CREDIT TABLE

FOR

101 - CIVIL ENGINEERING

SEMESTER – I

Sl. No.	Course Code	Course Title	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	101101	Physics (Mechanics)	30	70	100	3	1	0	4	4
2	101102	Mathematics –I (Calculus, Multivariable Calculus and Linear Algebra)	30	70	100	3	1	0	4	4
3	100101	Basic Electrical Engineering	30	70	100	3	1	0	4	4
4	100102	Engineering Graphics & Design	30	70	100	1	0	0	1	1
Practical										
1	101101P	Physics (Mechanics & Mechanics of Solids)	20	30	50	0	0	3	1.5	3
2	100101P	Basic Electrical Engineering	20	30	50	0	0	2	1	2
3	100102P	Engineering Graphics & Design	20	30	50	0	0	4	2	4
	Total				550				17.5	22

TOTAL MARKS: 550 TOTAL CREDITS: 17.5 TOTAL HOURS: 22

IA (INTERNAL ASSESMENT), ESE (END SEMESTER EXAMINATION

DEFINITION OF CREDIT

Hour	Component	Credit
1	Lecture (L) per week	**1**
1	Tutorial (T) per week	**1**
1	Practical (P) per week	**0.5**

BSC	**Physics (Mechanics)**	**L:3**	**T:1**	**P:3**	**Credit:5.5**

MECHANICS

PRE-REQUISITES: HIGH-SCHOOL EDUCATION

MODULE 1: VECTOR MECHANICS OF PARTICLES (20 LECTURES)

TRANSFORMATION OF SCALARS AND VECTORS UNDER ROTATION TRANSFORMATION; FORCES IN NATURE; NEWTON'S LAWS AND ITS COMPLETENESS IN DESCRIBING PARTICLE MOTION; FORM INVARIANCE OF NEWTON'S SECOND LAW; SOLVING NEWTON'S EQUATIONS OF MOTION IN POLAR COORDINATES; PROBLEMS INCLUDING CONSTRAINTS AND FRICTION; EXTENSION TO CYLINDRICAL AND SPHERICAL COORDINATES; POTENTIAL ENERGY FUNCTION; F = - GRAD V, EQUIPOTENTIAL SURFACES AND MEANING OF GRADIENT; CONSERVATIVE AND NON-CONSERVATIVE FORCES, CURL OF A FORCE FIELD; CENTRAL FORCES; CONSERVATION OF ANGULAR MOMENTUM; ENERGY EQUATION AND ENERGY DIAGRAMS; ELLIPTICAL, PARABOLIC AND HYPERBOLIC ORBITS; KEPLER PROBLEM; APPLICATION: SATELLITE MANOEUVRES; NON- INERTIAL FRAMES OF REFERENCE; ROTATING COORDINATE SYSTEM: FIVE-TERM ACCELERATION FORMULA. CENTRIPETAL AND CORIOLIS ACCELERATIONS; APPLICATIONS: WEATHER SYSTEMS, FOUCAULT PENDULUM; HARMONIC OSCILLATOR; DAMPED HARMONIC MOTION
– OVER-DAMPED, CRITICALLY DAMPED AND LIGHTLY-DAMPED OSCILLATORS; FORCED OSCILLATIONS AND RESONANCE.

MODULE 2: PLANAR RIGID BODY MECHANICS (10 LECTURES

DEFINITION 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 — ONLY NEED TO HIGHLIGHT THE DISTINCTION FROM TWO-DIMENSIONAL MOTION IN TERMS OF
(A) ANGULAR VELOCITY VECTOR, AND ITS RATE OF CHANGE AND (B) MOMENT OF INERTIA TENSOR; THREE-DIMENSIONAL MOTION OF A RIGID BODY WHEREIN

ALL POINTS MOVE IN A COPLANAR MANNER: E.G. ROD EXECUTING CONICAL MOTION WITHCENTER OF MASS FIXED — ONLY NEED TO SHOW THAT THIS MOTION LOOKS TWO-DIMENSIONAL BUT IS THREE- DIMENSIONAL, AND TWO-DIMENSIONAL FORMULATION FAILS.

