undergraduate level is to acquaint students with a language that enjoys currency as a lingua franca of the globe. For prospective engineers nothing could be more useful or productive than being able to reach out to the world of technology. In the ELCS lab the students are trained in Communicative English Skills, phonetics, word accent, word stress, rhythm and intonation, making effective oral presentations - both extempore and Prepared- seminars, group discussions, presenting techniques of writing, role play, telephonic skills, asking and giving directions, information transfer , debates, description of person, place, objects etc; . The lab encourages students to work in a group, engage in peer-reviews and inculcate team spirit through various exercises on grammar, vocabulary, listening and pronunciation games, etc

Objectives :

1.To facilitate computer-aided multi-media instruction enabling individualized and independent language learning

2.To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.

3.To train students to use language appropriately for interviews, group discussion and public speaking

4.To help the students to cultivate the habit of reading passages from the computer monitor, thus provides them the required facility to face computer-based competitive exams such as GRE, TOEFL, GMAT etc.

5.To train them to face interviews with confidence and enable them to prepare resume with cover letter.

6.To prepare them to use communicative language and participate in public speaking.

7.To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.

8.To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.

9.To expose the Students to participate in group discussions, debates with ease.

List of Exercises :

I	**Activities on Fundamentals of Listening and Inter-personal Communication**	**6 Hours**
	Listening to conversation, listening to technical presentation- listening to online video conferencing ,interviews and webinars -starting a conversation - responding appropriately and relevantly - using appropriate body language - Role Play in different situations & Discourse Skills- using visuals.	
II	**Activities on Reading Comprehension**	**6 Hours**
	General Vs Local comprehension- reading for facts- guessing meanings from context-Scanning-skimming and inferring meaning- critical reading & effective googling- TOFEL,IELTS-reading online journals.	
III	**Activities on Writing Skills**	**6 Hours**
	Structure and presentation of different types of writing - letter writing - Resume writing- e- correspondence - Proposal writing - Technical report writing - Portfolio writing - planning for writing - improving one's writing.	
IV	**Activities on Presentation Skills**	**6 Hours**
	Oral presentations (individual and group) through JAM sessions – presentation on online platform (webinars, online meeting) - seminars -PPTs and written presentations through posters- projects-report- e-mails- assignments etc.- creative and critical thinking.	
V	**Activities on Soft Skills**	**6 Hours**

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Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Time management-stress management –paralinguistic features-Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.

TOTAL: 30 HOURS

Course Outcomes (COs):

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

CO1: Compose grammatically correct sentences for oral as well as written communication.
CO2: Interpret perfectly after paying attention to an audio on any theme.
CO3: Organize formal presentations effectively.
CO4: Explain the content of any written or visual material.
CO5: Generate technical and non-technical documents with appropriate contents and context.
CO6: Monitor, analyse and adjust their own communication.

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , "Advanced Communication Skills Laboratory Manual" , Pearson Education 2011.
3. Paul V. Anderson ,"Technical Communication",. Cengage Learning pvt. Ltd. New Delhi, 2007.
4. "English Vocabulary in Use series", Cambridge University Press 2008.
5. "Management Shapers Series" ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., "Effective Technical Communication", Tata McGrawHill, New Delhi, 2005.
7. Jones, D, "The Pronunciation of English", CUP, . Cambridge,2002.

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B.E. Civil Engineering

FullTime Curriculum and Syllabus

First Year – Second Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1901MA201	Engineering Mathematics – II (Differential equations)	3	2	0	4	40	60	100
1901CH201	Water Technology and Green Chemistry	3	0	0	3	40	60	100
1901GEX03	Programming for Problem Solving	3	0	0	3	40	60	100
1901ENX01	English for Engineers	2	0	0	2	40	60	100
1901GE201	Engineering Exploration	2	0	0	2	40	60	100
Laboratory Course								
1901CHX51	Engineering Chemistry Lab	0	0	2	1	50	50	100
1901GE253	Basic Workshop Lab	0	0	2	1	50	50	100
1901GEX52	Computer Programming Lab	0	0	2	1	50	50	100
1901HSX51	Communication Skill Lab	0	0	2	1	50	50	100
1901GE252	Engineering Intelligence - II	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester

1901MA201	ENGINEERING MATHEMATICS –II (Differential equations)	L	T	P	C
		3	2	0	4

Aim of the course: This course focuses on acquiring sound knowledge of techniques involved in application of differentiation, eigen values and eigen vectors and using transformation of quadratic form into canonical form through orthogonal transformation acquaint with the concepts of multiple integrals, needed for problems in all engineering disciplines, develop an understanding of the standard techniques of Linear algebra theory so as to enable the student to apply them with confidence, in application areas such as Computer Graphics, Robotic Automations, Computer Vision Problems,Simulations and also make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

PREREQUISITES: Matices and determinants, differentiation, differential equations

MODULE I : ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS

Second order linear differential equations with variable coefficients, method of variation of parameters.

MODULE II: COMPLEX VARIABLE – DIFFERENTIATION

Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; Conformal mappings, Mobius transformations

MODULE III :COMPLEX VARIABLE – INTEGRATION

Contour Integrals, Cauchy Integral formula (without proof), Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

MODULE IV: SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

Solution of algebraic and transcendental equations – Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formulae. Numerical Differentiation (first two derivatives) Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 th rules (single integral)

MODULE V: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first order Equation.Milne's and Adam's predicator-corrector methods.

For Further Reading :

https://nptel.ac.in/courses/111/105/111105134/

Skilled

COURSE OUTCOMES

After completion of this course, students can able to

CO1: Identify the solutions to second order linear homogeneous differential equations with variable coefficients.

CO2: Construct analytic functions and describe the transformation of real plane into imaginary plane using conformal mappings.

CO3: Determine complex contour integrals by using fundamental theorem, Cauchy theorem and residues.

CO4: Utilize numerical differentiation and integration whenever and wherever routine methods are not applicable.

CO5: Develop the appropriate numerical technique and interpret the results for initial values problems governed by ordinary differential equations.

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3.S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4.E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5.E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6.G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.
7.J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
8.Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
9.N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
10.B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
11.P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
12.S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

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1901CH201	WATER TECHNOLOGY AND GREEN CHEMISTRY (for *CIVIL ENGINEERING*)	L	T	P	C
		3	0	0	3

Aim of the course: Imparting knowledge on the principles of Aqua chemistry, structural polymer, light weight materials, constructional materials and metals for constructions with their applications.

PREREQUISITES: Knowledge of chemistry in higher secondary level

MODULE-I AQUA CHEMISTRY

Aqua chemistry -Chemical speciation in the environment and major pollutants in the environment (in atmosphere and aqueous system some examples mercury, cadmium, arsenic and fluoride)- Aqua chemistry -Sources, hard & soft water-sampling techniques Degree of hardness and its estimation (EDTA method)– Water Quality Parameters. boiler feed water-requirements - softening of hard water -external treatment –demineralization, Zeolite process internal treatment- desalination of sea water –reverse osmosis- Domestic water treatment –disinfection of water -Physical and chemical principles applied to water and wastewater treatment.-mixing, coagulation, sedimentation, filtration, and chemical precipitation.

MODULE-II STRUCTURAL POLYMERS

Structural Polymers- Structural Plastics and Composites- Polymer Membranes - Coatings - Adhesives, Non Weathering Materials - Flooring and Facade Materials - Glazed Brick - Photo Catalytic Cement - Acid Etched Copper and Composite Fibres (frp)

MODULE-III LIGHTWEIGHT MATERIALS

Lightweight Materials -Neoprene, Bridge pads, thermocole, Smart and Intelligent Materials – Special features –Case studies showing the applications of smart and Intelligent Materials. Petroleum products, Bituminous Materials-Fly ash –rice husk ash - properties and its application.

MODULE-IV CONSTRUCTIONAL MATERIALS

Constructional Materials- Refractories: definition, classification, properties –Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement– Nanotube concrete -properties and uses.

MODULE-V METALS FOR CONSTRUCTIONS

Metals For Constructions- Basic composition of mild steel, High yield deformed steel (Tor), Stainless Steel, High tensile steel and TMT steel. Corrosion and lubricant. Welding and soldering of ferrous and non-ferrous metals- Aluminium, Brass, Copper and Titanium.

COURSE OUTCOMES Employability

After completion of the course, the student will be able to

CO1: Explain the Aqua chemistry and domestic water treatment process
CO2: Descibe the polymeric materials in construction work.
CO3: Explain the Lightweight Materials and its application
wave equations.
CO4: Descibe the various types of construction materials and its properties.
CO5: Explain the role of metals for Constructions

TEXT BOOKS:

1. 1 Dara.S, Umare.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New delhi 2010.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age
4. Kumar Mehta P. and Paulo J. M. Monteiro, (2014), Concrete: Microstructure, Properties and Materials, 4th Edition, McGraw-Hill, New Delhi.
5. Shetty. M. S., (2017), Concrete Technology, S. Chand and Company Ltd, New Delhi.
6. Neville. A. M, (2012), Properties of Concrete, Pearson, New Delhi.
7. ACI 211.1-91 Reapproved 2009, Standard Practice for selecting Proportions for Normal, Heavyweight, and Mass Concrete, USA

REFERENCES (WEBSITES):

1. https://www.ccdc.cam.ac.uk/solutions/csd-system/components/csd/
2. onlinelibrary.wiley.com/doi/10.1002/9780470661345.smc107/pdf

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	L	T	P	C
PROGRAMMING FOR PROBLEM SOLVING (Common for all B.E./B.Tech Programme)	3	0	0	3

1901GEX03

COURSE OBJECTIVES:

1. To prepare students to comprehend the fundamental concepts
2. To demonstrate fine grained operations in number system
3. To gain exposure in programming language using C
4. To develop programming skills using the fundamentals and basics of C Language

MODULE I INTODUCTION TO PROGRAMMING **9 Hours**

Components of Computers and its Classifications- Problem Solving Techniques – Algorithm- Flowchart– Pseudo code – Program-Compilation -Execution

MODULE II BASICS OF C PROGRAMMING **9 Hours**

Structure of C program - C programming: Data Types – Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/output statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives.

MODULE III ARRAYS AND STRINGS **9 Hours**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – Example Program: Matrix Operations - String operations

MODULE IV FUNCTIONS AND POINTERS **9 Hours**

Introduction to functions: Function prototype, function definition, function call, Built-in functions – Recursion – Example Program – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference

MODULE V STRUCTURES & FILE PROCESSING **9 Hours**

Structure - Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Dynamic memory allocation -Files – Types - File processing: Sequential access, Random access -Command line arguments

TOTAL: 45 HOURS

FURTHER READING:

Object Oriented Programming Approach.

COURSE OUTCOMES: Skilled

On the successful completion of the course, students will be able to

CO1: Describe basic concepts of computers
CO2: Paraphrase the operations of number system
CO3: Describe about basic concepts of C-Language
CO4: Understand the code reusability with the help of user defined functions
CO5: Analyze the structure concept, union, file management and preprocessor in C language

REFERENCES:

1. Paul Deitel and Harvey Deitel, —C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, —Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, —Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

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1901ENX01	ENGLISH FOR ENGINEERS (Common for all B.E./B.Tech. Programme)	L	T	P	C
		3	0	0	3

Course Overview :

The course "English for Engineers" aims at honing the basic language skills of the learners. The course is a combination of introducing the rudiments of grammar and application of the principles in both verbal and written expressions. Students are trained to read and comprehend technical texts in the field of engineering. They are guided to acquire vocabulary building and write efficiently in technical writing .The course has been deftly planed and the learners are guided to use the LSRW skills for acquiring their technical knowhow and exhibiting their technical achievement by verbal and written mode .Students are encouraged to use English as a tool to get technical knowledge and display their attainment

Objective:

1.To teach the students to interpret grammatically correct sentences for oral as well as written communication.
2.To make the learners to identify perfectly after paying attention to an audio on any theme.
3.To expose the students to demonstrate formal presentations effectively.
4.To cultivate learners to explain the content of any written or visual material.
5.To help the learners to get trained in describing technical and non-technical documents with appropriate contents and context.
6.To motivate the students to classify, analyse and adjust their own communication.

MODULE I	FOCUS ON LANGUAGE (Vocabulary and Grammar)	9 Hours

Vocabulary -The Concept of Word Formation - Prefixes- Suffixes- Synonyms – Antonyms - Grammar -Articles- Preposition- Adjective-Adverb-Connectives -Tenses (present, past & future) - Conditional Clauses -Active voice –passive voice and Impersonal passive voice - Wh- Questions

MODULE II	LISTENING SKILLS	9 Hours

Listening-Types of Listening -listening to short or longer texts- listening and Note taking- -formal and informal conversations- telephonic etiquettes- narratives from different sources. - Correlative verbal and nonverbal communication - listening to panel members (how to response to panel members after listening panel members) – listening to facing online interviews (or) interviews on video conferencing mode - listening webinars.

MODULE III	SPEAKING SKILL	9 Hours

Speaking - Stress and intonation –Communication skills- Role of ICT in Communication, -Process of communication- oral presentation skills- verbal and non verbal communication-individual and group presentations- impromptu presentation- public speaking- Group discussion- speaking to the panel members (online interviews , video conferencing, online meeting and webinars.

MODULE IV	READING SKILLS	9 Hours

Reading– Intensive Reading –Predicting the content -Comprehending general and technical articles -Cloze reading - Inductive reading- Short narrative and descriptions from newspapers – Skimming and scanning-reading and interpretation-critical reading interpreting and transferring graphical information- sequencing of sentences-analytical reading on various Projects.

MODULE V	WRITING SKILLS	9 Hours

Writing- Precise writing –Summarizing- Interpreting visual texts (pie chart, bar chart, picture, advertisements etc., - Proposal writing (launching new units or department in a institution or industry & to get loan from bank) -Report writing (accident, progress, project, survey, Industrial visit)- job application-e- mail drafting- letter writing (permission, accepting and decaling)- e.mail drafting instructions –recommendations –checklist- uses of Print and electronic media (internet, fax, mobile, interactive video and teleconferencing, computer) e-governance.

TOTAL: 45 HOURS

Course Outcomes (COs): After successful completion of the course, students will be able to

Skilled

CO1: Interpret grammatically correct sentences for oral as well as written communication.
CO2: Identify perfectly after paying attention to an audio on any theme.
CO3: Demonstrate formal presentations effectively.
CO4: Explain the content of any written or visual material.
CO5: Describe technical and non-technical documents with appropriate contents and context.
CO6: Classify, analyse and adjust their own communication.

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Rizvi and Ashraf M., "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005.
3. G. Radhakrishna Pillai, "English for Success", Central Institute of English and Foreign Languages", Emerald Publishers ,Hyderabad, 2003
4. Jones. D, "The Pronunciation of English", CUP, Cambridge, 2002.

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1901GE201	ENGINEERING EXPLORATION	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- Build mindsets & foundations essential for designers
- Learn about the Human-Centered Design methodology and understand their real-world applications
- Use Design Thinking for problem solving methodology for investigating ill-defined problems.
- Undergo several design challenges and work towards the final design challenge
- Apply Design Thinking on the following Streams to Project Stream 1: Electronics, Robotics, IOT and Sensors Project Stream 2: Computer Science and IT Applications Project Stream 3: Mechanical and Electrical tools

Project Stream4: Eco-friendly solutions for waste management, infrastructure, safety, alternative energy sources, Agriculture, Environmental science and other fields of engineering.

HOW TO PURSUE THE PROJECT WORK?

- The first part will be learning-based-masking students to embrace the methodology by exploring all the phases of design thinking through the wallet/ bag challenge and podcasts.
- The second part will be more discussion-based and will focus on building some necessary skills as designers and learning about complementary material for human- centered design.
- The class will then divide into teams and they will be working with one another for about 2 – 3 weeks. These teams and design challenges will be the basis for the final project and final presentation to be presented.
- The teams start with Design Challenge and go through all the phases more in depth from coming up with the right question to empathizing to ideating to prototyping and to testing.
- Outside of class, students will also be gathering the requirements, identifying the challenges, usability, importance etc
- At the end, Students are required to submit the final reports, and will be evaluated by the faculty.

Skilled

TASKS TO BE DONE:

Task 1: Everyone is a Designer

- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast

- Gain a quick introduction to the design thinking methodology
- Go through all stages of the methodology through a simple design challenge
- Podcast: Observe, Listen and Engage with the surrounding environment and identify a design challenge.

Task 3: Teams & Problems

- Start Design Challenge and learn about teams & problems through this
- Foster team collaboration, find inspiration from the environment and learn how to identify problems

Task 4: Empathizing

- Continue Design Challenge and learn empathy
- Learn techniques on how to empathize with users
- Go to the field and interview people in their environments
- Submit Activity Card

Task 5: Ideating

- Continue Design Challenge and learn how to brainstorm effectively
- Encourage exploration and foster spaces for brainstorming
- Submit Activity Card

Task 6: Prototyping

- Continue Design Challenge and learn how to create effective prototypes
- Build tangible models and use them as communication tools
- Start giving constructive feedback to classmates and teammates
- Submit Activity Card

Task 7: Testing

- Finish Design Challenge and iterate prototypes and ideas through user feedback

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- Evolve ideas and prototypes through user feedback and constructive criticism
- Get peer feedback on individual and group performance
- Submit Activity Card Task 8:
- Final Report Submission and Presentation

- Method of Evaluation: Same as Mini project category. Project exhibition may be conducted.

REFERENCES:

1. Tom Kelly, The Art of Innovation: Lessons in Creativity From IDEO, America's Leading Design Firm (Profile Books, 2002)
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (HarperBusiness, 2009)
3. Jeanne Liedtka, Randy Salzman, and Daisy Azer, Design Thinking for the Greater Good: Innovation in the Social Sector (Columbia Business School Publishing, 2017)

OTHER USEFUL DESIGN THINKING FRAMEWORKS AND METHODOLOGIES:

1. Human-Centered Design Toolkit (IDEO); https://www.ideo.com/post/design-kit
2. Design Thinking Boot Camp Bootleg(Stanford D-School); https://dschool.stanford.edu/resources/the-bootcamp-bootleg
3. Collective Action Toolkit (frogdesign); https://www.frogdesign.com/wpcontent/uploads/2016/03/CAT_2.0_English.pdf
4. Design Thinking for Educators (IDEO); https://designthinkingforeducators.com/

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1901CHX51	ENGINEERING CHEMISTRY LAB	L	T	P	C
		0	0	2	1

Aim of the course: Engineering Chemistry laboratory course is designed to provide basic chemistry and its application to the first year engineering students. The course includes the study of applications of water quality chemistry, identification of acidic and alkaline nature of water,molecular weight determination and explaining the principles behind each experiments.