SUGGESTED REFERENCE BOOKS

- *ENGINEERING MECHANICS, 2ND ED. — MK HARBOLA*
- *INTRODUCTION TO MECHANICS — MK VERMA*
- *AN INTRODUCTION TO MECHANICS — D KLEPPNER& R KOLENKOW*
- *PRINCIPLES OF MECHANICS — JL SYNGE & BA GRIFFITHS*
- *MECHANICS — JP DEN HARTOG*
- *ENGINEERING MECHANICS - DYNAMICS, 7TH ED. - JL MERIAM*
- *MECHANICAL VIBRATIONS — JP DEN HARTOG*
- *THEORY OF VIBRATIONS WITH APPLICATIONS — WT THOMSON*

BSC	Mathematics –I (Calculus, Multivariable Calculus and Linear Algebra)	L:3	T:1	P:0	Credit:4

CALCULUS (SINGLE VARIBALE)

MODULE 1A: CALCULUS: (12 LECTURES)

INTERVALS, CONVERGENCE OF SEQUENCES AND SERIES OF REAL NUMBERS, LIMIT AND CONTINUITY OF FUNCTIONS, DIFFERENTIABILITY OF FUNCTIONS, ROLLE'S THEOREM, MEAN VALUE THEOREMS, TAYLOR'S AND MACLAURIN THEOREMS WITH REMAINDERS; INDETERMINATE FORMS AND L'HOSPITAL'S RULE; MAXIMA AND MINIMA, RIEMANN INTEGRATION, FUNDAMENTAL THEOREM OF CALCULUS.

MODULE 1B: CALCULUS: (8 LECTURES)

EVOLUTES AND INVOLUTES; EVALUATION OF DEFINITE AND IMPROPER INTEGRALS; BETA AND GAMMA FUNCTIONS AND THEIR PROPERTIES; APPLICATIONS OF DEFINITE INTEGRALS TO EVALUATE SURFACE AREAS AND VOLUMES OF REVOLUTIONS.

MODULE 1C: SERIES: (PREREQUISITE 2B) (8 LECTURES)

POWER SERIES, TAYLOR'S SERIES. SERIES FOR EXPONENTIAL, TRIGONOMETRIC AND LOGARITHMIC FUNCTIONS; FOURIER SERIES: HALF RANGE SINE AND COSINE SERIES, PARSEVAL'S THEOREM

TEXTBOOKS/REFERENCES:

- *G.B. THOMAS AND R.L. FINNEY, CALCULUS AND ANALYTIC GEOMETRY, 9TH EDITION, PEARSON, REPRINT, 2002.*
- *VEERARAJAN T., ENGINEERING MATHEMATICS FOR FIRST YEAR, TATA MCGRAW- HILL, NEW DELHI, 2008.*
- *RAMANA B.V., HIGHER ENGINEERING MATHEMATICS, TATA MCGRAW HILL NEW DELHI, 11TH REPRINT, 2010.*
- *N.P. BALI AND MANISH GOYAL, A TEXT BOOK OF ENGINEERING MATHEMATICS, LAXMI PUBLICATIONS,REPRINT, 2010.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 35TH EDITION, 2000.*

MATRICES AND LINEAR ALGEBRA

MODULE 2A: MATRICES (IN CASE VECTOR SPACES IS NOT TO BE TAUGHT) (14

LECTURES)

ALGEBRA OF MATRICES, INVERSE AND RANK OF A MATRIX, RANK-NULLITY THEOREM; SYSTEM OF LINEAR EQUATIONS; SYMMETRIC, SKEW-SYMMETRIC AND ORTHOGONAL MATRICES; DETERMINANTS; EIGENVALUES AND EIGENVECTORS; DIAGONALIZATION OF MATRICES; CAYLEY-HAMILTON THEOREM, ORTHOGONAL TRANSFORMATION AND QUADRATIC TO CANONICAL FORMS.

MODULE 2B: MATRICES (IN CASE VECTOR SPACES IS TO BE TAUGHT) (8 LECTURES)

MATRICES, VECTORS: ADDITION AND SCALAR MULTIPLICATION, MATRIX MULTIPLICATION; LINEAR SYSTEMS OF EQUATIONS, LINEAR INDEPENDENCE, RANK OF A MATRIX, DETERMINANTS, CRAMER'S RULE, INVERSE OF A MATRIX, GAUSS ELIMINATION AND GAUSS-JORDAN ELIMINATION.

MODULE 2C: VECTOR SPACES (PREREQUISITE 4B) (10 LECTURES)

VECTOR SPACE, LINEAR DEPENDENCE OF VECTORS, BASIS, DIMENSION; LINEAR TRANSFORMATIONS (MAPS), RANGE AND KERNEL OF A LINEAR MAP, RANK AND NULLITY, INVERSE OF A LINEAR TRANSFORMATION, RANK- NULLITY THEOREM, COMPOSITION OF LINEAR MAPS, MATRIX ASSOCIATED WITH A LINEAR MAP.

MODULE 2D: VECTOR SPACES (PREREQUISITE 4B-C) (10 LECTURES)

EIGENVALUES, EIGENVECTORS, SYMMETRIC, SKEW-SYMMETRIC AND ORTHOGONAL MATRICES, EIGENBASES. DIAGONALIZATION; INNER PRODUCT SPACES, GRAM-SCHMIDT ORTHOGONALIZATION.

TEXTBOOKS/REFERENCES:

- *D. POOLE, LINEAR ALGEBRA: A MODERN INTRODUCTION, 2ND EDITION, BROOKS/COLE, 2005.*
- *V. KRISHNAMURTHY, V.P. MAINRA AND J.L. ARORA, AN INTRODUCTION TO LINEAR ALGEBRA, AFFILIATED EAST–WEST PRESS, REPRINT 2005.*
- *ERWIN KREYSZIG, ADVANCED ENGINEERING MATHEMATICS, 9TH EDITION, JOHN WILEY & SONS, 2006.*
- *VEERARAJAN T., ENGINEERING MATHEMATICS FOR FIRST YEAR, TATA MCGRAW-HILL, NEW DELHI, 2008.*
- *N.P. BALI AND MANISH GOYAL, A TEXT BOOK OF ENGINEERING MATHEMATICS, LAXMI PUBLICATIONS, REPRINT, 2010.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 35TH EDITION, 2000*

ESC	Basic Electrical Engineering	L:3	T:1	P:2	Credit:5

MODULE 1: DC CIRCUITS (8 LECTURES)

ELECTRICAL CIRCUIT ELEMENTS (R, L AND C), VOLTAGE AND CURRENT SOURCES, KIRCHHOFF CURRENT AND VOLTAGE LAWS, ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION. STAR-DELTA CONVERSION, NETWORK THEOREMS (SUPERPOSITION, THEVENIN, NORTON AND MAXIMUM POWER TRANSFER THEOREMS). TIME-DOMAIN ANALYSIS OF FIRST- ORDER RL AND RC CIRCUITS

MODULE 2: AC CIRCUITS (8 LECTURES)

REPRESENTATION OF SINUSOIDAL WAVEFORMS, PEAK, RMS AND AVERAGE VALUES (FORM FACTOR AND PEAK FACTOR), IMPEDANCE OF SERIES AND PARALLEL CIRCUIT, PHASOR REPRESENTATION, REAL POWER, REACTIVE POWER, APPARENT POWER, POWER FACTOR, POWER TRIANGLE. ANALYSIS OF SINGLE-PHASE AC CIRCUITS CONSISTING OF R, L, C, RL, RC, RLC COMBINATIONS (SERIES AND PARALLEL), RESONANCE. THREE-PHASE BALANCED CIRCUITS, VOLTAGE AND CURRENT RELATIONS IN STAR AND DELTA CONNECTIONS.

MODULE 3: MAGNETIC CIRCUITS: (4 LECTURES)

INTRODUCTION, SERIES AND PARALLEL MAGNETIC CIRCUITS, ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.

MODULE 4: TRANSFORMERS (6 LECTURES)

MAGNETIC MATERIALS, BH CHARACTERISTICS, IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT, LOSSES IN TRANSFORMERS, REGULATION AND EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.

MODULE 5: ELECTRICAL MACHINES (10 LECTURES)

CONSTRUCTION, WORKING, TORQUE-SPEED CHARACTERISTIC AND SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR. GENERATION OF ROTATING MAGNETIC FIELDS, CONSTRUCTION AND WORKING OF A THREE-PHASE

INDUCTION MOTOR, SIGNIFICANCE OF TORQUE-SLIP CHARACTERISTIC. LOSS COMPONENTS AND EFFICIENCY, STARTING AND SPEED CONTROL OF INDUCTION MOTOR. CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.

MODULE 6: ELECTRICAL INSTALLATIONS (6 LECTURES)

COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING. TYPES OF BATTERIES, IMPORTANT CHARACTERISTICS FOR BATTERIES. ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.