List of Practical Experiments

1. Determination of total, temporary & permanent hardness of water by EDTA method
2. Determination of strength of given hydrochloric acid using pH meter
3. Estimation of iron content of the given solution using potentiometer
4. Estimation of sodium present in water using flame photometer
5. Corrosion experiment – weight loss method
6. Determination of molecular weight of a polymer by viscometry method
7. Conductometric titration of strong acid Vs strong Base
8. Estimation of dissolved oxygen in a water sample/sewage by Winklers method.
9. Comparison of alkalinities of the given water samples
10. Determination of concentration of unknown colored solution using spectrophotometer
11. Determination of percentage of copper in alloy
12. Determination of ferrous iron in cement by Spectrophotometry method
13. Adsorption of acetic acid on charcoal
14. Determination the flash point and fire point of a given oil using Pensky martine closed cup apparatus
15. Determination the calorific value of solid fuels
16. Determination the structural of the compound using chemo software.

COURSE OUTCOMES Employability

After completion of the course, the student will be able to

CO1: Measure the hardness and alkalinity of given water sample

CO2: Find the amount and percentage of iron in unknown sample using EMF and photometric methods

CO3: Determine the amount of strong acid present in the given sample using PH metric and conductometric methods

CO4: Determine the amount of dissolved oxygen and heavy metal present in the given sample

CO5: Determine the molecular weight of the given polymer

TEXT BOOKS:

1. Experimental organic chemistry, Daniel R. Palleros, John Wiley & Sons, Inc., New Yor (2001)
2. "Engineering Chemistry", Jain & Jain, 15th edition, Dhanpat Rai Publishing company, New Delhi.
3. Vogel"s Textbook of practical organic chemistry, Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R LBS Singapore (1994).
4. LBS Singapore (1994). Kolthoff I.M., Sandell E.B. et al Mcmillan, Madras 1980.

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1901GE253	BASIC WORKSHOP AND MANUFACTURING PRACTICES LAB (Common to Civil, EEE and MECH.)	L	T	P	C
		0	0	2	1

List of Experiments Skilled

1. Forming of simple object in sheet metal using suitable tools.(Example: Dust Pan, Rectangular tray and Cone making)
2. Prepare V (or) Half round (or) Square (or) Dovetail joint from the given mild Steel flat.
3. Fabrication of a simple component using thin and thick plates using arc welding.

   (Example: Butt , Lap and T - Joints)
4. Making a simple component using carpentry power tools.(Example: Cross Lap, T-Lap and Dove tail joints)
5. Construct a household pipe line connections using pipes, Tee joint, four way joint, elbow, union, bend, Gate valve and Taps.

TOTAL: 30 Hours

REFERENCES: Lab manual

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1901GEX52	COMPUTER PROGRAMMING LAB	L T P C 0 0 2 1

(Common for all B.E./B.Tech. Programme)

List of Experiments:

1. Working with word and style sheets
2. Write a C program to implement basic concepts
3. Write a C program to implement Decision Making and Branching statements
4. Write a C program to implement looping statements
5. Write a C program to implement Arrays
6. Write a C program to implement Strings
7. Write a C program to implement pointers
8. Write a C program to implement Structures
9. Write a C program to work with files in C

Skilled

Total: 45 Hours

References:

1. Paul Deitel and Harvey Deitel, —C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, —Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, —Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw- Hill Education, 1996.

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1901HSX51	COMMUNICATION SKILLS LAB	L T P C 0 0 2 1

(Common for all B.E./B.Tech. Programme)

Course Overview:

English- being the foremost global language has its domination in internationally sensitive domains such as science and technology, business and commercial relation, education and diplomatic relationships, politics and administration and so on. It is the language of corporate India, a passport for better career, better pay, and advanced knowledge and for communication with the entire world. In higher education, English is the prevalent prestigious language. Careers in any area of business communication or within the government, or in science and technology require fluency in English The basic idea behind offering English as a practical subject at the undergraduate level is to acquaint students with a language that enjoys currency as a lingua franca of the globe. For prospective engineers nothing could be more useful or productive than being able to reach out to the world of technology. In the ELCS lab the students are trained in Communicative English Skills, phonetics, word accent, word stress, rhythm and intonation, making effective oral presentations - both extempore and Prepared- seminars, group discussions, presenting techniques of writing, role play, telephonic skills, asking and giving directions, information transfer , debates, description of person, place, objects etc; . The lab encourages students to work in a group, engage in peer-reviews and inculcate team spirit through various exercises on grammar, vocabulary, listening and pronunciation games, etc

Objectives :

- To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.
- To train students to use language appropriately for interviews, group discussion and public speaking
- To help the students to cultivate the habit of reading passages from the computer monitor, thus provides them the required facility to face computer-based competitive exams such as GRE, TOEFL, GMAT etc.
- To train them to face interviews with confidence and enable them to prepare resume with cover letter.
- To prepare them to use communicative language and participate in public speaking.
- To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.
- To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.
- To expose the Students to participate in group discussions, debates with ease.

List of Exercises :

I Activities on Fundamentals of Listening and Inter-personal Communication 6 Hours

Listening to conversation, listening to technical presentation- listening to online video conferencing ,interviews and webinars -starting a conversation - responding appropriately and relevantly - using appropriate body language - Role Play in different situations & Discourse

II Activities on Reading Comprehension 6 Hours

General Vs Local comprehension- reading for facts- guessing meanings from context-Scanning-skimming and inferring meaning- critical reading & effective googling- TOFEL,IELTS-reading online journals.

III Activities on Writing Skills 6 Hours

Structure and presentation of different types of writing - letter writing - Resume writing- e- correspondence - Proposal writing - Technical report writing - Portfolio writing - planning for writing - improving one's writing

IV Activities on Presentation Skills 6 Hours

Oral presentations (individual and group) through JAM sessions – presentation on online platform (webinars, online meeting) - seminars -PPTs and written presentations through posters- projects- report- e-mails- assignments etc.- creative and critical thinking.

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V Activities on Soft Skills **6 Hours**

Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Time management-stress management –paralinguistic features- Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.

TOTAL: 30 HOURS

Course Outcomes (COs):

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

CO1: Compose grammatically correct sentences for oral as well as written communication.

CO2: Interpret perfectly after paying attention to an audio on any theme.

CO3: Organize formal presentations effectively.

CO4: Explain the content of any written or visual material.

CO5: Generate technical and non-technical documents with appropriate contents and context. CO6: Monitor, analyse and adjust their own communication.

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , "Advanced Communication Skills Laboratory Manual" , Pearson Education 2011.
3. Paul V. Anderson ,"Technical Communication",. Cengage Learning pvt. Ltd. New Delhi, 2007.
4. "English Vocabulary in Use series", Cambridge University Press 2008.
5. "Management Shapers Series" ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., "Effective Technical Communication", Tata McGrawHill, New Delhi, 2005.
7. Jones, D, "The Pronunciation of English", CUP, . Cambridge,2002.

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1901GE252 ENGINEERING INTELLIGENCE II **L T P C**
0 0 2 1

Prerequisite: Engineering Intelligence - I

MODULE I VOCABULARY BULIDING **6 Hours**
Parts of Grammar- SVA- Art of Writing- word building activities

MODULEII COMMUNICATION WORKSHOP **6 Hours**
Story Telling- Newspaper Reading-Extempore.

MODULEIII INTERPERSONAL SKILLS **6 Hours**
Personality Development - Creativity and innovation –Critical Thinking and Problem Solving – Work Ethics-Technical Skill Vs Interpersonal Skills

MODULEIV LEADERSHIP& EMPLOYABILITY SKILLS **6 Hours**
Levels of Leadership-Making of leader-Types of leadership-Transactions Vs Transformational Leadership – Exercises - Industry Expectations & Career Opportunities- Recruitment patterns.

MODULE V RESUME BUILDING **6 Hours**
Importance of Resume- Resume Preparation - introducing onself

TOTAL: 30 HOURS

Course Outcomes:
On the successful completion of the course, students will be able to
CO1: Understand various vocabulary building activites
CO2: Use various communication skill workshop for reading and writing.
CO3: Apply interpersonal skill to motivate creating and innovating skills
CO4: Apply various leadership and employability skill to get career opportunities
CO5: Prepare resume with necessary components

REFERENCES:
1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxfor Publishers.
2. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007.
3. Arun Sharma and Meenakshi Upadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017.

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NAGAPATTINAM – 611 002

B.E. Civil Engineering

Full Time Curriculum and Syllabus

Second Year – Third Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1902ME301	Engineering Mechanics	3	0	0	3	40	60	100
1902CE301	Engineering Geology	3	0	0	3	40	60	100
1902CE302	Fluid Mechanics and Machines	3	0	0	3	40	60	100
1902CE303	Strength of Materials	3	0	0	3	40	60	100
1902CE304	Engineering Surveying	3	0	0	3	40	60	100
Laboratory Course								
1902CE351	Surveying Lab	0	0	2	1	50	50	100
1902CE352	Strength of Materials Lab	0	0	2	1	50	50	100
1902CE353	Fluid Mechanics and Machines Lab	0	0	2	1	50	50	100
1904GE351	Life Skills: Soft Skills	0	0	2	1	100	-	100
Audit Course								
1901MCX01	Environmental Science	3	0	0	0	-	-	-

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1902ME301	ENGINEERING MECHANICS (Common to B.E Civil and Mechanical Engineering)	L	T	P	C
		3	0	0	3

MODULE I	BASIC CONCEPTS AND FORCE SYSTEM	09 Hours
Introduction to mechanics - idealization of mechanics - laws of mechanics - principle of transmissibility - vector - addition, subtraction and product. Force- types - system of forces - resultant forces - composition of forces - resolution of force-free body diagram for real world systems.		
MODULE II	**STATICS OF PARTICLES AND FORCE SYSTEM**	**09 Hours**
Equilibrium of particle in space, moment of couple-equilibrant Moment about point and specific axis-moment at couple- simplification of force and couple systems.		
MODULE III	**STATICS OF RIGID BODIES**	**09 Hours**
Equilibrium of rigid bodies in two and three dimensions - beams - types of loads, supports and their reactions Two and three force Members-Static determinacy.		
MODULE IV	**PROPERTIES OF SURFACES AND SOLIDS**	**09 Hours**
Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas Parallel axis theorem radius of gyration of area- product of inertia- mass moment of inertia.		
MODULE V	**DYNAMICS OF PARTICLES AND FRICTION**	**09 Hours**
Displacement, Velocity and Acceleration their relationship–Relative Motion–Curvilinear motion-Introduction - mechanism of friction-types -laws of friction - friction on horizontal and inclined planes, ladder and wedge friction – rolling resistance.		
		TOTAL: 45 HOURS

Course outcomes: Employability

CO1: Draw a free body diagram from the given real-world system and add or subtract or resolve the forces involved in the system.

CO2:. Calculate the moment created by the applied force with reference to any reference in a three-dimensional space.

CO3: Determine the appropriate support system for the given real-world system by calculating the reactions generated.

CO4: Suggest suitable cross section or geometry for a load bearing support to prevent it from collapsing due to bending

CO5: Calculate the frictional force involved in various real-world systems.

REFERENCES:

1. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers - Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007.
2. N.H. Dubey, Engineering Mechanics- Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2013.
3. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2006.
4. R.C. Hibbeller, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009.
5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010.
6. S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.
7. Nptel.ac.in

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1902CE301	ENGINEERING GEOLOGY	L	T	P	C
		3	0	0	3

UNIT I	PHYSICAL GEOLOGY	9 Hours

Geology in civil engineering – branches of geology – structure of earth and its composition – weathering of rocks – scale of weathering – soils - landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics – Earth quakes – Seismic zones in India.

UNIT II	MINEROLOGY	9 Hours

Physical properties of minerals – Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals.

UNIT III	PETROLOGY	9Hours

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

UNIT IV	STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS	9Hours

Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering. Geophysical methods – Seismic and electrical methods for subsurface investigations.

UNIT V	APPLICATION OF GEOLOGICAL INVESTIGATIONS	9Hours

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings – Hydro geological investigations and mining - Coastal protection structures. Investigation of Landslides, causes and mitigation.

	Total:	45Hours

Course outcomes: Employability

1. Illustrate the concepts of geological formations, weathering and plate tectonics above and below the surface of the earth.
2. Interpret the physical, mechanical and engineering properties of minerals.
3. Classify the rocks based on their origin, composition, engineering properties and uses.
4. Discuss the geological structures such as fold, fault, joints etc and Outline the subsurface the geological formation by geophysical investigation using seismic and electric method.
5. Describe the geological condition for construction of dams, tunnels, building and road cuttings.

References:

1. Parbin Singh. A "Text book of Engineering and General Geology", Katson publishing house, Ludhiana 2009.
2. Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India Learning Private Limited, New Delhi, 2012.
3. Venkat Reddy. D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2010.
4. Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2010
5. Gokhale KVGK, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2011.

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1902CE302	FLUID MECHANICS AND MACHINES	L	T	P	C
		3	0	0	3

UNIT I	**FLUID PROPERTIES AND FLUID STATICS**	**9 Hours**

Fluid properties - density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, capillarity and surface tension. Fluid statics- Hydrostatic law -Pascal's law - Pressure measurement - Buoyancy and meta-centre.

UNIT II	**FLUID KINEMATICS AND FLUID DYNAMICS**	**9 Hours**

Classification of fluid flow - Reynolds Transport Theorem - Velocity and acceleration - Continuity equation - Stream line, Streak line, Path line, Velocity Potential and Stream function. Dynamics: Euler's equations of motion - Bernoulli's theorem and proof - Application of Bernoulli's equation - Pitot tube, Orifice meter, Venturi meter.

UNIT III	**FLOW THROUGH PIPES AND FLOW PROFILE**	**9 Hours**

Development of laminar and turbulent flows in circular pipes - Hagen-Poiseuille equation - Darcy-Weisbach equation - Major and minor losses - pipes in series and in parallel. Empirical formulae for friction loss - Definition and differences between pipe flow and open channel flow - Types of Flow- gradually varied flows- rapidly varied flow (concept only) and application- Hydraulic jumps.

UNIT IV	**DIMENSIONAL ANALYSIS, SIMILITUDE AND MODEL ANALYSIS**	**9 Hours**

Dimensional homogeneity - Dimensionless numbers - Methods of dimensional analysis -Rayleigh's method - Buckingham's pi theorem - Method of selecting repeating variables - Types of similarities-Hydraulic similitude - Model analysis - Types of models - Similarity laws.

UNIT V	**PUMPS AND TURBINES**	**9 Hours**

Impulse-momentum principle - Impact of jet - Velocity triangle - Types of pumps - Properties of centrifugal pump - Pump characteristics - Specific speed, NPSH, slip - Reciprocating pump -Indicator diagram - Classification of turbines - Efficiency of turbines.

	Total:	**45 Hours**

COURSE OUTCOMES: Employability

1. Explain the fundamental properties of fluids and methods of pressure measurement in fluid statics.
2. Understand the principles of kinematics with specific emphasis on application of continuity equation, stream function etc.
3. Identify factors affecting flow through pipes to estimate head loss and understand the flow profile concept.
4. Assess the performance of a model by dimensional analysis and similitude.
5. Compute the efficiency and performance of pumps and turbines

REFERENCES:

1. Jain. A.K., "Fluid Mechanics", Khanna Publishers, Delhi,2010.
2. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi,2002.
3. Subramanya K., "Flow in open channels", Tata McGraw Hill, New Delhi,2000.
4. Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York,2009.
5. Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi,2008.
6. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi,2008.
7. Mays L. W., "Water Resources Engineering", John Wiley and Sons (WSE), New York, 2005.

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1902CE303	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

UNIT I	**STRESS, STRAIN AND ENERGY PRINCIPLES**	**9 Hours**

Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law – Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses –Resilience- Strain Energy due to Axial load, shear, flexure and torsion – Compound Bars. Castigliano's theorems - Principle of virtual work – application of energy theorems for computing deflections in beams and trusses.

UNIT II	**SHEAR AND BENDING IN BEAMS**	**9 Hours**

Theory of Simple Bending - Shear force and Bending Moment Diagrams for statically determinate beam and indeterminate beam with different loading conditions.

UNIT III	**COLUMNS AND CYLINDER**	**9 Hours**

Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core section – Thin and Thick cylinders – Compound cylinders.

UNIT IV	**TORSION**	**9 Hours**

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel – Design of buffer springs.

UNIT V	**STATE OF STRESS IN TWO AND THREE DIMENSIONS**	**9 Hours**

2D State of Stress – 2D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle - Determination of 3D principal stresses and principal planes – Volumetric strain –Theories of failure – Principal stress - Principal strain – shear stress – Strain energy and distortion energy theories – application in analysis of stress, load carrying capacity.

Employability

Total:	**45 Hours**

Course outcomes After completion of the course, Student will be able to

1. Explain the fundamental concepts of stress and strain in mechanics of solids and structures.
2. Determine Shear force and bending moment in indeterminate beams and determinate beams.
3. Solve the long and short columns and determine the design loads.
4. Calculate the power transmission by the shaft and deflection of spring using torsional properties.
5. Discuss about the principal stresses and planes for an element in three-dimensional state of stress and study various theories of failure.