SUGGESTED TEXT / REFERENCE BOOKS

- *D. P. KOTHARI AND I. J. NAGRATH, "BASIC ELECTRICAL ENGINEERING", TATA MCGRAW HILL, 2010.*
- *D. C. KULSHRESHTHA, "BASIC ELECTRICAL ENGINEERING", MCGRAW HILL, 2009.*
- *L. S. BOBROW, "FUNDAMENTALS OF ELECTRICAL ENGINEERING", OXFORD UNIVERSITY PRESS, 2011.*
- *E. HUGHES, "ELECTRICAL AND ELECTRONICS TECHNOLOGY", PEARSON, 2010.*
- *V. D. TORO, "ELECTRICAL ENGINEERING FUNDAMENTALS", PRENTICE HALL INDIA, 1989.*
- *BASIC ELECTRICAL ENGINEERING BY FITZERALD, ET AL, TATA MCGRAW HILL*
- *FUNDAMENTALS OF ELECTRICAL ENGG. BY R. PRASAD, PHI PUBLICATION*
- *BASIC ELECTRICAL ENGINEERING BY V.K. MEHTA AND ROHIT MEHTA, S.CHAND PUBLICATION*

COURSE OUTCOMES

- TO UNDERSTAND AND ANALYZE BASIC ELECTRIC AND MAGNETIC CIRCUITS
- TO STUDY THE WORKING PRINCIPLES OF ELECTRICAL MACHINES AND POWER CONVERTERS.
- TO INTRODUCE THE COMPONENTS OF LOW VOLTAGE ELECTRICAL INSTALLATIONS

LABORATORY

LIST OF EXPERIMENTS/DEMONSTRATIONS

- BASIC SAFETY PRECAUTIONS. INTRODUCTION AND USE OF MEASURING INSTRUMENTS
  – VOLTMETER, AMMETER, MULTI-METER, OSCILLOSCOPE. REAL-LIFE RESISTORS, CAPACITORS AND INDUCTORS.
- MEASURING THE STEADY-STATE AND TRANSIENT TIME-RESPONSE OF R-L, R-C, AND R-L-C CIRCUITS TO A STEP CHANGE IN VOLTAGE (TRANSIENT MAY BE OBSERVED ON A STORAGE OSCILLOSCOPE). SINUSOIDAL STEADY STATE RESPONSE OF R-L, AND R- C CIRCUITS – IMPEDANCE CALCULATION

AND VERIFICATION. OBSERVATION OF PHASE DIFFERENCES BETWEEN CURRENT AND VOLTAGE. RESONANCE IN R-L-C CIRCUITS.

- TRANSFORMERS: OBSERVATION OF THE NO-LOAD CURRENT WAVEFORM ON AN OSCILLOSCOPE (NON- SINUSOIDAL WAVE-SHAPE DUE TO B-H CURVE NONLINEARITY SHOULD BE SHOWN ALONG WITH A DISCUSSION ABOUT HARMONICS). LOADING OF A TRANSFORMER: MEASUREMENT OF PRIMARY AND SECONDARY VOLTAGES AND CURRENTS, AND POWER.
- THREE-PHASE TRANSFORMERS: STAR AND DELTA CONNECTIONS. VOLTAGE AND CURRENT RELATIONSHIPS (LINE-LINE VOLTAGE, PHASE-TO-NEUTRAL VOLTAGE, LINE AND PHASE CURRENTS). PHASE-SHIFTS BETWEEN THE PRIMARY AND SECONDARY SIDE. CUMULATIVE THREE-PHASE POWER IN BALANCED THREE-PHASE CIRCUITS.
- DEMONSTRATION OF CUT-OUT SECTIONS OF MACHINES: DC MACHINE (COMMUTATOR- BRUSH ARRANGEMENT), INDUCTION MACHINE (SQUIRREL CAGE ROTOR), SYNCHRONOUS MACHINE (FIELD WINGING - SLIP RING ARRANGEMENT) AND SINGLE-PHASE INDUCTION MACHINE.
- TORQUE SPEED CHARACTERISTIC OF SEPARATELY EXCITED DC MOTOR.
- SYNCHRONOUS SPEED OF TWO AND FOUR-POLE, THREE-PHASE INDUCTION MOTORS. DIRECTION REVERSAL BY CHANGE OF PHASE-SEQUENCE OF CONNECTIONS. TORQUE- SLIP CHARACTERISTIC OF AN INDUCTION MOTOR. GENERATOR OPERATION OF AN INDUCTION MACHINE DRIVEN AT SUPER- SYNCHRONOUS SPEED.
- SYNCHRONOUS MACHINE OPERATING AS A GENERATOR: STAND-ALONE OPERATION WITH A LOAD. CONTROL OF VOLTAGE THROUGH FIELD EXCITATION.
- DEMONSTRATION OF (A) DC-DC CONVERTERS (B) DC-AC CONVERTERS – PWM WAVEFORM
  (C) THE USE OF DC-AC CONVERTER FOR SPEED CONTROL OF AN INDUCTION MOTOR AND (D) COMPONENTS OF LT SWITCHGEAR.

LABORATORY OUTCOMES

- GET AN EXPOSURE TO COMMON ELECTRICAL COMPONENTS AND THEIR RATINGS.
- MAKE ELECTRICAL CONNECTIONS BY WIRES OF APPROPRIATE RATINGS.
- UNDERSTAND THE USAGE OF COMMON ELECTRICAL MEASURING INSTRUMENTS.
- UNDERSTAND THE BASIC CHARACTERISTICS OF TRANSFORMERS AND ELECTRICAL MACHINES.
- GET AN EXPOSURE TO THE WORKING OF POWER ELECTRONIC CONVERTERS

ESC	Engineering Graphics & Design	L:1	T:0	P:4	Credit:3

TRADITIONAL ENGINEERING GRAPHICS:

PRINCIPLES OF ENGINEERING GRAPHICS; ORTHOGRAPHIC PROJECTION; DESCRIPTIVE GEOMETRY; DRAWING PRINCIPLES; ISOMETRIC PROJECTION; SURFACE DEVELOPMENT; PERSPECTIVE; READING A DRAWING; SECTIONAL VIEWS; DIMENSIONING & TOLERANCES; TRUE LENGTH, ANGLE; INTERSECTION, SHORTEST DISTANCE.

COMPUTER GRAPHICS:

ENGINEERING GRAPHICS SOFTWARE; -SPATIAL TRANSFORMATIONS; ORTHOGRAPHIC PROJECTIONS; MODEL VIEWING; CO-ORDINATE SYSTEMS; MULTI-VIEW PROJECTION; EXPLODED ASSEMBLY; MODEL VIEWING; ANIMATION; SPATIAL MANIPULATION; SURFACE MODELLING; SOLID MODELLING, INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM).

(EXCEPT THE BASIC ESSENTIAL CONCEPTS, MOST OF THE TEACHING PART CAN HAPPEN CONCURRENTLY IN THE LABORATORY)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING

PRINCIPLES OF ENGINEERING GRAPHICS AND THEIR SIGNIFICANCE, USAGE OF DRAWING INSTRUMENTS, LETTERING, CONIC SECTIONS INCLUDING THE RECTANGULAR HYPERBOLA (GENERAL METHOD ONLY); CYCLOID, EPICYCLOID, HYPOCYCLOID AND INVOLUTE; SCALES – PLAIN, DIAGONAL AND VERNIER SCALES

MODULE 2: ORTHOGRAPHIC PROJECTIONS

PRINCIPLES OF ORTHOGRAPHIC PROJECTIONS-CONVENTIONS - PROJECTIONS OF POINTS AND LINES INCLINED TO BOTH PLANES; PROJECTIONS OF PLANES INCLINED PLANES - AUXILIARY PLANES

MODULE 3: PROJECTIONS OF REGULAR SOLIDS

THOSE INCLINED TO BOTH THE PLANES- AUXILIARY VIEWS; DRAW SIMPLE ANNOTATION, DIMENSIONING AND SCALE. FLOOR PLANS THAT INCLUDE: WINDOWS, DOORS, AND FIXTURES SUCH AS WC, BATH, SINK, SHOWER, ETC.