REFERENCES (BOOKS):

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi,2007.
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi,2010.
3. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi,2009.
4. Bansal.R.K "Strength of materials", Laxmi Publications (P) Ltd, New Delhi2014.
5. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, NewDelhi,1995.
6. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, NewDelhi-1997

REFERENCES (WEBSITES):

7. https://nptel.ac.in/courses/105105108/
8. https://nptel.ac.in/courses/105106172/

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1902CE304	ENGINEERING SURVEYING	L	T	P	C
		3	0	0	3

UNIT I	**CHAIN SURVEYING**	**9 Hours**
Definition – Objectives and uses of surveying – Chain Surveying – Instrument used for chaining- Types of Chains and Tapes – Chaining – Ranging – Tape Correction – Problems.		
UNIT II	**COMPASS SURVEYING**	**9 Hours**
Prismatic Compass: Construction Details functions and Temporary adjustment – Types of Bearings – Problems – Local Attraction – Direction correction – Problems.		
UNIT III	**LEVELING**	**9 Hours**
Levelling – Levels – Functions – Accessories – Types of levels: Dumpy level – Leveling staff – Bench Mark – Reduced Level – Rise and Fall – Line of Collimation – Back Site – Fore Site – Intermediate Site – Change Point – Height of Instruments – Problems.		
UNIT IV	**CURVES**	**9 Hours**
Types of Curves – Elements of simple circular curve – Simple curve – Transition curve – Vertical Curve.		
UNIT V	**GPS & TOTAL STATION SURVEYING**	**9 Hours**
Basic Concept – Different Segment – Space Control and user segments – Signal structure – Hand Held receivers – Basic Principles – Measuring and Working Principles – Sources of errors – Maintenances of total station Instruments.		
	Total:	**45 Hours**

Employability

Course outcomes:

1.	Appreciate the need for accurate and through note taking in field work to serve as a legal record.
2.	Gain a basic understanding of the principles and operation of the Compass.
3.	Gain the ability to measure difference in elevation, leveling the ground using Dumpy Level.
4.	Improve ability to design curves in Highways Alignment.
5.	Gain a basic understanding of the principles and operation of the global position system & Total Station.

REFERENCES:

1. Roy S.K.,"Fundamentals of Surveying", 2nd Edition, Prentice Ha of India,2004
2. Arora K.R.,"Surveying Vol 1& 2", Standard Book House, 10th Edition2008.
3. Alfred Leick,"GPS statellite Surveying", John Wiley & Sons Inc., 3rd Edition,2004.
4. Goucheng Xu,"GPS Theory, Agorithms and Appications", Springer – Berlin,2003.
5. Satheesh Gopi, rasathish Kumar, N. Madhu,"Advanced Surveying, Total Stations GPS and Remote Sensing" Pearson education,2007.
6. https://nptel.ac.in/courses/105/107/105107122/
7. https://nptel.ac.in/courses/105/107/105107121/

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1902CE351	SURVEYING LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Survey of an Area by Chain (Closed Traverse and Plotting).
2. Chaining Across Obstacles (Obstacles to Ranging but not Chaining).
3. Chaining Across Obstacles (Obstacles to Chaining but not Ranging).
4. Chaining Across Obstacles (Obstacles to both Chaining and Ranging).
5. Determination of Distance between Two Inaccessible Points with Compass.
6. Survey of a given area by Prismatic Compass (Closed Traverse) and plotting after adjustment.
7. Fly levelling using Dumpy level (Differential Leveling).
8. Longitudinal Section and Cross Section.
9. Study of Theodolite.
10. Measurement of Horizontal Angle by Repetition Method.
11. Measurement of Horizontal Angle by Reiteration Method.
12. Determining a Height of Object by Measuring Vertical Angle.
13. Stake Out suing Total Station (Demonstration).

Total: 45 Hours

ADDITIONAL EXPERIMENTS:

1. Using in the field for taking levelling checking and measurements.
2. Electronic instrument

Course outcomes: Employability

After completion of the course, Student will be able to

CO1	On completion of this course student shall be able to understand the Surveying of the Lands and Plots using various method.
CO2	Understanding the working principle of all surveying instruments.
CO3	Understanding the usage of Surveying equipment's in various construction fields.

REFERENCES:

1. G. Brancato, S. Macchia, M. Murgia, M. Signore, G. Simeoni - Italian National Institute of Statistics, ISTAT.
2. K. Blanke, T. Körner, A. Nimmergut - Federal Statistical Office Germany, FSO.
3. P. Lima, R. Paulino - National Statistical Institute of Portugal, INE
4. J.H.P. Hoffmeyer-Zlotnik - German Center for Survey Research and Methodology, ZUMA.
5. Surveying Lab Manual – A.Pirakasam, AP/Civil, EGSPEC

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1902CE352	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Tension test on Mild steel rod
2. Tension test on tor steel rod
3. Torsion test on MS bar
4. Tension and compression test on springs
5. Compression test on bricks and concrete cubes
6. Water absorption test on bricks
7. Brinell and Rockwell Hardness test
8. Compression and bending test on wood specimens
9. Charpy and Izod Impact Test
10. Double shear test
11. Test on cement

Total: 45 Hours

Course Outcomes:

1. The experimental works involved in this laboratory make the student to determine the properties of different structural elements.
2. The student should be able to obtain the strength of the material and stiffness properties of structural elements.

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008, Specification for cold worked steel high strength deformed bars for concrete reinforcement, 2008.
3. Strength of Materials Lab Manual – G.Prakash, AP/Civil, EGSPEC

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1902CE353	FLUID MECHANICS AND MACHINES LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Calibration of Rotometer
2. Flow through Venturimeter Orifice meter
3. Flowthrough variable ductarea -Bernoulli's Experiment
4. Flow through Orifice, Mouthpiece and Notches
5. Determination of friction coefficient in pipes
6. Determination of loss coefficients for pipe fittings
7. Characteristics of Centrifugal pumps
8. Characteristics of Gear pump
9. Characteristics of Submersible pump
10. Characteristics of Reciprocating pump
11. Characteristics of Pelton wheel turbine
12. Characteristics of Francis turbine
13. Characteristics of Kaplan turbine

Total: 45Hours

COURSE OUTCOMES:

1.measure the flow properties of fluid
2.conduct the experiment to find the losses in pipes
3.conduct experiment to find characteristics curves of various pumps
4.conduct experiment to find characteristics curves of various turbines

ADDITIONAL EXPERIMENTS:

1.Characteristics of multi stage Centrifugal pumps
2.Characteristics of jet on vane

REFERENCES:

1. Sarbjit Singh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd,Learning
2. Private Limited, Delhi,2009.
3. "Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, 2004.
4. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2000.
5. Subramanya K. "Flow in open channels", Tata McGraw Hill Publishing. Company, 2001
6. Fluid Mechanics and Machinery Lab Manual – E.Venkatesan, AP/Civil, EGSPEC

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1904GE351	LIFE SKILLS: SOFT SKILLS	L	T	P	C
		0	0	2	1

MODULE I	**INTRODUCTION TO SOFT SKILLS**	**6 Hours**
Soft Skills an Overview - Basics of Communication – Body Language – Positive attitude –Improving Perception and forming values – Communicating with others.		
MODULE II	**TEAM VS TRUST**	**6 Hours**
Interpersonal skills – Understanding others – Art of Listening - Group Dynamics –Essential of an effective team - Individual and group presentations - Group interactions – Improved work Relationship		
MODULE III	**SELLING ONESELF**	**6 Hours**
How to brand oneself – social media – job hunting – Resume writing – Group Discussion – Mock G.D - .Interview skills – Mock Interview		
MODULE IV	**PROPERTIES OF PURE SUBSTANCES**	**6 Hours**
What is Etiquette – Key Factors – Greetings – Meeting etiquette – Telephone etiquette – email etiquette – Dining etiquette – Dressing etiquette		
MODULE V	**GAS MIXTURES AND PSYCHROMETRIC PROPERTIES**	**6 Hours**
1. My family. Myself. 2. Meeting people. Making Contacts. 3. A city. Getting about town. 4. Our flat. Home life. 5. Travelling. Going abroad. 6. Going through Customs.7. At a hotel. 8. Shopping. 9. Eating out.10. Making a phone call.11.A modern office.12. Discussing business.		
		TOTAL: 30 HOURS

Skilled.

REFERENCES:

1. Dr. K. Alex, "soft skills", Third Edition, S.Chand& Publishing Pvt Limited,2009.
2. Arunakoneru, "Professional Communication", Second Edition, Tata McGraw-Hill Education,2008.
3. D.K.Sarma, "You & Your Career", First Edition Wheeler Publishing & Co Ltd,1999.
4. Shiv Khera "You Can Win", Third Edition Mac Millan Publisher India Pvt Limited,2005.

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1901MCX01	ENVIRONMENTAL SCIENCE (Common to all Branches of B.E/ B.Tech)	L	T	P	C
		2	0	0	0

MODULE I	ECOSYSTEMS AND BIODIVERSITY	10 Hours

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity – threatstobiodiversity:habitatloss,poachingofwildlife,man-wildlifeconflicts–endangeredandendemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place

MODULE II	NATURAL RESOURCES	10 Hours

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Documentation of the effect of modern Agriculture in your nearby Village.

MODULE III	ENVIRONMENTAL POLLUTION	9 Hours

Definition – Source, causes, effects and control measures of: (a) Air pollution - Mitigation procedures- Control of particulate and gaseous emission, Control of SO_X, NO_x, CO and HC) -Technology for capturing CO_2 (metallo organic frame works)(b) Water pollution – Waste water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies.
Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

MODULE IV	SOCIAL ISSUES AND THE ENVIRONMENT	8 Hours

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management -environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards- disaster management: floods, earthquake- Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India)

MODULE V	HUMAN POPULATION AND THE ENVIRONMENT	8 Hours

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies.
Documentation study of the Human health and the environment in nearby Hospital (Statistical report)

TOTAL: 45 HOURS

Course outcomes:

CO1: Describe the physical, chemical and biological components of the ecosystem and their function.

CO2:Explain the water quality parameters and removal of pollutants.

CO3: Explain the scientific principles to analysis various environment implications in day to day life.

CO4: Describe the various environmental protection acts for key social system affecting the environment.

CO5: Summarise the major diseases, women welfare, child development and the impacts of population explosion

REFERENCES:

1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi,2007.

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4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
5. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006
6. Ravikrishnan"Environmental Science and Engineering" Sri Krishna Hi-tech Publishing Company Pvt
https://en.wikipedia.org/wiki/Carbon_capture_and_storage

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NAGAPATTINAM – 611 002

B.E. Civil Engineering

Full Time Curriculum and Syllabus

Second Year – Fourth Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1901MA401	Engineering Mathematics III	3	2	0	4	40	60	100
1902CE401	Building Materials and Management	3	0	0	3	40	60	100
1902CE402	Soil Mechanics	3	0	0	3	40	60	100
1902CE403	Transportation Engineering	3	0	0	3	40	60	100
1902CE404	Concrete Technology	3	0	0	3	40	60	100
1901CE405	Biology for Engineers	3	0	0	3	40	60	100
Laboratory Course								
1902CE451	Computer Aided Building and Drawing Lab	0	0	2	1	50	50	100
1902CE452	Soil Mechanics Lab	0	0	2	1	50	50	100
1904GE451	Life Skills: Verbal Ability	0	0	2	1	100	-	100
Audit Course								
1901MCX02	Indian Constitution	3	0	0	0	-	-	-

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1901MA401	ENGINEERING MATHEMATICS III	L	T	P	C
		3	2	0	4

UNIT I	**FOURIER SERIES**	**12 Hours**
Dirichlet'sconditions–GeneralFourierseries–Oddandevenfunctions–Halfrangesineseries–Halfrange cosine series–Parseval's identity– Harmonic analysis – Simple Applications		
UNIT II	**FOURIER TRANSFORMS**	**12 Hours**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem– Parseval's identity		
UNIT III	**BASIC STATISTICS AND PROBABILITY**	**12 Hours**
Statistics – Definition, Types. Types of variables – Organizing data - Descriptive Measures. Basic definitions and rules for probability, conditional probability independence of events, Baye"s theorem, and random variables.		
UNIT IV	**TESTING OF HYPOTHESIS**	**12 Hours**
Large sample test based on Normal distribution for single mean and difference of means - Tests based on t and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.		
UNIT V	**DESIGN OF EXPERIMENTS**	**12 Hours**
One way and two way classifications – Completely randomized design – Randomized block design –Latin square design -factorial design.		
	TOTAL	**60Hours**

Course outcomes:	After completion of this course, students can able to
	CO1: Use Fourier series analysis which is central to many applications in engineering
	CO2: Apply Fourier transform techniques used in wide variety of situations
	CO3: Understand the axiomatic formulation of modern probability theory and think of random variables
	CO4: Make use of the concept of testing of hypothesis for small and large samples in real life situations
	CO5: Make use of the concept of classification of design of experiments in optimization problems

REFERENCES:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Walpole R.E. Myers S.L, Ye.K, "Probability and statistics for Engg and scientists", 8th edition Pearson education,2007
4. P.N.Arora., S.Arora., " Statistics for Management".,S.Chand ltd, 2009
5. M.B.K.Moorthy., " Probability and Statistics"., Scitech Publications (India) Pvt Ltd ,December 1,2 011
6. www.nptelvideos.in/2012/11/mathematics-iii.html

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1902CE401	BUILDING MATERIALS AND MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I	**BUILDING MATERIALS**	**9 Hours**

Lime, Brick, Timber and its Products, Floor and Wall Tiles, Pozzolanas, Ferrous metals, Thermal Insulation Material. Finishing Materials: Glass, Timber, Aluminum, Plastics, Paints, Varnishes, Distemper, Waterproofing and Damp Proofing Materials, Ferrocement and its application, Fabre textiles – Geo membranes and Geotextiles for earth reinforcement.

UNIT II	**BUILDING COMPONENTS**	**9 Hours**

Partition wall and Cavity wall, Composite Masonry, Doors, Windows, Ventilators, Stairs, Lift, Ramps, Escalators, Anti Termite Treatment, Brick masonry- Bond- Jointing-Stone masonry
Temporary building structures - Site Clearance - Marking –Earthwork, Slip and moving forms, scaffolding, Plumbing and Sanitation, Fire Protection, Introduction to Building Maintenance, Acoustics and Sound Insulation.

UNIT III	**SUB STRUCTURE AND SUPERSTRUCTURE TECHNIQUES**	**9 Hours**

Techniques of box jacking- pipe jacking- under water construction of diaphragm walls and basement Tunneling techniques, caisson -sinking cofferdam, Dewatering and stand by plant equipment for underground open excavation, Launching girders, bridge decks, off shore platforms, braced domes and space decks.

UNIT IV	**CONSTRUCTION EQUIPMENTS**	**9 Hours**

Selection of equipment for earth work - types of earthwork equipment, Equipment for material handling and erection of structures, Equipment for dredging, trenching, tunneling, Equipment for compaction, batching and mixing and concreting, Equipment for foundation and pile driving.

UNIT V	**MANAGEMENT**	**9 Hours**

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management.

Total:	**45 Hours**

COURSE OUTCOMES:

1. Summarize the most common and advanced materials used for construction.
2. Illustrate the construction process of various building components.
3. Explain the various construction methods and techniques involved in sub structure and super structure.
4. Choose the appropriate modern construction tools and equipment in various construction activities.
5. Choose the appropriate method of management for materials.

REFERENCES:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3.Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.
5.Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
6.Gambhir. M.L., &NehaJamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

Online sources:

1.https://www.classcentral.com/course/swayam-basic-construction-materials-22914
2.https://www.classcentral.com/course/swayam-construction-methods-and-equipment-management-22940
3.https://nptel.ac.in/courses/105/102/105102088/
4.https://freevideolectures.com/course/86/building-materials-and-construction

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1902CE402	SOIL MECHANICS	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION	9 Hours

Definition of soil and soil mechanics – Formation of soil – types of soil – Three phase system of soil and their relationships – Specific gravity – Definition – Determination – Field density - sand replacement and core cutter method.

UNIT II	INDEX PROPERTIES AND SOIL CLASSIFIATION	9 Hours

Classification of soil – Grain size analysis – Stoke"s law and hydrometer analysis– Consistency of soils – Atterberg"s limit - Liquid limit, Plastic limit and Shrinkage limit – Determination - plasticity index, liquidity index , consistency index ,shrinkage ratio, flow index and toughness index – Classification of coarse grained and fine grained soil as per BIS.

UNIT III	PERMEABILITY AND SEEPAGE	9 Hours

Permeability –Definition – Assumption - one dimensional flow through soil – Darcy"s law – Limitations - Discharge velocity and seepage velocity – factors affecting the permeability – permeability determination - lab and field methods – permeability in stratified soil deposits – Introduction of flow net and its properties - application of flow net.

UNIT IV	COMPACTION AND CONSOLIDATION	9 Hours

Compaction–fieldandlabmethods–Proctor"stest–factorsaffectingthecompaction–effectofcompaction in soil properties–Consolidation –Terzaghi"s theory of one dimensional consolidation -partial differential equation (no analytical solution) – Lab method - coefficient of consolidation – Determination - √t and log t methods.

UNIT V	STRESS DISTRIBUTION AND SHEAR STRENGTH	9 Hours

Introduction – stresses in soil – concept of effective and neutral stresses – stress distribution in soil media – Boussinesq analysis – Point load, Uniformly distributed load, line load – rectangular load - pressure bulb – Newmark's chart – Introduction. Shear strength – shear strength of cohesive and cohesion less soils – Mohr coulomb's theory –Direct shear, Triaxial, unconfined shear strength - factors affecting the shear strength.

	Total:	45 hours

Employability

Course outcomes

1. Calculate the various physical properties of the given soil sample.
2. Classify the given soil sample as per BIS method by using their Index properties.
3. Calculate the permeability properties of soil by constant and variable head methods.
4. Analyze the effect of compaction and consolidation in soil properties.
5. Analyze the stress distribution at a depth below the ground level.

REFERENCES:

1. Raju .K.V.B .and Ravichandran .P.T, "Mechanics of Soils", AyyappaaPublications, 2000.
2. Punmia .B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., 2005.
3. GopalRanjan and Rao .A.S.R, "Basic and Applied Soil Mechanics", New age international (p) Ltd., 2007.
4. Terzaghi .K and Peck .R.B, "Soil Mechanics in Engineering Practice", JohnWiley Ltd., 1996.
5. Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors, 2011.

Online source:

https://nptel.ac.in/courses/105/101/105101201/#

https://www.kopykitab.com/GATE-Study-Material-Geotechnical-Engineering-Civil-Engineering-by-Panel-Of-Experts

https://civilenggforall.com/soil-mechanics-and-foundations-textbook-by-civilenggforall-free-download-pdf/

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1902CE403	TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3

UNIT I	HIGHWAY PLANNING AND GEOMETRIC DESIGN	9 Hours

Importance Road transportation, Highway alignment, Engineering surveys for highway location. Geometric design – Cross section element, width, camber, design – speed, sight distances, requirements and design of horizontal and vertical alignments.