MODULE 4: SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

COVERING, PRISM, CYLINDER, PYRAMID, CONE – AUXILIARY VIEWS; DEVELOPMENT OF SURFACES OF RIGHT REGULAR SOLIDS- PRISM, PYRAMID, CYLINDER AND CONE; DRAW THE SECTIONAL ORTHOGRAPHIC VIEWS OF GEOMETRICAL SOLIDS, OBJECTS FROM INDUSTRY AND DWELLINGS (FOUNDATION TO SLAB ONLY)

MODULE 5: ISOMETRIC PROJECTIONS

PRINCIPLES OF ISOMETRIC PROJECTION – ISOMETRIC SCALE, ISOMETRIC VIEWS, CONVENTIONS; ISOMETRIC VIEWS OF LINES, PLANES, SIMPLE AND COMPOUND SOLIDS; CONVERSION OF ISOMETRIC VIEWS TO ORTHOGRAPHIC VIEWS AND VICE-VERSA, CONVENTIONS

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS

LISTING THE COMPUTER TECHNOLOGIES THAT IMPACT ON GRAPHICAL COMMUNICATION, DEMONSTRATING KNOWLEDGE OF THE THEORY OF CAD SOFTWARE [SUCH AS: THE MENU SYSTEM, TOOLBARS (STANDARD, OBJECT PROPERTIES, DRAW, MODIFY AND DIMENSION), DRAWING AREA (BACKGROUND, CROSSHAIRS, COORDINATE SYSTEM), DIALOG BOXES AND WINDOWS, SHORTCUT MENUS (BUTTON BARS), THE COMMAND LINE (WHERE APPLICABLE), THE STATUS BAR, DIFFERENT METHODS OF ZOOM AS USED IN CAD, SELECT AND ERASE OBJECTS.; ISOMETRIC VIEWS OF LINES, PLANES, SIMPLE AND COMPOUND SOLIDS]

MODULE 7: CUSTOMISATION& CAD DRAWING

CONSISTING OF SET UP OF THE DRAWING PAGE AND THE PRINTER, INCLUDING SCALE SETTINGS, SETTING UP OF UNITS AND DRAWING LIMITS; ISO AND ANSI STANDARDS FOR COORDINATE DIMENSIONING AND TOLERANCING; ORTHOGRAPHIC CONSTRAINTS, SNAP TO OBJECTS MANUALLY AND AUTOMATICALLY; PRODUCING DRAWINGS BY USING VARIOUS COORDINATE INPUT ENTRY METHODS TO DRAW STRAIGHT LINES, APPLYING VARIOUS WAYS OF DRAWING CIRCLES.

MODULE 8: ANNOTATIONS, LAYERING & OTHER FUNCTIONS

COVERING APPLYING DIMENSIONS TO OBJECTS, APPLYING ANNOTATIONS TO DRAWINGS; SETTING UP AND USE OF LAYERS, LAYERS TO CREATE DRAWINGS, CREATE, EDIT AND USE CUSTOMIZED LAYERS; CHANGING LINE LENGTHS THROUGH MODIFYING EXISTING LINES (EXTEND/LENGTHEN); PRINTING DOCUMENTS TO PAPER USING THE PRINT COMMAND; ORTHOGRAPHIC

PROJECTION TECHNIQUES; DRAWING SECTIONAL VIEWS OF COMPOSITE RIGHT REGULAR GEOMETRIC SOLIDS AND PROJECT THE TRUE SHAPE OF THE SECTIONED SURFACE; DRAWING ANNOTATION, COMPUTER-AIDED DESIGN (CAD) SOFTWARE MODELING OF PARTS AND ASSEMBLIES. PARAMETRIC AND NON-PARAMETRIC SOLID, SURFACE, AND WIREFRAME MODELS. PART EDITING AND TWO-DIMENSIONAL DOCUMENTATION OF MODELS. PLANAR PROJECTION THEORY, INCLUDING SKETCHING OF PERSPECTIVE, ISOMETRIC, MULTIVIEW, AUXILIARY, AND SECTION VIEWS. SPATIAL VISUALIZATION EXERCISES. DIMENSIONING GUIDELINES, TOLERANCING TECHNIQUES; DIMENSIONING AND SCALE MULTI VIEWS OF DWELLING.

MODULE 9: DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT THAT ILLUSTRATES

GEOMETRY AND TOPOLOGY OF ENGINEERED COMPONENTS: CREATION OF ENGINEERING MODELS AND THEIR PRESENTATION IN STANDARD 2D BLUEPRINT FORM AND AS 3D WIRE- FRAME AND SHADED SOLIDS; MESHED TOPOLOGIES FOR ENGINEERING ANALYSIS AND TOOL- PATH GENERATION FOR COMPONENT MANUFACTURE; GEOMETRIC DIMENSIONING AND TOLERANCING; USE OF SOLID-MODELING SOFTWARE FOR CREATING ASSOCIATIVE MODELS AT THE COMPONENT AND ASSEMBLY LEVELS. FLOOR PLANS THAT INCLUDE: WINDOWS, DOORS, AND FIXTURES SUCH AS WC, BATH, SINK, SHOWER, ETC. APPLYING COLOUR CODING ACCORDING TO BUILDING DRAWING PRACTICE; DRAWING SECTIONAL ELEVATION SHOWING FOUNDATION TO CEILING; INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM).