UNIT II	HIGHWAY MATERIALS	9 Hours

Highway materials – Soil, Stone aggregates, Bituminous Binders, Bituminous paving mixes, Portland cement and cement concrete.

UNIT III	TRAFFIC MANAGEMENT AND CONTROL	9 Hours

Traffic characteristics; Road user and vehicular characteristics, Traffic Engineering studies and Analysis: Traffic volume studies, Traffic Regulation and control: Traffic regulations, traffic control devices, traffic signs and signals. Design of road Intersection: Intersections at grade, Un-channelized intersections, Channelized intersections and rotary intersections.

UNIT IV	PAVEMENT DESIGN	9 Hours

Flexible Pavements- components and their functions, Factors affecting design and performance, design methods. Rigid Pavements- components and their functions, Factors affecting design and performance, design methods.

UNIT V	CONSTRUCTION AND MAINTENANCE	9 Hours

Construction: Embankment and subgrade, Excavation of earth, Construction of flexible pavements, cement concrete pavements. Maintenance: Important of highway maintenance works, Deterioration and damages in road Infrastructure, Maintenance in flexible pavements and maintenance measures.

	Total:	45 Hours

Course Outcomes:	Employability
	After completion of the course, Student will be able to
	1. Carry out highway planning, alignment and geometric design
	2. Determine the characteristics of pavement materials
	3. Implement traffic studies, traffic regulations and control, and intersection design
	4. Design flexible and rigid pavements as per IRC
	5. Carry out construction and maintenance of roads

REFERENCES:

1. Veeraragavan. A, Khanna. S.K., Ceg Justo, Highway Engineering, Nem Chand & Brothers, 2014.
2. Sharma, S.K. "Principles Practice and Design of Highway Engineering", S. Chand & Co Ltd, 2013.
3. Gupta B.L and Amith Gupta, Highway and Bridge Engg., Standard publishers, and Distributor, 2010.
4. ParthaChakroborthy and Animesh Das, Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd., 2013.
5. LrKadiyali, LrKadyali, NbLal ,"Principles And Practice Of Highway Engineering ", Khanna Publishers. 2013.
6. Rangwala.S.C, Highway Engineering, Charotar Book Distributors, 2013.

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1.https://nptel.ac.in/courses/105/101/105101087/

2.https://nptel.ac.in/courses/105/105/105105107/

3.http://www.nptelvideos.in/2012/11/introduction-to-transportation.html

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1902CE405	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

UNIT I	**CONSTITUENT MATERIALS**	9 Hours
Cement-Different types-Chemical composition and Properties - Tests on cement-IS Specifications-Aggregates- Classification-Mechanical properties and tests as per BIS Grading requirements- Water- Quality of water for use in concrete.		
UNIT II	**CHEMICAL AND MINERAL ADMIXTURES**	9 Hours
Accelerators-Retarders- Plasticizers- Super plasticizers- Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaolin -Their effects on concrete properties		
UNIT III	**PROPORTIONING OF CONCRETE MIX**	9 Hours
Principles of Mix Proportioning-Properties of concrete related to Mix Design-Physical properties of materials required for Mix Design - Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples		
UNIT IV	**FRESH AND HARDENED PROPERTIES OF CONCRETE**	9 Hours
Workability-Tests for workability of concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS - Properties of Hardened concrete- - Stress-strain curve for concrete-Determination of Young"s Modulus		
UNIT V	**SPECIAL CONCRETES**	9Hours
Light weight concretes - High strength concrete - fiber reinforced concrete – Ferro cement - Ready mix concrete - SIFCON-Shotcrete – Polymer concrete - High performance concrete- Geopolymer Concrete.		
	Total:	45 Hours

Course Outcomes:	Employability
	After completion of the course, Student will be able to
	1.Explain the properties of various ingredients of concrete
	2.Interpret the suitable admixture for concrete with special properties
	3.Apply the concrete mix using I.S code methods
	4.Illustrate the properties of fresh and hardened concrete
	5.Explain the special concrete and their specific applications interpret

REFERENCES:

1. Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007.
2. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995.
3. Gambir, M.L; "Concrete Technology", 3rdEdition, Tata McGraw Hill Publishing Co Ltd,

Online reference/website may be added

1.https://nptel.ac.in/courses/105/102/105102012/
2.https://nptel.ac.in/courses/105/104/105104030/
3.https://nptel.ac.in/courses/105/106/105106176/

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1902CE403	BIOLOGY FOR ENGINEERS (For B.E. Civil Engineering)	L	T	P	C
		3	0	0	3

UNIT I	LIFE (INTRODUCTION TO CELLS)	8 Hours

Biomolecules: Carbohydrates, Proteins, Nucleic Acids, Lipids, Enzymes. Cell structure and composition; The central dogma in molecular biology; Darwinian evolution; Molecular perspective and classification; Phylogenetic trees; Study of inter-and intra-species relationships; Microorganisms and Infectious Diseases.

UNIT II	LIFE PROCESSES (FUNCTIONING OF HUMAN SYSTEMS)	7 Hours

Muscular System; Nervous System; Special Senses; Sensory organs (eye, ear, smell, taste, touch); Cardiovascular System; Respiratory System; Renal System; Immune System; Endocrine System; Cancer and Life style diseases; Stem cells.

UNIT III	ENVIRONMENTAL ENGINEERING APPLICATIONS:	10 Hours

Waste water management- Phytoremediation technique- Root zone system - Treated lagoon anaerobic and aerobic condition) - Constructed wetland technique. Solid waste management - Composting methods. Air pollution -Effect of air pollution on human health and other living things- treating by biomaterials.

UNIT IV	CONCRETE TECHNOLOGYAPPLICATIONS	10 Hours

Self-healing concrete, use of bacteria to increase the strength of concrete. Autonomous Healing – need, how does bio concrete works? – Finding right bacteria- interest from industry- full scale testing – limitations. Bio concrete mark II

UNIT V	RESTORATION OF SOIL	10 Hours

Restoration of soil by biological means. biological soil treatments – Bioventing – Biodegradation- Biosparging- Bioaugmentation- Composting- Landfarming – Biopiles – Bioreactors. Phytoremediation – Restoration by means of vegetation – based upon the ability of vegetation to absorb toxins. Micro remediation – restoration using mushrooms Based on the ability of mushrooms to exude enzymes which cause the breakdown of the contaminants

Total: 45 Hours

Employability

Course outcomes

1. Understand the cell biology and Functioning of Human Systems.
2. Realize evolution of biology as a multi-disciplinary field.
3. Get awareness on application of engineering principles in biology, and engineering robust solutions inspired by biological examples.
4. Recognize the basic organization and functioning of living organisms from an engineering perspective
5. Relate Biological applications on Waste water management, solid waste management and Air pollution
6. Communicate about use of bacteria to increase the strength of concrete and Restoration of soil by biological means

REFERENCE BOOKS

1.Biology for Engineers, Rajiv Singal, CBS Publishers and Distributors Pvt Ltd; First Edition (4June 2019).
2.Biology for Engineers, Wiley Editorial, Wiley (2018).
3. Environmental Biology, Matthew R. Fisher, Open Oregon Educational Resources, 2018.
4. Self-healing Concrete, Michelle M. Pelletier, University of Rhode Island, 2010.
5.Biological Approaches to Sustainable Soil Systems, Norman Uphoff et al., CRC Press; 1 edition (March 3, 2006)
6. https://nptel.ac.in/courses/121/106/121106008/
7. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-bt23/

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1902CE451	COMPUTER AIDED BUILDING AND DRAWING LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Functional planning – Introduction to anthropometrics and ergonomics – Occupancy classification of
2. Buildings –Essentials of National Building Code – Essentials of Building and development rules–
3. Introduction to green building.
4. Building Physics : Sun's movement and building: Sun control devices –Exposed walls and Openings
5. Lighting and acoustics
6. Introduction to AutoCAD – Draw and modify tools- Dimensioning-Layers- Blocks-Printing- Two dimensional
7. drawing 3D commands
8. Door, Windows, Ventilators.
9. Foundation, Staircase
10. Residential buildings – Plan, Section, Elevations
11. Public buildings like office, dispensary, post office, bank etc
12. Industrial buildings

Total: 30 Hours

ADDITIONAL EXPERIMENTS:

1. Commercial building like sky scrapers
2. Domed structures

Course Outcomes:

After completion of the course, student will be able to

1. Ability to develop a concept drawing based on the requirements
2. Ability to draw Building Drawing as per planning authority requirement in AutoCAD.
3. Understand to draw plan, elevation and section of public and industrial structures
4. Apply the requirements to draw plan, elevation and section of load bearing and framed structures.
5. Analysis the building code and sun movements before drawing

1. Sikka V. B., A Course in Civil Engineering Drawing, 4th Edition, S.K. Kataria and Sons, 1998.
2. George Omura, "Mastering in AUTOCAD 2002", BPB Publications, 2002
3. Verma.B.P., "Civil Engineering Drawing and House Planning", Khanna Publishers, 1989.
4. A Guide to building information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc., 2008.
5. Marimuthu V.M., Murugesan R. and Padmini S., "Civil Engineering Drawing-I", Pratheeba Publishers, 2008.
6. Computer Aided Building and Drawing Lab Manual – N.Karthika, AP/Civil, EGSPEC

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1902CE452	SOIL MECHANICS LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Determination of water content
2. Determination of specific gravity
3. Determination of grain size distribution of Sieve Analysis
4. Determination of grain size by Hydrometer
5. Determination of Liquid limit and Plastic of the soil
6. Determination of Shrinkage limit of the soil
7. Determination of Dry density by Standard Proctor Compaction test
8. Determination of Field density by Core cutter method
9. Determination of Field density by Sand Replacement method
10. Determination of Permeability Coefficient using Constant head method
11. Determination of Permeability Coefficient using Variable head method
12. Determination of shear strength by using Direct Shear test
13. Determination of compression strength by using Unconfined compressive strength test

ADDITIONAL EXPERIMENTS:

1. Consolidation Test
2. Triaxial Test

Course outcomes

Employ ... today.

1. Develop experience to classify the soil.
2. Identify the concept of optimum moisture content of the soil.
3. Recognize the concept of field density of the soil.
4. Practice of the concept to do performance test on Compressive and shear strength .
5. Apply the techniques to determine index properties and engineering properties by conducting appropriate tests.

REFERENCES:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2007.
2. GopalRanjan and Rao A.S.R. "Basic and Applied soil mechanics", Wiley Eastern Ltd, New Delhi (India), 2000.
3. AroraK.R.,"Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors. New Delhi. 2002.
4."Soil Engineering Laboratory Instruction Manual" published by Engineering College Co- operative Society, Anna University, Chennai, 1996.
5. Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) Limited Publishers, New Delhi, 2002.
6. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
7. Soil Mechanics Lab Manual – N.R.Vethamoorthy, AP/Civil, EGSPEC

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1904GE451	LIFE SKILLS: VERBAL ABILITY	L	T	P	C
		2	0	0	1

MODULE I	**VOCABULARY USAGE**	**6 Hours**
Introduction - Synonyms and Antonyms based on Technical terms – Single word Substitution – Newspaper, Audio and video listening activity.		
MODULE II	**COMPREHENSION ABILITY**	**6 Hours**
Skimming and Scanning – Social Science passages – Business and Economics passages – latest political and current event based passages – Theme detection – Deriving conclusion from passages.		
MODULE III	**BASIC GRAMMAR AND ERROR DETECTION**	**6 Hours**
Parallelism – Redundancy – Ambiguity – Concord - Common Errors – Spotting Errors – Sentence improvement – Error Detection FAQ in Competitive exams.		
MODULE IV	**REARRANGEMENT AND GENERAL USAGE**	**6 Hours**
Jumble Sentences – Cloze Test - Idioms and Phrases – Active and passive voice – Spelling test.		
MODULE V	**APPLICATION OF VERBAL ABILITY**	**6 Hours**
Business Writing - Business Vocabulary - Delivering Good / Bad News - Media Communication - Email Etiquette – Report Writing - Proposal writing – Essay writing– Indexing –Market surveying.		
		TOTAL: 30 HOURS

REFERENCES:

1. Arun Sharma and Meenakshi Upadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition2017
2. R S Aggarwal and VikasAggarwal , Quick Learning Objective General English ,S.Chand Publishing House, 2017
3. Dr.K.Alex , Soft Skills, S.Chand Publishing House, Third Revise Edition,2014
4. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition, 2007.
5. https://nptel.ac.in/courses/109/107/109107155/
6. https://nptel.ac.in/courses/109/105/109105144/

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1901MCX02	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	0

UNIT I	**EVOLUTION OF THE INDIAN CONSTITUTION**	**9 Hours**
1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution.		
UNIT II	**UNION, STATE AND LOCAL GOVERNMENT**	**9 Hours**
Union Government: Executive-President, Prime Minister, Council of Minister **State Government:** Executive: Governor, Chief Minister, Council of Minister **Local Government:** Panchayat Raj Institutions, Urban Government		
UNIT III	**RIGHTS AND DUTIES:**	**9 Hours**
Fundamental Rights, Directive principles, Fundamental Duties		
UNIT IV	**F RELATION BETWEEN FEDERAL AND PROVINCIAL UNITS:**	**9 Hours**
Union-State relations, Administrative, legislative and Financial, Inter State council, NITI Ayog, Finance Commission of India		
UNIT V	**STATUTORY INSTITUTIONS:**	**9 Hours**
Elections-Election Commission of India, National Human Rights Commission, National Commission for Women		
	Total:	**45 Hours**

COURSE OUTCOMES:	After completion of the course, Student will be able to

CO1: Know the background of the present constitution of India.
CO2: Understand the working of the union, state and local levels.
CO3: Gain consciousness on the fundamental rights and duties.
CO4: Be able to understand the functioning and distribution of financial resources between the centre and states.
CO5: Be exposed to the reality of hierarchical Indian social structure and the ways the grievances of the deprived sections can be addressed to raise human dignity in a democratic way.

REFERENCES:

1. D.D. Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi.
2. SubhashKashyap, Our Parliament, National Book Trust, New Delhi.
3. PeuGhosh, Indian Government &Politics, Prentice Hall of India, New Delhi.
4. B.Z. Fadia&KuldeepFadia, Indian Government &Politics, Lexis Nexis, New Delhi.

ONLINE SOURCES:

5. https://byjus.com/free-ias-prep/constitution-of-india-an-overview/
6. https://nptel.ac.in/courses/129/106/129106002/

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Chennai AccreditedbyNAAC with „A"Grade|Accredited byNBA
(CSE, EEE, MECH, ECE, CIVIL, IT)

NAGAPATTINAM–611002

B.E. Civil Engineering

FullTime Curriculum and Syllabus

Third Year – Fifth Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1902CE501	**Structural Analysis I**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
1902CE502	Design of RCC Structures I	3	0	0	3	40	60	100
1902CE503	Design of Steel Structures	3	0	0	3	40	60	100
1902CE504	Foundation Engineering	3	0	0	3	40	60	100
1902CE505	Environmental Engineering	3	0	0	3	40	60	100
	Elective I	3	0	0	3	40	60	100
Laboratory Course								
1902CE551	Concrete and Highway Engineering Lab	0	0	2	1	50	50	100
1902CE552	Environmental Engineering Lab	0	0	2	1	50	50	100
1904CE553	Mini Project	0	0	2	1	50	50	100
1904GE551	Life Skills: Aptitude I	0	0	2	1	100	-	100
Audit Course								
1901MCX03	Essence of Indian Traditional Knowledge	2	0	0	0	-	-	-

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1902CE501	STRUCTURAL ANALYSIS I	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concept of analysis of indeterminate structures.
2. To Understand the methods of analysis of indeterminate trusses for external loads, lack of fit and thermal effects and also the influence line concept for indeterminate structure.
3. To study behavior of arches, Settlement and temperature effects.

Unit I	**INDETERMINATE FRAMES**	**9 Hours**

Degree of static and kinematic indeterminacies for plane frames – analysis of indeterminate pin-jointed frames – rigid frames (Degree of statical indeterminacy up to two) – Energy and consistent deformation methods.

Unit II	**SLOPE DEFLECTION METHOD**	**9 Hours**

Analysis of continuous beams - sinking of supports – rigid frames (with and without sway)

Unit III	**MOMENT DISTRIBUTION METHOD**	**9 Hours**

Distribution and carryover of moments – Stiffness and carry over factors - Analysis of continuous beams - sinking of supports – Rigid frames (with and without sway).

Unit IV	**MOVING LOADS AND INFLUENCE LINES**	**9 Hours**

Influence lines for reactions in statically determinate structures – influence lines for member forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections –Calculation of critical stress resultants due to concentrated and distributed moving loads. Muller Breslau's principle – Influence lines for continuous beams and single storey rigid frames.

Unit V	**ARCHES**	**9 Hours**

Arches as structural forms – Examples of arch structures – Types of arches – Analysis of three hinged, two hinged and fixed arches, parabolic and circular arches – Settlement and temperature effects.

Total:	**45 Hours**

Further Reading:

1. To analyze and find out BMD

Employability

Course Outcomes:

After completion of the course, Student will be able to

1. Analyze The Pin Jointed Plane Frames Using Energy And Consistent Deformation Method.
2. Analyze Indeterminate Structures Using Slope Deflection Method.
3. Analyze Indeterminate Structures Using Moment Distribution Method.
4. Analyze Indeterminate Beams With Moving Loads.
5. Analyze the arches under external loads, temperature effects and support settlements.

References:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", Laxmi Publications Pvt. Ltd, New Delhi, 2003.
2. L.S. Negi& R.S. Jangid, "Structural Analysis", Tata McGraw Hill Publications, New Delhi, 6th Edition, 2003.
3. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, " Theory of structures", Laxmi Publications Pvt. Ltd., New Delhi, 2004
4. Reddy. C.S., "Basic Structural Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2013.
5. BhavaiKatti, S.S, "Structural Analysis – Vol. 1 & Vol. 2", Vikas Publishing Pvt Ltd., New Delhi, 2008
6. Wang C.K. , "Indeterminate Structural Analysis", Tata McGraw Hill Education Pvt. Ltd.,New Delhi, 2010
7. DevadasMenon, "Structural Analysis", Narosa Publishing House, 2008
8. Ghali.A., Nebille and Brown. T.G., "Structural Analysis - A unified classical and matrix approach" Sixth Edition, SPON press, New York, 2013.
9. Gambhir. M.L., "Fundamentals of Structural Mechanics and Analysis"., PHI Learning Pvt.Ltd., New Delhi, 2011.