SUGGESTED TEXT/REFERENCE BOOKS:

- *BHATT N.D., PANCHAL V.M. & INGLE P.R., (2014), ENGINEERING DRAWING, CHAROTAR PUBLISHING HOUSE*
- *SHAH, M.B. &RANA B.C. (2008), ENGINEERING DRAWING AND COMPUTER GRAPHICS, PEARSON EDUCATION*
- *AGRAWAL B. & AGRAWAL C. M. (2012), ENGINEERING GRAPHICS, TMH PUBLICATION*
- *NARAYANA, K.L. & P KANNAIAH (2008), TEXT BOOK ON ENGINEERING DRAWING, SCITECHPUBLISHERS*
- *(CORRESPONDING SET OF) CAD SOFTWARE THEORY AND USER MANUALS*

COURSE OUTCOMES

ALL PHASES OF MANUFACTURING OR CONSTRUCTION REQUIRE THE CONVERSION OF NEW IDEAS AND DESIGN CONCEPTS INTO THE BASIC LINE LANGUAGE OF GRAPHICS. THEREFORE, THERE ARE MANY AREAS (CIVIL, MECHANICAL, ELECTRICAL, ARCHITECTURAL AND INDUSTRIAL) IN WHICH THE SKILLS OF THE CAD TECHNICIANS PLAY MAJOR ROLES IN THE DESIGN AND DEVELOPMENT OF NEW PRODUCTS OR CONSTRUCTION. STUDENTS PREPARE FOR

ACTUAL WORK SITUATIONS THROUGH PRACTICAL TRAINING IN A NEW STATE-OF-THE-ART COMPUTER DESIGNED CAD LABORATORY USING ENGINEERING SOFTWARE

THIS COURSE IS DESIGNED TO ADDRESS:

- TO PREPARE YOU TO DESIGN A SYSTEM, COMPONENT, OR PROCESS TO MEET DESIRED NEEDS WITHIN REALISTIC CONSTRAINTS SUCH AS ECONOMIC, ENVIRONMENTAL, SOCIAL, POLITICAL, ETHICAL, HEALTH AND SAFETY, MANUFACTURABILITY, AND SUSTAINABILITY
- TO PREPARE YOU TO COMMUNICATE EFFECTIVELY
- TO PREPARE YOU TO USE THE TECHNIQUES, SKILLS, AND MODERN ENGINEERING TOOLS NECESSARY FOR ENGINEERING PRACTICE

THE STUDENT WILL LEARN:

- INTRODUCTION TO ENGINEERING DESIGN AND ITS PLACE IN SOCIETY
- EXPOSURE TO THE VISUAL ASPECTS OF ENGINEERING DESIGN
- EXPOSURE TO ENGINEERING GRAPHICS STANDARDS
- EXPOSURE TO SOLID MODELLING
- EXPOSURE TO COMPUTER-AIDED GEOMETRIC DESIGN
- EXPOSURE TO CREATING WORKING DRAWINGS
- EXPOSURE TO ENGINEERING COMMUNICATION

CREDITTABLE FOR101-CIVILENGINEERING

SEMESTER– II

Sl. No.	Course Code	CourseTitle	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	BSC	Chemistry	30	70	100	3	1	0	4	4
2	BSC	Mathematics–II(Differential Equations)	30	70	100	3	1	0	4	4
3	ESC	ProgrammingforProblem Solving	30	70	100	3	0	0	3	3
4	ESC	WorkshopManufacturing Practices	30	70	100	1	0	0	1	1
5	HSMC	English	30	70	100	2	0	0	2	2
Practical										
1	BSC	Chemistry	20	30	50	0	0	3	1.5	3
2	ESC	ProgrammingforProblem Solving	20	30	50	0	0	4	2	4
3	ESC	WorkshopManufacturing Practices	20	30	50	0	0	4	2	4
4	HSMC	English	20	30	50	0	0	2	1	2
	Total				700				20.5	27

TOTAL MARKS: 700 TOTAL CREDITS: 20.5TOTALHOURS:27

IA (INTERNAL ASSESMENT), ESE (END SEMESTER

EXAMINATION)