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1902CE502	DESIGN OF RCC STRUCTURES I	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop an understanding on the basic concepts in the behavior and design of reinforced concrete systems and elements using working stress method.
2. To introduce the basic concepts and steps in the design of beams and slabs mainly in accordance with Limit state method.
3. To underline the design principles of RC members for shear, bond, and torsion.
4. To introduce the concepts in the design of RC Column design.
5. To give the knowledge in the concept of RC footings.

Unit I **METHODS OF DESIGN** **9 Hours**

Working stress method - Ultimate load method - Limit state method - Characteristic strength - Characteristic load - Design values - Partial safety factors - Codal provisions - Practical aspects of design - Design of flexural members and slabs by working stress method.

Unit II **LIMIT STATE DESIGN FOR FLEXURE** **9 Hours**

Analysis and design of One way and two way slabs – Singly and doubly reinforced rectangular beams - Cantilever beams - Standard method of detailing of RC beams and slabs.

Unit III **LIMITSTATEDESIGN FOR BOND, ANCHORAGE, SHEAR AND TORSION** **9 Hours**

Behavior of RC members in bond and anchorage – Curtailment of reinforcement - Design requirements as per code provision – Behavior of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion.

Unit IV **LIMIT STATE DESIGN OF COLUMNS** **9 Hours**

Columns – Assumptions – Effective length – Classification – Design guidelines – Axially loaded short columns with lateral ties and helical reinforcement – Columns subjected to uni-axial bending and biaxial bending –Standard method of detailing of RC columns.

Unit V **LIMIT STATE DESIGN OF FOOTING** **9 Hours**

Introduction and selection of footing under different site conditions - Design of wall footing – Design of axially and eccentrically loaded rectangular footing – Combined footing - Standard method of detailing of RC footing.

Total: 45 Hours

Further Reading :

1. students can be able to design all rcc elements of a building
2. students can be able to select suitable footing type

Employability.

Course Outcomes:

After completion of the course, Student will be able to

1. Know the basic principles of different design methods
2. Design flexural members using limit state method under different loading and end conditions.
3. Design flexural members of any cross sectional shape for shear, bond, and torsion.
4. Design RC columns of any cross section with different end conditions.
5. Select and design RC footing of different cross section under various site conditions

References:

1. B. C Punmia, Ashok. Kumar Jain, Arun Kumar Jain "Limit State Design of Reinforced Concrete", Laxmi Publications (P) Ltd, NewDelhi 2007.
2. UnnikrishnaPillai, S., DevdasMenon, "Reinforced Concrete Design",Tata McGraw-Hill Publishing Company Ltd., New Delhi 2003.
3. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi 2002.
3. Varghese, P.C., "Limit State Design of Reinforced Concrete",Prentice Hall of India, Pvt. Ltd., New Delhi 2002
4. Krishna Raju, N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi, 2003.

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1902CE503	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the properties of steel sections and design basics and codal provisions- Design of connections
2. To design steel members subjected to tension and compression member.
3. Design steps involved in beams, built up beams and design of plate girder

Unit I	**INTRODUCTION**	9 Hours

Structural steel sections – Limit state design concepts - Connections- bolted and welded joints - Failure of joints - Efficiency of joints - Eccentric connections

Unit II	**TENSION MEMBERS**	9 Hours

Types of sections – Net area – net effective sections for angles and Tee in tension – Design of connections in tension members – use of lug angles – Design of tension splice – Concept of Shear lag.

Unit III	**COMPRESSION MEMBERS**	9 Hours

Effective length about major and minor principal axis - I.S code provisions- permissible stresses - Design rules- design of one component - two components and built up compression members under axial load- Design of Lacings and Battens - Different types of column bases - Slab base and Gusseted base - connection details

Unit IV	**BEAMS**	9 Hours

Design of laterally supported and unsupported beams – Built up beams – design of Plate Girders – Intermediate and bearing stiffeners – Web splicing.

Unit V	**INDUSTRIAL STRUCTURES**	9 Hours

Design of roof trusses – Elements of roof trusses – Design of purlins – Estimation of wind loads – Design of gantry girders

Total:	45 Hours

Further Reading

Advanced steel structures / Composite steel structures

Course Outcomes: After completion of this course, students can able to

Employability

1. Explain the limit state design concept and design of bolted and welded connections.
2. Use the IS codal provisions to the design of tension members.
3. Use the IS codal provisions to the design of compression members
4. Apply the design principles in beams and plate girders.
5. Analysis various components involved in roof truss structures

References:

1. S.S. Bhavikatti ,"Design of Steel Structures", I. K. International Pvt Ltd, 2009.
2. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., "Design of Steel Structures", 3rd edition, McGraw-Hill Publications, 1992
3. Negi L.S." Design of Steel Structures", Tata McGraw Hill Publishing Pvt Ltd, New Delhi, 2007.

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1902CE504	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. Familiarize the students with a basic understanding of the essential steps involved in a geotechnical site investigation.
2. Introduce to the students, the principal types of foundations and the factors governing the choice of the most suitable type of foundation for a given solution.
3. Familiarize the student with the procedures used for: a) bearing capacity estimation, b) load carrying capacity of pile, c) determining earth pressure and e) concept on stability of slope.

Unit I	SOIL EXPLORATION AND SITE INVESTIGATION	9 Hours

Introduction – Planning and stages in sub-surface exploration – depth and spacing of exploration – Methods of exploration – Test pit – Trenches – Geophysical methods: Seismic refraction and Electrical resistivity method –Boring : Auger boring, Shell and Auger, Wash boring and Rotary drilling – Types of soil sample: disturbed and undisturbed soil samples – Features of sampler affecting soil disturbance – standard penetration test – static and dynamic cone penetration test – bore log report

Unit II	SHALLOW FOUNDATION AND BEARING CAPACITY	9 Hours

Introduction – Bearing capacity- definition – types of shear failure – Bearing capacity of shallow foundation on homogeneous deposits - Methods: Terzaghi's ,Skempton's and BIS methods – Effect of water table on bearing capacity – Plate load test – Bearing capacity from in-situ tests - SPT, SCPT and plate load test methods of improving bearing capacity of soil.

Unit III	FOOTING, RAFT AND SETTLEMENT OF FOUNDATION	9 Hours

Types of foundation – contact pressure distribution below isolated footing – types and proportioning of combined footing – types and application of mat foundation – floating foundation – Settlement: total and differential settlements – causes and methods of minimizing settlement

Unit IV	DEEP FOUNDATION	9 Hours

capacity of single pile in cohesion less and cohesive soil – static formula – dynamic formulae (Engineering News and Hileys) – Capacity from in-situ tests (SPT and SCPT) – Negative skin friction – Carrying capacity of Pile group – Pile load test – Under-reamed piles – Introduction to well foundation and Diaphragm wall.

Unit V	EARTH PRESSURE AND STABILITY OF SLOPES	9 Hours

Earth pressure in soils: active and passive states – Lateral earth pressure Rankine's theory – stratified soil – Cullman's Graphical method –Slopes – Infinite and finite slopes – types of failure – causes of failure – Procedure for slip circle method and method of slices.

Total: 45 Hours

Further Reading:

To select suitable foundation for various soil condition.

Course Outcomes:

After completion of the course, Student will be able to

1. Illustrate the suitable techniques used for sub soil exploration.
2. Explain the type of foundation required for the given soil condition.
3. Select the dimensions of the foundation for various types of footing.
4. Interpret the load carrying capacity of piles.
5. Explain the stability analysis of retaining walls.

References:

1. Bowles .J.E, "Foundation analysis and design", McGraw Hill, 2001.
2. Murthy .V.N.S, "Textbook of Soil Mechanics and Foundation Engineering",CBS Publishers and Distributors, New Delhi, 2009.
3. Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.
4.Punmia .B.C, "Soil Mechanics and Foundations Engineering", Laxmi Publications Pvt.Ltd. New Delhi, 2005.
5.Das .B.M, "Principles of Foundation Engineering" (Fifth edition), Thomson Books, 2010

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1902CE505	ENVIRONMENTAL ENGINEEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To examine the water supply system and conveyance system.
2. To create an ability to evaluate the water treatment and advanced water treatment system.
3. To train the students to analyze water distribution system and supply to buildings.
4. To understand the importance of planning and design of sewerage system.
5. To create an ability to design the waste water treatment system.
6. To impart the signification of disposal of Sewage.

Unit I **WATER SUPPLY SYSTEMS – SOURCE AND CONVEYANCE** **9 Hours**

Objectives – Population forecasting – Design period – Water demand –Sources of water – Source selection – Water quality parameters and significance –Standards – Intake structures – Conveyance – Hydraulics – Laying, jointing and testing of pipes – Pump selection –Appurtenances.

Unit II **DESIGN PRINCIPLES OF WATER TREATMENT** **9 Hours**

Objectives – Selection of unit operations and processes – Principles of flocculation, sedimentation, filtration, disinfection – Design principles of flash mixer, flocculator, clarifiers, filters – Disinfection devices – Softening – Demineralization – Aeration – Iron removal – Defluoridation – Operation and maintenance aspects – Residue management.

Unit III **DISTRIBUTION** **9 Hours**

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks – Hardy cross method – Equivalent pipe method - Pipe Appurtenances -operation and maintenance -Leak detection, Methods. House service connection - Systems of plumbing.

Unit IV **SEWERAGE SYSTEM, COLLECTION AND TRANSMISSION** **9 Hours**

Sources of wastewater – Quantity of sanitary sewage – Storm runoff estimation – Wastewater characteristics and significance – Effluent disposal stand over – Design of sewers – Computer applications – Laying, jointing and testing of sewers – Sewer appurtenances – Pump selection.

Unit V **SEWAGE TREATMENT AND DISPOSAL** **9 Hours**

Objectives – Selection of unit operation and process – Design principles of primary and secondary treatment, screen chamber, grit chamber, primary sedimentation tanks, activated sludge process – Aeration tank and oxidation ditch – Trickling filter –Stabilization ponds – Septic tanks with soak pits – Sludge: treatment and disposal –Biogas recovery – Sewage farming.

Disposal on land – Disposal into water bodies – Oxygen sag curve – Streeter Phelp's model – Wastewater reclamation techniques.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

Employability.

1. Design the components of the transmission main for the water conveyance
2. Design the water treatment units based on its principles and functions
3. Extend the water distribution to the individual buildings
4. Build a sewerage system by flow estimation and designing suitable size of sewers
5. Design the treatment units for the treatment of waste water based on the quality and quantity.

References:

1.Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2003.

2.Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2005

3.Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997.

4.Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005.

5.Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.

6.Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

7.Government of India, "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, New Delhi, 2003

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1903CE001	PRE-FABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the knowledge in the area of prefabricated structures
2. To introduces the concept of prefabrication of multi – storied structures with components
3. Use of Construction equipments and the implementation of project management system

Unit I	**Introduction**	**9 Hours**

Need for prefabrication – Principles – Types of prefabrication - Disuniting of structures - Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection – Elimination of erection stresses

Unit II	**PREFABRICATED COMPONENTS**	**9 Hours**

Behavior of structural components – Large panel constructions –roof and floor slabs – Wall panels – Columns – Shear walls.

Unit III	**DESIGN PRINCIPLES**	**9 Hours**

Form factor - Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation – Precision and dimensional Tolerance.

Unit IV	**JOINTS IN STRUCTURAL MEMBERS**	**9 Hours**

Types of joints - Joints for different structural connections – Dimensions and detailing – Design of expansion joints

Unit V	**PROGRESSIVE COLLAPSE & CODE PROVISIONS**	**9 Hours**

Progressive Collapse – Fire Resistance – Renovation, Demounting and Demolition -Code provisions – IS 15916:2010 – ASCE 7-02, ACI 318-02, GSA PBS Facilities Standards 2000, GSA PBS Facilities Standards 2003, GSA PBS Progressive collapse Guidelines 2003 - Importance of avoidance of progressive collapse.

	Total:	**45 Hours**

Further Reading: None

Design some of the prefabricated elements and also have the knowledge of the construction methods.

Course Outcomes: Employability.

After completion of the course, Student will be able to

1. Illustrate the design principles for prefabricated structures
2. Explain the various connections in prefabricated structures
3. Apply the principles and systems of prefabrication in the field
4. Identify suitable prefabricated components for specific use
5. Utilize the various code provisions regarding progressive collapse

References:

1. L. Mokk, Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian, Academy of Sciences, Budapest, 2007
2. CBRI, Building materials and components, India, 1996
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
4. Koncz T., Manual of precast concrete construction, Vols.I,II and III,Bauverlag, GMBH, 1971.
5. B.Lewicki, Building wih large prefabricates, Elsevier Publishing Company Amserdam / London /Newyork.1966
6. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 1978
7. IS 15916:2010 – Building design and erection using prefabricated concrete – Code of practice

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1902CE551	CONCRETE AND HIGHWAY ENGINEERING LAB	L	T	P	C
		0	0	4	2

Course Objectives:

1. This course provides an understanding of the basic properties of construction materials, and presents laboratory standards and testing requirements for these materials.
2. To familiarize the students to do the experiments as per the guidelines of BIS.
3. To develop an understanding of the highway materials and to obtain knowledge on properties of these materials.

List of Experiments:

1. Tests on cement

1. Determination of specific gravity of cement.
2. Determination of standard consistency of cement.
3. Determination of initial and final setting times of cement.
4. Determination of compressive strength of cement mortar.

2. Tests on aggregates

1. Determination of Specific gravity and water absorption of fine & coarse aggregates.
2. Determination of Fineness modulus of fine aggregate & coarse aggregate.

3. Tests on fresh and hardened concretes

1.Determination of degree of workability: Slump cone test, Flow table, Compaction factor and Vee bee Consistometer
2. Determination of Compressive strength of concrete
3. Determination of Flexural strength of concrete
4. Determination of Splitting tensile strength of concrete

4. Tests on Highway materials- Sub-grade material and Aggregates

1. Crushing value test, impact value test, angularity test and abrasion test on aggregates.
2.Marshall stability for bituminous mix
3.Bitume extractor for bituminous mix

5. Tests on Bitumen

1. Penetration test and Ductility test.
2. Flash point test and viscosity test.

Total: 45 Hours

Additional Experiments:

1. CBR test on the soil/ granular material.

Employability.

Course Outcomes:

After completion of the course, Student will be able to

1. Evaluate the properties of cement
2. Understand the quality of aggregates used in concrete
3. Analyze the properties of fresh and hardened concrete
4. Knowledge gain about the highway materials
5. Evaluate the properties of bitumen

References:

1. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003
2. Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007
3. Gambir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007
4. IS10262-1982 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998
5. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995

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1902CE552	ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
		0	0	2	1

Course Objectives:

1. To know the basics, importance of water and wastewater treatment and methods measurement.
2. Tostudy the various effects of water and waste water pollution.
3. Effect of BOD and COD
4. To find Calcium, Potassium and Sodium
5. Heavy metal effects and finding methods

List of experiments

1. Measurement of pH, Electrical conductivity and turbidity
2. Determination of Calcium, Potassium and Sodium
3. Determination of Phosphate and Sulphate
4. Determination of Optimum Coagulant Dosage by Jar test apparatus
5. Determination of available Chlorine in Bleaching powder and residual chlorine in water
6. Determination of Ammonia Nitrogen
7. Estimation of suspended, volatile and fixed solids
8. Determination of Dissolved Oxygen
9. Estimation of B.O.D
10. Estimation of C.O.D

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. characterize given water and waste water sample

References:

1. Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998
2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi
3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi-6

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MINI PROJECT

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1902CE553

Aim: To carry out a thematic design project in one of the specializations of civilengineering

Course Objectives:
To carry out a project this will make the students aware of the different facets of civil engineering

List of areas
1. Structural Engineering
2. Geotechnical Engineering
3. Water Resources Engineering

Course outcomes:

At the end of the course, the students will be able to

Structural Engineering

1.Prepare a structural lay out from architectural drawings Calculation loads Design of representative structural elements like slab, beam, columns, foundation etc.

2.Carry out testing in Strength of materials / concrete / structural labs

3.Learn any software and solving a problem using that.

Geotechnical Engineering

1. Collect samples of soil and identification of their types Collection of literature on types of foundation Presentation of soil improvement techniques

2.Learn any software and solving a problem using that.

Water Resources And Environmental Engineering

1.Carry out population survey and working out water requirement. Preparation of a schematic diagram of water / wastewater treatment plants Assessment of quality of water / sewage by experiments Design of dock gates

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ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE **L T P C**
2 0 0 0

1902MCX03 (Common to All Branches) Mandatory Course

Prerequisite: Nil
Course Objectives: The course will introduce the students to

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes: After successful completion of the course, the students will be able to
1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

MODULE - I Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

MODULE - II Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

MODULE - III Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

MODULE – IV Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music; divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

MODULE – V Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

REFERENCES:
1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

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LIFE SKILL III - APTITUDE – I

1904GE551

Course Objective (s):

- To brush up problem solving skill and to improve intellectual skill of the students
- To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
- To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
- To enhance analytical ability of students
- To augment logical and critical thinking of Student

Unit 1	**Number System**	6 Hours
Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division.		
Unit 2	**Ratio and proportions**	6 Hours
Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion - Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages -		
Unit 3	**Average, Percentages**	6 Hours
Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method - Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages -		
Unit 4	**Coding and decoding, Direction sense**	6 Hours
Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.		
Unit 5	**Logical Reasoning**	6 Hours
Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out		
		Total 30 Hours

Skilled.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Learners should be able to understand number and solving problems least time using various shortcuts
CO2: compare two quantities using ratio and proportion, Solve problems on Partnership, Mixture & Allegation and ages least time using shortcuts and apply real life situations
CO3: Learns should be able to understand the concept behind Average and Percentage.
CO4: Workout concepts of Coding and Decoding, ability to visualize directions and understand the logic behind a sequence.
CO5: Learners should be able to find a series the logic behind a sequence.

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References :

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
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E.G.S.PILLAYENGINEERINGCOLLEGE

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(CSE, EEE, MECH, ECE, CIVIL, IT)

NAGAPATTINAM–611002

B.E. Civil Engineering

FullTime Curriculum and Syllabus

Third Year – Sixth Semester

Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
Theory Course									
1902CE601	Structural Analysis II	3	0	0	3	40	60	100	PC
1902CE602	Design of RCC Structures II	3	0	0	3	40	60	100	PC
1902CE603	Hydrology And Water Resources Engineering	3	0	0	3	40	60	100	PC
1902CE604	Global Warming And Climate Change **(Open Elective)**	3	0	0	3	40	60	100	PE
1903CE007	Remote Sensing And GIS **(PC Elective)**	3	0	0	3	40	60	100	PCE
1901MGX01	Total Quality Management **(HSS Elective)**	3	0	0	3	40	60	100	HSSE
Laboratory Course									
1902CE651	Computer Aided Design And Drafting Lab	0	0	2	1	50	50	100	PC
1904GE651	Life Skill : Aptitude – II & GD	0	0	2	1	100	-	100	HSS

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1902CE601	STRUCTURAL ANALYSIS II	L	T	P	C
		3	0	0	3

Course Objectives:

1. To obtain the ability to analyze indeterminate beams and rigid frames by Flexibility and Stiffness Matrix method.
2. To develop a clear understanding of Displacement functions in Structural element by Finite Element method.
3. To know the concept of plastic structures and analysis of space and Cable structures.

Unit I	MATRIX FLEXIBILITY METHOD	9 Hours

Equilibrium and compatibility- Determinate Vs indeterminate structures – Indeterminacy – Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

Unit II	STIFFNESS MATRIX METHOD	9 Hours

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two)

Unit III	PLASTIC ANALYSIS OF STRUCTURES	9 Hours

Statically indeterminate axial problems – beams in pure bending – Plastic hinge and mechanism –Plastic analysis of indeterminate beams and frames

Unit IV	INTRODUCTION TO FINITE ELEMENT ANALYSIS	9 Hours

Introduction- Steps involved in FEA – Displacement functions – truss element – beam element – Triangular elements.

Unit V	SPACE AND CABLE STRUCTURES	9 Hours

Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables – suspension bridges with two and three hinged stiffening girders.

	Total:	45 Hours

Further Reading:

1. To analyze and find out the BMD.
2. To analyze the indeterminate structures.

Course Outcomes: Employability.

After completion of the course, Student will be able to

1. Analyze structures using matrix flexibility method.
2. Analyze structures using stiffness method.
3. Perform plastic analysis for indeterminate beams and frames.
4. Implement basic concepts of finite element analysis.
5. Analyze Space Truss using tension Coefficient method and beams curved in plan and cable suspension bridges.

References:

1. Punmia,B.C., Ashok Kumar and Arun Kumar Jain, " Theory of Structures", Laxmi Publications, 2005.
2. Vaidyanathan, R. and Perumal, P., "Comprehensive structural Analysis – Vol I & II", Laxmi Publications, New Delhi, 2003.
3. Negi L.S &Jangid R.S., "Structural Analysis", Tata McGraw Hill Publications, New Delhi, 2003.
4. Ghali.A, Nebille, A.M. and Brown, T.G, "Structural Analysis" A unified classical and Matrix approach", 6th Edition, Spon Press, London and New York, 2013.
5. Gambhir, M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.
6. William Weaver Jr& James M. Gere, "Matrix Analysis of Framed Structures", CBS Publishers and Distributors, New Delhi, 2004

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1902CE602	DESIGN OF RCC STRUCTURES - II	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop an understanding on the basic concepts in the behavior and design of reinforced concrete structures such as Retaining Wall and counterfort retaining wall.
2. To provide knowledge on design of various components in the water tank by working stress method.
3. To provide knowledge on design of various reinforced concrete structures such as staircases, flat slabs and RC walls.
4. To expose the basic concepts about the yield line theory for the analysis and design of slab of various cross sections.
5. To expose the behavior of masonry structures, and be able to design for various loading conditions.

Unit I	**RETAINING WALLS**	**9 Hours**

Retaining walls - types - earth pressure - effects of surcharge - Stability requirements - Cantilever and counterfort retaining walls - detailing of reinforcement.

Unit II	**WATER TANKS**	**9 Hours**

R.C water tanks resting on ground - general design requirements – Overhead circular and rectangular tanks - Analysis and design by working stress method - detailing of reinforcement - codal provisions.

Unit III	**STAIRS AND CONCRETE WALLS**	**9 Hours**

Staircases - Ordinary and Doglegged –Direct design method – Reinforced concrete walls.

Unit IV	**YIELD LINE THEORY**	**9 Hours**

Yield line – Assumptions – Characteristics – Upper bound and lower bound theories - Yield line analysis - Design of slabs.

Unit V	**BRICK MASONRY**	**9 Hours**

Introduction - classification of walls - Lateral supports and stability - effective height of wall and columns - effective length of walls - Design loads, load dispersion - Permissible stresses - design of axially and eccentrically loaded brick walls

Total:	**45 Hours**

Further Reading :

1.Students can be able to work on retaining and storage structures
2. Students can be able to design shear walls, deck bridges.

Course Outcomes:

After completion of the course, Student will be able to

Employability

1.Design various types of retaining walls under various loading conditions.
2.Design and detailing of different types of water tanks along with the staging and foundation.
3.Attain sufficient knowledge of design for staircases, flat slabs and reinforced concrete walls and gain knowledge about the principles of design of mat foundation, box culvert and road bridges
4.Apply the yield line theory for design of square, rectangular, circular and triangular slabs.
5.Design axially and eccentrically loaded brick walls based on the knowledge gained for various loading conditions

References:

1. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain "Limit State Design of Reinforced Concrete", Laxmi Publications (P) Ltd, New Delhi 2007
2. Dayaratnam, P., "Brick and Reinforced Brick Structures", Oxford & IBH Publishing House, 1997.
3. UnnikrishnaPillai, S., DevdasMenon, "Reinforced Concrete Design".

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1902CE603	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

Unit I	**PRECIPITATION AND ABSTRACTIONS**	**9 Hours**

Hydrological cycle-Meteorological measurements–Requirements, types and forms ofprecipitation-Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception-Evaporation. Horton"s equation, pan evaporation measurements and evaporation suppression-Infiltration-Horton"s equation-double ring infiltrometer, infiltration indices

Unit II	**RUNOFF**	**9 Hours**

Watershed, catchment and basin-Catchment characteristics-factors affecting runoff-Run off estimation using empirical-Strange"s table and SCS methods–Stage discharge relationships flow measurements-Hydrograph–Unit Hydrograph–IUH

Unit III	**FLOOD AND DROUGHT**	**9 Hours**

Natural Disasters-Flood Estimation-Frequency analysis-Flood control-Definitions of droughtsMeteorological, hydrological and agricultural droughts-IMD method-NDVI analysis-Drought Prone Area Programme (DPAP)

Unit IV	**RESERVOIRS**	**9 Hours**

Classification of reservoirs, General principles of design, site selection, spillways, elevation–area-capacity-storage estimation, sedimentation-life of reservoirs–rule curve

Unit V	**GROUNDWATER AND MANAGEMENT**	**9Hours**

Origin-Classification and types-properties of aquifers-governing equations–steady andunsteady flow-artificial recharge-RWH in rural and urbanareas

Total:	**45 Hours**

Further Reading:

1. How to prepare data for GIS and RS
2. Civil engineering application for various fields

Course Outcomes:

Employability.

After completion of the course, Student will be able to

1. Explain the key drivers on water resources, hydrological processes andtheir integrated behavior in catchments
2. Make use of hydrological models to surface water problemsincluding basin characteristics, runoff and Hydrograph
3. Outline the concept of hydrological extremes such as Flood and Droughtand management strategies
4. Describe the importance of spatial analysis of rainfall and design water storage reservoirs
5. Illustrate the concepts of groundwater for water resources management

References:

Subramanya .K. "Engineering Hydrology"-Tata McGraw Hill, 2010

David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007

VenTe Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw HillInternational Book Company, 1998.

Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998

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1903CE007 REMOTE SENSING AND GIS **L T P C**
3 0 0 3

Module I	**EMR AND ITS INTERACTION WITH ATMOSPHERE & EARTH MATERIAL**	**9**
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's 74 Displacement Law- Atmospheric scattering, absorption-Atmospheric windows-spectral signature concept-typical spectral reflective characteristics of water, vegetation and soil.		
Module II	**PLATFORMS AND SENSORS**	**9**
Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – Resolution concept – Pay load description of important Earth Resources and Meteorological Satellites – Airborne and space borne TIR and microwave sensors.		
Module III	**IMAGE INTERPRETATION AND ANALYSIS**	**9**
Types of Data Products – types of image interpretation – basic elements of image interpretation – visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and Unsupervised.		
Module IV	**GEOGRAPHIC INFORMATION SYSTEM**	**9**
Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).		
Module V	**DATA ENTRY, STORAGE AND ANALYSIS**	**9**
Data models – vector and raster Data – data ompression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System – Monitoring and Modeling using GIS .		
		TOTAL: 45 Periods

Course Outcomes: After completion of the course, Student will be able to	
CO1	Understand the principles of aerial and satellite remote sensing, the energy interactions with earth surface features, spectral properties of water, vegetation and soil.
CO2	Understand the basic concept of Remote Sensing and different types of platforms and sensors.
CO3	Analyze the concept of image interpretation and digital image processing.
CO4	Apply the basic concept of GIS applications through standard GIS software's, different types of data representation in GIS.
CO5	Apply knowledge of GIS software and work with GIS software in various application fields.

Sl. No.	**Title of the Book**	**Author(s)**	**Publisher**
REFERENCES			
R1	Concepts and Techniques of Geographic Information Systems	Lo.C.P. &A.K.W.Yeung	Prentice Hall of India Pvt. Ltd., 2002
R2	Principles of GIS	Peter A.Burrough&Racheal A. McDonnell	Oxford University Press, 2000
R3	An Introduction to GIS	Ian Heywood	Pearson Education Asia, 2000
REFERENCE WEBSITES			
1	http://www.academicearth.org/courses/introduction-to-robotics		

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2	http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm
3	http://www.informationweek.com/news/galleries/healthcare/patient/229100383

1901MGX01	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives: To facilitate the understanding of Quality Management principles and process.

Unit I	INTRODUCTION	9 Hours

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Costs of quality.

Unit II	TQM PRINCIPLES	9 Hours

Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating

Unit III	TQM TOOLS AND TECHNIQUES I	9 Hours

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

Unit IV	TQM TOOLS AND TECHNIQUES II	9 Hours

Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

Unit V	QUALITY SYSTEMS	9Hours

Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.. TOTAL: 45 PERIODS OUTCOMES : x The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

	Total:	45 Hours

Further Reading:

1. Engineering economics and cost analysis
2. Construction and planning management

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the concepts, dimension quality and philosophies of TQM.
2. Understand the principles of TQM and its strategies.
3. Apply seven statistical quality and management tools.
4. Understand TQM tools for continuous improvement.
5. Understand the QMS and EMS.

References:

6. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
7. ShridharaBhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.

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1902CE604	GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the Earth's Climate System and the concept of Global Warming.
2. To analyze the global warming and their effects due to climate change.
3. To comprehend the impact of climate change on society and its mitigation measures.

Unit I	INTRODUCTION OF GLOBAL WARMING	9 Hours

Introduction - the gas law - ideal gas equation- the mole concept- sample calculations- ppm - sulphur pollutants-oxides of nitrogen - particulate - Green House Gases.

Unit II	MITIGATION MEASURE, EMISSION TARGETS AND CARBON TREADING	9 Hours

Introduction-reduction of carbon dioxide emissions from power generation- carbon credits-carbon dioxide from vehicle - miscellaneous source of carbon dioxide- uptake of carbon dioxide by vegetation

Unit III	OVERVIEW OF CLIMATE VARIABILITY AND CLIMATE SCIENCE	9 Hours

Climate dynamics, climate change and climate prediction - the chemical and physical climate system and aspects - El Nino and global warming - global change in recent history.

Unit IV	BASICS OF GLOBAL CLIMATE	9 Hours

Components and phenomena in the climate system - basics of radioactive forcing - atmospheric circulation-ocean circulation-land surface processes - the carbon cycle.

Unit V	PHYSICAL PROCESSES IN THE CLIMATE SYSTEM	9 Hours

Conservation of momentum-equation of state- temperature equation - continuity equation -conservation of mass applied to moisture – saturation - wave processes in the atmosphere and ocean.

	Total:	45 Hours

Course Outcomes:

Employability

After completion of the course, Student will be able to

1. Outline the principle involved in the greenhouse gas emission.
2. Explain the carbon emission and its mitigation methods.
3. Illustrate about the climate variability parameters.
4. Describe the climate components and the circulation system.
5. Discuss about the physical processes involved in the climate system.

References:

1.Atmospheric Pollution- 1st edition-2014 Dr. Clifford Jones & ISBN 978-87-7681-416-8

2.The science of global warming and our energy future – Edmond A.Mathez& Jason E. Serdon – 2nd Edition- Columbia University Press –New York.

3.Climate Change-JOSEPH ROMM- 2nd Edition –oxford university press

4.William Nordhaus, The Climate Casino: Risk, Uncertainty, and Economics for a Warming World (Yale, 2013; ISBN 978-0-300-21264-8)

5.Roger A. Pielke, Jr., The Climate Fix (Basic Books, 2010; ISBN 978-0-465-02519-0)

6. Hadley Wickham and Garrett Grolemund, R for Data Science (O'Reilly, 2017; ISBN 978- 1-491-91039-9). This book is also available as a free online edition at r4ds.had.co. nz/.

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1902CE651	COMPUTER AIDED DESIGN AND DRAFTING LAB	L	T	P	C
		0	0	2	1

Course Objectives:

1. To learn the software developing skills for structural design
2. To understand the computing skills in the field of geotechnical engineering.
3. To study the different software packages for analysis and design

List of Experiments:

1. Design of building elements (RC)-Standard method of detailing RC beams, slabs and columns – Special requirements of detailing with reference to erection process.
2. Design of Industrial Buildings - Steel roof trusses
3. Design of Overhead water tanks (RC & Steel)
4. Design of box culvert and slab bridges
5. Design of steel chimneys

Total: 45 Hours

Additional Experiments:

1. Transportation planning process- Trip generation and distribution- Network analysis - Shortest path algorithms
2. Water resources - Pipe networks - Canal design - Backwater profile - Synthetic derivation of stream flows using random numbers - Dam stability

Course Outcomes:

Employability

After completion of the course, Student will be able to

1. Learn software developing skills for structural design
2. Study the different software packages for analysis and design
3. Use computer software to model any type of structure
4. Compute loads and use computer software to analyse a structure
5. Use computer software to design a structure based on is codal provisions.

References:

1. Krishna Raju N, "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi, 2003.
2. Krishna Raju N, Structural Design and Drawing (Reinforced Concrete and Steel). University press, Hyderabad, 2006
3. Krishnamoorthy, C.S. and Rajeev, S., Computer Aided Design and Analytical Tools, Narosa, 1993.
4. Papacostas, C.S., Fundamentals of Transportation Engineering Prentice-Hall of India, 2001
5. Loucks, D.P., Stedinger, J.R. and Haith, D.A., Water Resource Systems Planning and Analysis, Prentice-Hall INC, 1981.

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LIFE SKILL IV - APTITUDE – II & GD

1904GE651

Course Objective (s):

- To brush up problem solving skill and to improve intellectual skill of the students
- To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
- To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
- To enhance analytical ability of students
- To augment logical and critical thinking of Student

Unit 1	**Profit and Loss Simple Interest, Compound Interest**	**6 Hours**
Problems on Profit and Loss percentage- Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.		
Unit 2	**Blood relations, Clocks, Calendars**	**6 Hours**
Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations -Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .		
Unit 3	**Time and Distance, Time and Work**	**6 Hours**
Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.		
Unit 4	**Data Interpretation and Data Sufficiency**	**6 Hours**
Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy		
Unit 5	**Analytical Reasoning**	**6 Hours**
Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons		
		Total 30 Hours

Skilled.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Implement business transactions using profit and loss & Interest Calculation.

CO2:Workout family relationships concepts, ability to visualize clocks & calendar and understand the logic behind a Sequence.

CO3:Calculate concepts of speed, time and distance, understand timely completion using time and work.

CO4: Learners should be able to understand various charts and interpreted data least time.

CO5 : Workout puzzles, ability to arrange things in an orderly fashion.

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3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
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5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

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NAGAPATTINAM–611002

B.E. Civil Engineering

FullTime Curriculum and Syllabus

SEMESTER VII									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CIA	ES	Total	
Theory Course									
1702CE701	Quantity Surveying & Cost Estimation	3	0	0	3	40	60	100	PC
1702CE702	Waste Water Engineering	3	0	0	3	40	60	100	PC
1702CE703	Structural Dynamics and Earth Quake Engineering	3	0	0	3	40	60	100	PC
1701MGX01	Professional Ethics	3	0	0	3	40	60	100	HS
1703CE015	Pre-Stressed Concrete (Elective V)	3	0	0	3	40	60	100	PE
	Elective VI (Open)	3	0	0	3	40	60	100	PE
Laboratory Course									
1702CE751	Computer Aided Design and Drafting Lab	0	0	4	2	50	50	100	PC
1702CE752	Water And Waste Water Engineering Lab	0	0	2	1	50	50	100	PC
1702CE753	Mini Project III	0	0	2	1	100	0	100	PC
1704GE751	Competitive exams Preparation	2	0	0	2	100	0	100	EEC
1702CE754	In plant Training / Internship Presentation	0	0	0	1	-	-	-	-
Total		**21**	**0**	**10**	**25**	**540**	**460**	**1000**	**-**

L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester

1702CE701	QUANTITY SURVEYING & COST ESTIMATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide the student with the ability to estimate the quantities of item of works involved in buildings
2. To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works
3. To understand the techniques of development and management of groundwater
4. To be introduced to the different theories of traffic flow
5. To be aware of the importance of traffic safety

Unit I — **Procedure of estimation quantity** — **9 Hours**

Introduction– Estimate–Types of Estimates–Units of measurements–Methods of building estimate– calculation of quantities of earthwork, stone masonry, brick masonry, plastering, cement concrete, R.C.C, PCC Doors, Windows, Flooring, White Washing, colour washing and painting Nourishing for load bearing structures and framed structures.

Unit II — **ESTIMATE OF OTHER STRUCTURES** — **9Hours**

Estimating of septic tank, soakpit–sanitary and water supply installations–water supply pipeline–sewer line–tube well–open well–estimate of bituminous and cement concrete roads–estimate of retaining walls–culverts–estimating of irrigation works–aqueduct, syphon, fall

Unit III — **SPECIFICATION AND TENDERS** — **9Hours**

Data–Schedule of rates–Analysis of rates–Specifications–sources– Preparation of detailed and general specifications – Tenders – TTT Act – e-tender– Preparation of Tender Notice and Document–Contracts–Types of contracts–Drafting of contract documents–Arbitration and legal requirements

Unit IV — **VALUATION** — **9 Hours**

Necessity–Basics of value engineering –Capitalised value –Depreciation–Escalation– Value of building– Calculation of Standard rent –Mortgage–Lease

Unit V — **REPORT PREPARATION** — **9 Hours**

Principles for report preparation–report on estimate of residential building–Culvert–Roads – Water supply and sanitary installations–Tubewells– Openwells.

Total: 45 Hours

Further Reading:

1. Effective cost of good quality of building in civil engineering world.
2. Estimation of bridge ,road,culvert and other special structure using some software

Course Outcomes:

1. The student shall be able to estimate the material quantities, prepare a bill of quantities, make specifications and prepare tender documents. Student shall be able to prepare value estimates.
2. To know the importance of preparing the types of estimates under different conditions
3. To apply logical thoughts and prepare the rate analysis and bills
4. To analyze and synthesize cost effective approach for civil engineering projects
5. To comprehend detailed report on estimation and valuation process

References:

1. Dutta, B.N., Estimating And Costing, S Dutta & Co., Lucknow 2006.
2. .Rangawala, S.C., Estimating And Costing, Charotar Anand Publications, 1996
3. .Kohli, D.D. And Kohli R.C., A Text Book On Estimating, Costing And Accounts, S.Chand And Co, New Delhi, 1994
4. Cpwd Specifications And Schedule Of Rates

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1702CE702	WASTE WATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the importance of planning and design of sewerage system.
2. To create an ability to evaluate the waste water treatment system.
3. To impart the signification of disposal of Sewage.

Unit I **PLANNING FOR SEWERAGE SYSTEMS** **09 Hours**

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

Unit II **DESIGN OF SEWER** **09 Hours**

Sewerage – Hydraulics of flow in sewers – Design period - Design of sanitary and storm sewers – Small bore systems – Materials of sewers– Laying, joining & testing of sewers – Forces acting on sewers– Cleaning and maintenances of sewers- Sewer appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.

Unit III **PRIMARY TREATMENT OF SEWAGE** **09 Hours**

Objective – Unit Operation and Processes – Selection of treatment processes – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects – Onsite sanitation - Septic tank, Grey water harvesting.

Unit IV **SECONDARY TREATMENT OF SEWAGE** **09 Hours**

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.

Unit V **DISPOSAL OF SEWAGE AND SLUDGE** **09 Hours**

Standards for Disposal - Methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sewage farming – Deep well injection – Soil dispersion system -Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal.

Total: 45 Hours

Further Reading:

1. Design the necessary treatment units for energy conservation.
2. Design the suitable disposal unit for the sludge without endangering the environment.

Course Outcomes:

After completion of the course, Student will be able to

1. Examine the waste water quality characteristics and standards.
2. Design sewerage systems and discuss about the treatment process step by step done in primary level.
3. Design the various unit operations for waste water treatment.
4. Design the sludge treatment and disposal methods.
5. Perform quality analysis of sewage the characteristics and composition of sewage, self - Purification of streams.

References:

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2003.
2. Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2005
3. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997.
4. Wastewater Engineering – Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2003.

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1702CE703	STRUCTURAL DYNAMICS AND EARTH QUAKE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.To introduce dynamic loading and the dynamicperformance of the structures to the students. Different types of dynamic loading also tobe discussed.

2.The detailed study on the performance of structures under earthquake loading is also one of the focus of the course.

Unit I	**PRINCIPLES OF VIBRATION ANALYSIS**	**9 Hours**

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility.

Unit II	**MULTIPLE DEGREE OF FREEDOM SYSTEM**	**9 Hours**

Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).

Unit III	**ELEMENTS OF EARTHQUAKE ENGINEERING**	**9 Hours**

Earthquake magnitude and intensity Focus and Epicentre, Causes and Effects of Earthquakes, Characteristics of Earthquake, Seismic zone mapping– Spectral Acceleration.

Unit IV	**DESIGN SEISMIC FORCES**	**9 Hours**

Codal provision for design - IS 1893-2002 – Response spectrum – determination of lateral forces – base shear – by response spectrum method for 2 storey moment resistant frame- calculation of drift Aspects in planning and layout - regular and irregular buildings- calculation of centre of mass and centre of rigidity for simple layouts- eccentricity and torsion.

Unit V	**Ductile Detailing**	**9 Hours**

Ductility of R.C structures- Confinement- detailing as per IS-13920-1993- moment redistribution – principles of design of beams, columns – beam column joints – soft story concept. Base Isolation: Isolation systems – Effectiveness of base isolation.

Total:	**45 Hours**

Further Reading: At the end of the course,

1. Analyse structures subjected to dynamic loading.
2. Design the structures for seismic loading as per code provisions.

Course Outcomes:

Employability

After completion of the course, Student will be able to

1. Analyze single degree of freedom systems without damping and with damping
2. Analyse multi degree freedom system and continuous systems using iterative techniques.
3. Knowledge on earthquakes and Effects of Earthquakes
4. Knowledge on earthquakes and its resistant features for different types of buildings
5. Determine the design lateral forces by means of codal provisions.

References:

1. PankajAgarwal, "Earthquake Resistant Design of Structures" PHI Learning Private Limited, New Delhi, 2010.
2. Chopra. AK, "Dynamics of Structures – Theory and Applications to Earthquake Engineering" Second Edition, Pearson Education, 2003
3. SK.Duggal,"Earthquake Resistant Design of Structures", Oxford University Press, New Delhi, 2010
4. "Learning earthquake Design and Construction", Earthquake Tips 1 to 24, Authored by C.V.R. Murthy, IIT, Kanpur. eqtips@iitk.ac.in Web sites: www.nicee.org.
5. IS 1893: 2001, (Part I) "Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings", BIS, 2002.

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1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.The primary goal is to stimulate critical and responsible reflection on moral issues surrounding engineering practice and to provide the conceptual tools necessary for pursuing those issues.
2.Also to make the students aware of the different ethical issues, codes of conduct for engineers in the society and moralities in an organization.

Unit I	INTRODUCTION & HUMAN VALUES	9 Hours

Morals, Values and Ethics- Work Ethic - Team work – Types of Ethics - Respect for Others- Living Peacefully- Honesty- Courage - Valuing Time - Co-operation - Commitment- Self-Confidence - Customs and religion-Caring and Sharing.

Unit II	ENGINEERING ETHICS	9 Hours

Engineering ethics – Variety of moral issues – Types of Inquiry – Professional accountability – Self Interest – Moral dilemmas – Kohlberg's Theory – Gilligan's Theory – Theories about Right Action – Ethical codes of IEEE and Institution of Engineers.

Unit III	SAFETY & RESPONSIBILITY OF ENGINEERS	10 Hours

Engineering as experimentation – Safety and Risks – Risk – benefit analysis – Computer Technology Privacy – Social Policy – Engineering standards – Communicating Risk and Public Policy – Occupational Crime – Professional Rights and Employee Rights – Whistle Blowing – Collective Bargaining – Conflicts of Interest.

Unit IV	ENGINEER'S ROLE	9 Hours

Engineers as Managers, Advisors, Consultants, Experts and Witness – Engineers role in industry and society – Theories about right action – Moral leadership - Collegiality and loyalty – IPR – Discrimination - Bhopal gas tragedy case study.

Unit V	GLOBAL ISSUES	8 Hours

Multinational corporations-Environmental Ethics- Weapons Development- Code of Conduct – Eco – friendly production system – Sustainable technology & development – ozone depletion – Eco system – Pollution control.

	Total:	45 Hours

Further Proceeding:

1. Analysis about Safety and Risk Management in an Organisation
2. Analysis about Code of Conduct for Ethical & Moral values

Course Outcomes: Skilled

After completion of the course, Student will be able to

3. Obtain awareness on Human Values & Social Values of the every individual.
4. Knowledge about ethical theories and relevant code of conduct for engineers.
5. Enumerate the safety and responsibility of engineers in the society.
6. Realize their responsibilities, professional rights and moralities for the enhancement of an organization.
7. Explain about the environmental impacts at present day scenario.

References:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey,2004 (Indian Reprint now available)
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available).
4. John R Boatright, "Ethics and the conduct of business", Pearson Education, New Delhi,2003.

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1702CE751	COMPUTER AIDED DESIGN AND DRAFTING LAB B.E CIVIL ENGINEERING	L	T	P	C
		0	0	4	2

Course Objectives:

1. To learn the software developing skills for structural design
2. To understand the computing skills in the field of geotechnical engineering.
3. To study the different software packages for analysis and design

List of Experiments:

1. Design of building elements (RC)-Standard method of detailing RC beams, slabs and columns – Special requirements of detailing with reference to erection process.
2. Design of Industrial Buildings - Steel roof trusses
3. Design of Overhead water tanks (RC & Steel)
4. Design of box culvert and slab bridges
5. Design of steel chimneys

Total: 45 Hours

Additional Experiments:

1. Transportation planning process- Trip generation and distribution- Network analysis - Shortest path algorithms
2. Water resources - Pipe networks - Canal design - Backwater profile - Synthetic derivation of stream flows using random numbers - Dam stability

Course Outcomes:

Employability

After completion of the course, Student will be able to

1. Learn software developing skills for structural design
2. Study the different software packages for analysis and design
3. Use computer software to model any type of structure
4. Compute loads and use computer software to analyse a structure
5. Use computer software to design a structure based on is codal provisions.

References:

1. Krishna Raju N, "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi, 2003.
2. Krishna Raju N, Structural Design and Drawing (Reinforced Concrete and Steel). University press, Hyderabad, 2006
3. Krishnamoorthy, C.S. and Rajeev, S., Computer Aided Design and Analytical Tools, Narosa, 1993.
4. Papacostas, C.S., Fundamentals of Transportation Engineering Prentice-Hall of India, 2001
5. Loucks, D.P., Stedinger, J.R. and Haith, D.A., Water Resource Systems Planning and Analysis, Prentice-Hall INC, 1981.

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1702CE752	WATER AND WASTE WATER ENGINEERING LAB B.E CIVIL ENGINEERING	L	T	P	C
		0	0	4	2

Course Objectives:

1. To know the basics, importance of water and wastewater treatment and methods measurement.
2. To study the various effects of water and waste water pollution.
3. Effect of BOD and COD
4. To find Calcium, Potassium and Sodium
5. Heavy metal effects and finding methods

List of experiments

1. Determination of Ammonia Nitrogen in waste water.
2. CoagulationandPrecipitationprocessfor treating waste water
3. Determination of suspended, volatile fixed and settles able solids in wastewater.
4. B.O.D. test
5. C.O.D. test
6. Nitrate in wastewater
7. Phosphate in wastewater
8. Determination of Calcium, Potassium and Sodium
9. Heavy metals determination-Chromium, Lead and Zinc. (Demonstration only)

Total: 45 Hours

Additional Experiments:

1. conductivity meter
2. UASB Reacter

Course Outcomes:

After completion of the course, Student will be able to

1. characterize given water and waste water sample
2. perform filtration techniques and methods
3. characterize hazardous and non-hazardous substances

References:

1. Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998
2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi
3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi-6

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1704CE753 **MINI PROJECT III** **0 0 2 1**

Aim:

To carry out a design project in one of the specializations of civil engineering withsubstantial multidisciplinary component

Course Objectives:

The student should be made to:

To guide the students in such a way so that they carry out a work on a topic as a forerunner to the full fledged project work to be taken subsequently in VIII semester. The project work shall consist of substantial multidisciplinary component

List of Experiments:

The students will carry out a project in one of the following civil engineering areasbut with substantial multidisciplinary component involving Architecture,Mechanical engg. Electrical engg., Biotechnology, Chemical engg., Computerscience.

1. Structural Engineering
2. Geotechnical Engineering
3. Water Resources engineering and environmental engg.
4. Geomatics Engineering and surveying
5. Construction management
6. Transportation engineering

Internship

Student groups will be formed (6 in a group) and a faculty member will be allocated to guide them. There will be three reviews. First review will not carry any marks but the project topic will be finalized in it. Of remaining 2 reviews one will be carried out in the mid-semester and the last one by the end of semester.

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1704GE751 BE PREPARED TO ACE THE TECHNICAL SKILLS IN COMPETITIVE EXAMS **2 0 0 2**

Course Objectives

The students should be made to:

1. Study the concepts of concrete structures, design and analysis.
2. Study the process and implementation of surveying,geotechnical engineering.
3. Familiar with the construction materials, management and waste water engineering

Employability

Total: 30 Periods

BUILDING MATERIALS : brick, stones, aggregates, cement,Timber

CONSTRUCTION PRACTICES: Construction of stone masonry, brick masonry and R.C.C. and block masonry– construction equipments.

ENGINEERING SURVEY: Survey - computation of areas - Chain Survey - Compass surveying - Plane table survey –levelling

STRENGTH OF MATERIALS: Stresses and strains -Thermal stresses- elastic constants - Beams and bending – Bending moment and shear force in beams

STRUCTURAL ANALYSIS: Indeterminate beams - Stiffness and flexibility methods of structural analysis – Slope deflection - Moment Distribution method – Arches and suspension cables

GEOTECHNICAL ENGINEERING: Formation of soils - types of soils - classification of soils for engineering practice – Field identification of soils - Physical properties of soils - Three phase diagram-Soil exploration - Soil sampling techniques -Borelog profile - shallow foundations

ENVIRONMENTAL ENGINEERING: Sources of water - Ground water Hydraulics - Characteristics of water - Water analysis -water treatment - water borne diseases. Sewerage system

DESIGN OF REINFORCED CONCRETE: Design of concrete members - limit state and working stress design concepts - design of slabs - one way, two way and flat slabs

HYDRAULICS: Hydrostatics-applications of Bernoulli equation – flow measurement in channels, Applications of Momentum equation, Kinematics of flow.

TRANSPORTATION ENGINEERING: Different modes of transport and their characteristics. Geometric design of highways. –Design and Construction of bituminous and concrete roads – Maintenance of roads.

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1704GE754 IN-PLANT TRAINING / INTERNSHIP PRESENTATION 0 0 2 1

In order to provide the experiential learning to the students, the students undergo in-plant training or internship during summer / winter vacation between III and VII semesters. A presentation based on in-plant training / internship shall be made in this semester and suitable credit may be awarded.

Internship

Internal Assessment Only	
Test	40
Presentation / Quiz / Group Discussion	40
Report	20
Grades (Excellent / Good / Satisfactory / Not Satisfactory)	

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CIVIL, IT)

NAGAPATTINAM–611002

B.E. Civil Engineering

FullTime Curriculum and Syllabus

SEMESTER VIII									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CIA	ES	Total	
Theory Course									
1703CE019	Storage And Industrial Structures (Elective VII)	3	0	0	3	40	60	100	PE
1703CE021	Repair And Rehabilitation of Structures (Elective VIII)	3	0	0	3	40	60	100	PE
1703CE025	Traffic Engineering and Management (Elective IX)	3	0	0	3	40	60	100	PE
Laboratory Course									
1702CE851	Project	0	0	18	9	50	50	100	PC
Total		**09**	**0**	**18**	**18**	**170**	**230**	**400**	-

L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester

1703CE019	STORAGE AND INDUSTRIAL STRUCTURES B.E CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study the design of material storage structures
2. To study the design procedures and practices of complex steel structures like industrial structures and Gantry girders.
3. To develop an in-depth knowledge in the area of design of industrial structure with the latest code of practice as per the Indian Standard

Unit I	PLANNING AND LAYOUT	9 Hours

Planning and layout of low-rise buildings for different functions such as residences, office buildings, shopping centers, hospitals, auditoria, etc. STEEL MILL BUILDINGS: Planning the general framing scheme - Planning the Trusses - Bracing of roofs - Vertical bracing of buildings - Design of roof Trusses and lattice girders

Unit II	DESIGN OF FRAMES	9 Hours

Design of simple and rigid frames – Gable frames – Knee bents

Unit III	DESIGN OF CHIMNEYS	9 Hours

Self-supporting - Guyed Chimneys - Design of towers

Unit IV	INDUSTRIAL ROOFING STRUCTURES	9 Hours

Trusses – Design of lattice girders – design of arches – Plate girders - Design of industrial sheds - Design of over head and under slung girders - Gantry girder - Design of gantry columns – Heavy duty plate girders.

Unit V	BUNKERS AND SILOS:	12 Hours

Pressure on side walls of bunkers and silos - Janssen's and Airy's theories - Complete design of single cell circular silos including their supporting structures and foundation - Design of rectangular and square bunkers - sloping bottom - design of staging.

	Total:	45 + 15 Hours

Further Reading:

design concrete and steel material storage structures.

Course Outcomes:

After completion of the course, Student will be able to

1. Discuss the planning and functional requirements of Industrial structures.
2. Discover the need to learn about the design concepts, and constructional aspects of Industrial structures
3. Design of Simple Industrial shed-gantry girder
4. Design steel gantry girders and portal frames
5. Design storage structures, bunkers and silos

References:

1. Dunham C W, "Planning Industrial Structures", McGraw Hill Book Company, Inc., 1980.
2. Subramanian N," Design of Steel Structures", Oxford University Press, NewDelhi 2008
3. Jayagopal L S, 'Structural Steel Design", Vikas Publications, 2012
4. Gaylord and Gaylord," Structural Engineering Hand Book", McGraw Hill book Co., 1990
5. Charles G Salmon & John E Johnson, "Steel Structures – Design & Behaviour", Harper Collins Publishers, 3rd edition, 1990.
6. Robert Englekirk, "Steel Structures, Controlling Behaviour through Design", John Wiley & Sons, Inc., 2003.
7. Ram Chandra, "Design of Steel Structures", Vol.2, Scientific Publication (India), Jodhpur, 2007

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1703CE021	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.To make the students to gain knowledge on quality of concrete ,durability aspects, causes of deterioration, assessment of distressed structures ,repairing of structures and demolition procedures.
2. To make the students to assess the durability of concrete due to various climate conditions
3.To prepare the students to select the appropriate rehabilitation, retrofitting and demolition for structures

Unit I	MAINTENANCE AND REPAIR STRATEGIES	9 Hours

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration

Unit II	STRENGTH AND DURABILITY OF CONCRETE	9 Hours

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness

Unit III	SPECIAL CONCRETES	9 Hours

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

Unit IV	TECHNIQUES FOR REPAIR AND PROTECTION METHODS	9 Hours

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection

Unit V	REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES	12 Hours

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques - Engineered demolition methods - Case studies.

	Total:	45 + 15 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Suggest maintenance and repair strategies
2. Examine the durability due to various climate conditions
3. Suggest the suitable materials and techniques for repair
4. Choose various rehabilitation and retrofitting techniques.
5. Select suitable demolition techniques for structures.

References:

1. 1.Shetty M.S., "Concrete Technology - Theory and Practice", S.Chand and Company, 2008
2. DovKominetzky.M.S., " Design and Construction Failures", Galgotia Publications Pvt.Ltd., 2001
3. Ravishankar.K., Krishnamoorthy.T.S, " Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
5. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013

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1703CE025		TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

- To learn the fundamentals of traffic engineering
- To learn the methods of intersection design
- To learn the skills of traffic control
- To be introduced to the different theories of traffic flow
- To be aware of the importance of traffic safety

Unit I — **TRAFFIC PLANNINGAND CHARACTERISTICS** — **9 Hours**

RoadCharacteristics– Roadusercharacteristics–PIEVtheory–Vehicle–Performance characteristics–FundamentalsofTrafficFlow–UrbanTrafficproblemsinIndia–Integrated planningoftown,country,regionalandallurbaninfrastructure–TowardsSustainableapproach.

Unit II — **TRAFFIC SURVEYS AND TRAFFIC DESIGN** — **10 Hours**

Traffic Surveys–Speed, journeytimeanddelaysurveys–VehiclesVolumeSurveyincludingnon-motorizedtransports–Methodsandinterpretation–OriginDestinationSurvey IntersectionDesign-channelization,Rotaryintersectiondesign–Signaldesign–Coordination of signals—Gradeseparation

Unit III — **TRAFFIC SAFETYANDENVIRONMENT** — **8 Hours**

Roadaccidents–Causes,effect,prevention,andcost–Streetlighting– Trafficandenvironment hazards–AirandNoisePollution,causes, abatementmeasures–Promotionandintegrationof public transportation–Promotionofnon-motorizedtransport.

Unit IV — **ROADSAFETY AND RULES** — **9 Hours**

Road Safety Audit - Global & Local perspective – Road safety issues – Road safety programmes – Types of RSA, planning, design, construction & operation stage audits – Methodology – Road safety audit measures

Unit V — **Traffic System Management** — **9 Hours**

Traffic System Management- Management techniques, one-way, tidal flow, turning restrictions etc. – Transportation System Management Process – TSM Planning & Strategies

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Carry out traffic studies
2. Design intersections
3. Implement traffic system management
4. Be aware of traffic flow theory
5. Enhance safety in all design aspects

References:

1. *Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2012*
2. *Khisty C J,LallB.Kent; Transportation Engineering-An Introduction, Prentice-Hall,NJ, 2005*
3. *May, A.D., Traffic Flow Fundamentals, Prentice – Hall, Inc., New Jersey,1990*

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1704CE851 **PROJECT WORK** **0 0 18 9**

Course Objectives:

To guide the students such a way that the they carry out a comprehensive work on the chosen topic which will stand them in good stead as they face real life situations. The project work so chosen by the student shall culminate in gaining of major design experience in the related area of specialization.

Course Outcomes (COs)

Upon completion of the course, the student should be able to,

a) Formulate a real world problem, identify the requirement and develop the design solutions.
b) Express the technical ideas, strategies and methodologies of civil engineering.
c) Utilize the new tools,softwares and techniques that contribute to obtain the solution of the project.
d) Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
e) Prepare report and present the oral demonstrations.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total: 180 Periods

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2101EV101		STATISTICS FOR ENVIRONMENTAL ENGINEERS	L	T	P	C
			3	2	0	4

Course Objectives:

1. To introduce the basic concept of Stochastic Processes
2. To enable the students in handling Estimation and Testing of Hypothesis
3. To learn the Application of Statistics in Engineering Decision Making

Module I	**Probability and Random Variable**	**9 + 3 Hours**

Probability concepts – Random Variables – Moment generating function – Standard distributions - Binomial - Poisson - rectangular or Uniform – Normal - Exponential distributions - Functions of random variables –Two dimensional random variables.

Module II	**Stochastic Processes**	**9 + 3 Hours**

Classification – Stationary and Random process – Markov process – Markov chains – Transition probability – Classification of Markov chain – Limiting distribution – First passage time – Poisson process – Birth and death process.

Module III	**Estimation Theory**	**9 + 3 Hours**

Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size- unbiased Estimators- Maximum Likelihood Estimation-Curve Fitting by Principle of Least square

Module IV	**Testing of Hypothesis- Parametric Tests**	**9 + 3 Hours**

Hypothesis testing: one sample and two sample tests for means and proportions of large samples z-test, one sample and two sample tests for means of small sample t-test, F-test for two sample standard deviations. ANOVA one and two way classification.

Module V	**Non Parametric Tests**	**9 + 3 Hours**

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Comparing two populations. Mann – Whitney U test and Kruskal Wallis test.

	Total:	**45 + 15 Hours**

Further Reading

Sampling, distribution, correlation, regression curve fitting by least square methods.

Course Outcomes:

After completion of the course, Student will be able to

1. To acquire knowledge in basic concepts of Probability
2. To characterize phenomenon which evolve with respect to time in a probabilistic manner
3. To estimate the sample size and prediction of unknown values
4. To solve Parametric and non - parametric statistical problem
5. To apply statistical techniques for solving Engineering problems

References:

1. Jay L. Devore, "Probability and Statistics For Engineering and the Sciences",Thomson and Duxbury, 2002.
2. Richard Johnson. "Miller& Freund's Probability and Statistics for Engineer", Prentice – Hall,Seventh Edition, 2007.
3. Gupta S.C. and Kapoor V.K."Fundamentals of Mathematical Statistics", Sultan an Sons, 2001.
4. Dallas E Johnson , "Applied Multivariate Methods for Data Analysis", Thomson an Duxbury press,1998.
5. Jay L. Devore, "Probability and Statistics For Engineering and the Sciences",Thomson and Duxbury, 2002.

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2102EV102		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

1. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
2. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
3. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered.
4. An exposure to toxicology due to industrial products and byproducts are also covered.
5. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Module I	**Classification And Characteristics**	**5 Hours**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Module II	**Microbes And Nutrient Cycles**	**10 Hours**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Module III	**Metabolism of Microorganisms**	**10 Hours**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Module IV	**Pathogens in Wastewater**	**10 Hours**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, α-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Module V	**Toxicology**	**10 Hours**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching.

	Total:	**45 Hours**

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

1. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
2. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
3. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
4. The candidate would know the role of microorganisms in contaminated water and the diseases caused.
5. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:

1. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
3. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, AcademicPress.
4. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall ofIndia Private Limited
5. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
6. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
7. Frank C. Lu and Sam Kacew, LU"s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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2102EV103	PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To educate the students on the principles and process designs of various treatment systems for water and wastewater
2. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Module I **Introduction** **5 Hours**

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch- continuous type-kinetics

Module II **Treatment Principles** **10 Hours**

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances.Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advancedoxidation /reduction – Recent Trends

Module III **Design of Municipal Water Treatment Plants** **10 Hours**

Selection of Treatment – Design of municipal water treatment plant Modules – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Module IV **Design of Industrial Water Treatment Plants** **10Hours**

Design of Industrial Water Treatment Modules- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Module V **Design of Wastewater Treatment Plants** **10 Hours**

Design of municipal wastewater treatment Modules-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Modules-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation Modules-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total: **45 Hours**

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

1. Identify the pollutants type in the wastewater
2. Understand the various treatment principles
3. Design the sewage treatment plants
4. Design suitable treatment Modules for various industries
5. Develop conceptual schematics required for the treatment of wastewater

References:

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shundar Lin, Handbook of EnvrnEnggCalculations, Mc Graw Hill, NewYork, 1999.

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2102EV104		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

1. To educate the students about water chemistry
2. To impart knowledge in the area of air and soil chemistry
3. To impart knowledge on the transformation of chemicals in the environment

Module I	**Introduction**	**9 Hours**

Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp) ,heavy metal precipitation, amphoteric hydroxides,CO_2 solubility in water and species distribution – Chemical kinetics , First order- 12 Principles of green chemistry.

Module II	**Aquatic Chemistry**	**11 Hours**

Water quality parameters- environmental significance and determination; Fate ofchemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction ,pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Module III	**Atmospheric Chemistry**	**7 Hours**

Atmospheric structure –chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Module IV	**Soil Chemistry**	**9 Hours**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Module V	**Environmental Chemicals**	**9 Hours**

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

	Total:	**45 Hours**

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

1. Distinguish the chemistry involved
2. Understand the chemistry involved in water
3. Identify and solvethe air pollution related issues
4. Understand the soil related chemistry and issues
5. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

References:

1. Sawyer,C.N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and
2. Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
3. Colin Baird „Environmental Chemistry", Freeman and company, New York, 1997.
4. Manahan, S.E., Environmental Chemistry, Eighth Edition, CRC press, 2005.
5. Ronbald A. Hites ,Elements of Environmental Chemistry, Wiley, 2007.

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2103EV001		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

1. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
2. To educate the students incomputer application on design.

Module I	**General Hydraulics and Flow Measurement**	**8 Hours**

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Module II	**Water Transmission and Distribution**	**10 Hours**

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Module III	**Wastewater Collection and Conveyance**	**10 Hours**

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Module IV	**Storm Water Drainage**	**7 Hours**

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Module V	**Case Studies and Software Applications**	**10 Hours**

Use of computer software in water transmission, water distribution and sewer design – EPANET2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	**45 Hours**

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

er completion of the course, Student will be able to

1. Understand the fluid flow properties
2. Design water supply main, distribution network and sewer for various field conditions
3. Design the drainage network for wastewater
4. Design the storm water drainage systems
5. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

References:

1. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Shimla, 2003
2. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban

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RESEARCHMETHODOLOGYANDIPRL T P C 3 0 0 3
2101RMX01

COURSEOBJECTIVES:
Toimpartknowledgeandskillsrequiredforresearch andIPR:

- Problemformulation,analysisandsolutions.
- Technicalpaperwriting/presentationwithoutviolatingprofessionalethics
- Patentdraftingandfilingpatents.

MODULE-I RESEARCH PROBLEM FORMULATION **9**
Meaning of research problem- Sources of research problem, criteria characteristics of a goodresearchproblem,errorsinselectingaresearchproblem,scopeandobjectivesofresearchproblem. Approaches of investigation of solutions for research problem, data collection, analysis,interpretation,necessaryinstrumentations

MODULE-II LITERATURE REVIEW **9**
Effectiveliteraturestudiesapproaches,analysis,plagiarism, andresearchethics.

MODULE-III TECHNICALWRITING/PRESENTATION **9**
Effective technical writing, how to write report, paper, developing a research proposal, format ofresearchproposal,apresentation and assessmentbyareviewcommittee.

MODULE-IV INTRODUCTIONTOINTELLECTUALPROPERTYRIGHTS(IPR) **9**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting andDevelopment: technological research, innovation, patenting, development. International Scenario:International cooperation on Intellectual Property. Procedure for grants of patents, Patenting underPCT.

MODULE-V INTELLECTUAL PROPERTYRIGHTS(IPR) **9**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patentinformationanddatabases.Geographical Indications. New Developments in IPR: Administration of PatentSystem,IPRofBiologicalSystems,ComputerSoftwareetc.
TraditionalknowledgeCaseStudies,IPRandIITs.

TOTAL:45PERIODS

COURCEOUTCOMES; Entrepreneurship

1. Abilitytoformulateresearch problem
2. Abilitytocarryoutresearchanalysis
3. Abilitytofollowresearchethics
4. Abilitytounderstandthattoday'sworldiscontrolledbyComputer,InformationTechnology,buttomorrowworld will beruled byideas,concept,and creativity
5. AbilitytounderstandaboutIPRandfilingpatentsinR&D.

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2102EV105		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1
Course Objectives:						
	1. To train in the analysis of physical parameters of water and waste water					
	2. To train in the analysis of chemical parameters of water and waste water					
List of Experiments:						
1. Good Laboratory Practices, Quality control, calibration of Glassware						03
2. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride)						12
3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).						12
4. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx)						09
5. Sampling and characterization of soil (CEC & SAR, pH and K).						09
		Total:				**45 Hours**
Course Outcomes:						
	After completion of the course, Student will be able to					
	1. assess quality of environment					
	2. conduct analysis on characteristics of water and waste water					
References:						
1. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.						
2. Washington, 2005.						
3. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.						
4. Second Edition, VCH, Germany, 1992.						

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2102EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Module I	**Introduction**	**10 Hours**

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Module II	**Aerobic Treatment of Wastewater**	**10 Hours**

Design of sewage treatment plant Modules –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Module III	**Anaerobic Treatment of Wastewater**	**10 Hours**

Attached and suspended growth, Design of Modules – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Module IV	**Sludge Treatment and Disposal**	**5 Hours**

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Module V	**Construction Operations and Maintenance Aspects**	**10 Hours**

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

	Total:	**45 Hours**

Course Outcomes: Employability

aftercompletion of the course, Student will be able to

1. Identify the pollutants type in the wastewater
2. Understand the various treatment principles
3. Design the sewage treatment plants
4. Design suitable treatment units for various industries
5. Develop conceptual schematics required for the treatment of wastewater

References:

1. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
4. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

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2102EV202		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Module I	**Introduction**	**8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Module II	**Industrial Pollution Prevention & Waste Minimisation**	**8 Hours**

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Module III	**Industrial Wastewater Treatment**	**10 Hours**

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Module IV	**Wastewater Reuse and Residual Management**	**9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Module V	**Case Studies**	**10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

	Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Define the Principles of pollution prevention and mechanism of oxidation processes.
2. Suggest the suitable technologies for the treatment of wastewater.
3. Discuss about the wastewater characteristics
4. Design the treatment systems
5. Apply the various Waste Disposal methods

References:

1. Industrial wastewater management, treatment & disposal, Water Environment
2. LawranceK.Wang, Yung . Tse Hung, Howard H.Lo and Constantine Yapijakis, " handlook of Industrial and Hazardous waste Treatment", Second Edition, 2004.
3. Metcalf & Eddy/ AECOM, water reuse Issues, Technologies and Applications, The Mc Graw- Hill companies, 2007.
4. Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007.
5. W.Wesley Eckenfelder, "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 1989.
6. Paul L. Bishop, „Pollution Prevention: - Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000.

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2103EV007		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Module I	**Sources, Classification and Regulatory Framework**	**9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management — Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Module II	**Waste Characterization and Source Reduction**	**8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Module III	**Storage, Collection and Transport Of Wastes**	**9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Module IV	**Waste Processing Technologies**	**10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Module V	**Waste Disposal**	**9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

	Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges
4. Apply the Waste Processing new Technologies
5. Apply the various Waste Disposal methods

References:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
4. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
5. Paul T Williams, Waste Treatment and Disposal, Wiley, 2005

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2103EV004		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:	
	To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Module I	Introduction	7 Hours

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Module II	Air Pollution Modelling	5 Hours

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Module III	Control Of Particulate Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Module IV	Control of Gaseous Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Module V	Indoor Air Quality Management	11 Hours

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total:	45 Hours

Course Outcomes:	Employability
	after completion of the course, Student will be able to
	1. Know the causes of climate change
	2. Know the effects of climate change on various environments and various models.
	3. Know the Transport Models
	4. Know the Dispersion Models
	5. Know the Software Modelling

References:

1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engg., Mc Graw Hill, New York, 1995.
3. David H.F. Liu, Bela G. Liptak „Air Pollution", Lweis Publishers, 2000.
4. Anjaneyulu. Y, „Air Pollution & Control Technologies" Allied Publishers (P) Ltd., India, 2002.
5. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
6. Wayne T.Davis, „Air Pollution Engineering Manual", John Wiley & Sons,Inc.,2000.
7. Daniel Vallero" Fundamentals of Air Pollution", Fourth Edition,2008.

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2102EV203		MODULE OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1
Course Objectives:						
	1.	To develop the skill for conducting Treatability studies of water and wastewater treatment by various Module Operations and Processes using laboratory scale models.				
	2.	To develop the skill for conducting Treatability studies of water and wastewater treatment by various Module Operations and Processes using laboratory scale models.				
List of Experiments:						
1. Coagulation and Flocculation						
2. Batch studies on settling						
3. Studies on Filtration- Characteristics of Filter media						
4. Water softening						
5. Adsorption studies/Kinetics						
6. Reverse Osmosis- Silt Density Index						
7. Kinetics of suspended growth process(activated sludge process)-Sludge volume Index						
8. Anaerobic Reactor systems / kinetics (Demonstration)						
9. Advanced Oxidation Processes – (Ozonation, Photocatalysis)						
10. Disinfection for Drinking water						
		Total:				**45 Hours**
Course Outcomes:		Employability				
		after completion of the course, Student will be able to				
	1.	Conduct treatability studies for water and waste water treatment.				
	2.	Design laboratory models for various Module operations and processes.				
References:						
1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.						
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.						
3. Casey T.J., Module Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.						
4. David W.Hendricks, „Water Treatment Module Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.						

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2103EV010		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

1. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
2. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Module I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Module II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Module III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in commModuley and institutional arrangements. Individual and family level impacts. CommModuleies in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Module IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Module V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.
3. Understand the necessity to study the Social Impact Assessment and EIA Documentation
4. Understand the necessity to study the Environmental Management Plan
5. Understand the necessity to study the Environmental Risk Assessment and Management

References:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003 World Bank –Source book on EIA
3. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
4. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York,1996.
5. K. V. Raghavan and A A. Khan, Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.

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