BSC	Mathematics–II(DifferentialEquations)	L:3	T:1	P:0	Credit:4

ORDINARYDIFFERENTIALEQUATIONS

MODULE3A:FIRSTORDERORDINARYDIFFERENTIALEQUATIONS(6LECTURES)

EXACT,LINEARANDBERNOULLI'SEQUATIONS,EULER'SEQUATIONS,EQUATIONSNOT OFFIRSTDEGREE:EQUATIONSSOLVABLEFORP,EQUATIONSSOLVABLEFORY,EQUATIONS SOLVABLE FOR X AND CLAIRAUT'S TYPE.

MODULE3B:ORDINARYDIFFERENTIALEQUATIONSOFHIGHERORDERS(8LECTURES)

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS, METHOD OF VARIATION OF PARAMETERS, CAUCHY-EULER EQUATION; POWER SERIES SOLUTIONS; LEGENDRE POLYNOMIALS, BESSEL FUNCTIONS OF THE FIRST KIND AND THEIR PROPERTIES.

TEXTBOOKS/REFERENCES:

- *ERWINKREYSZIG,ADVANCEDENGINEERINGMATHEMATICS,9THEDITION,JOHNWILEY & SONS, 2006.*
- *W.E.BOYCEANDR.C.DIPRIMA,ELEMENTARYDIFFERENTIALEQUATIONSAND BOUNDARY VALUE PROBLEMS, 9TH EDITION, WILEY INDIA, 2009.*
- *S.L.ROSS,DIFFERENTIALEQUATIONS,3RDED.,WILEYINDIA,1984.*
- *E.A.CODDINGTON,ANINTRODUCTIONTOORDINARYDIFFERENTIALEQUATIONS, PRENTICE HALL INDIA, 1995.*
- *E.L.INCE,ORDINARYDIFFERENTIALEQUATIONS,DOVERPUBLICATIONS,1958.*
- *G.F. SIMMONS AND S.G. KRANTZ, DIFFERENTIAL EQUATIONS, TATA MCGRAW HILL, 2007.*

PARTIALDIFFERENTIALEQUATIONS

MODULE3C:PARTIALDIFFERENTIALEQUATIONS–FIRSTORDER(6LECTURES)

FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS, SOLUTIONS OF FIRST ORDER LINEAR AND NON-LINEAR PDES.

MODULE3D:PARTIALDIFFERENTIALEQUATIONS–HIGHERORDER(10LECTURES)

SOLUTION TO HOMOGENOUS AND NON-HOMOGENOUS LINEAR PARTIAL DIFFERENTIAL EQUATIONS SECOND AND HIGHER ORDER BY COMPLIMENTARY FUNCTION AND PARTICULAR INTEGRAL METHOD. FLOWS, VIBRATIONS AND

DIFFUSIONS, SECOND-ORDER LINEAR EQUATIONS AND THEIR CLASSIFICATION, INITIAL AND BOUNDARY CONDITIONS (WITH AN INFORMALDESCRIPTIONOFWELL-POSEDPROBLEMS),D'ALEMBERT'SSOLUTIONOFTHEWAVE EQUATION;DUHAMEL'SPRINCIPLEFORONEDIMENSIONALWAVEEQUATION.SEPARATIONOF VARIABLESMETHODTOSIMPLEPROBLEMSINCARTESIANCOORDINATES.THELAPLACIANIN PLANE,CYLINDRICAL AND SPHERICAL POLAR COORDINATES, SOLUTIONS WITH BESSEL FUNCTIONSAND LEGENDRE FUNCTIONS. ONE DIMENSIONAL DIFFUSION EQUATION AND ITS SOLUTION BY SEPARATION OF VARIABLES. BOUNDARY-VALUE PROBLEMS: SOLUTION OF BOUNDARY-VALUE PROBLEMS FOR VARIOUS LINEAR PDES IN VARIOUS GEOMETRIES.

TEXTBOOKS/REFERENCES:

- *S.J.FARLOW,PARTIALDIFFERENTIALEQUATIONSFORSCIENTISTSANDENGINEERS, DOVER PUBLICATIONS, 1993.*
- *R.HABERMAN,ELEMENTARYAPPLIEDPARTIALDIFFERENTIALEQUATIONSWITH FOURIER SERIES*
- *ANDBOUNDARYVALUEPROBLEM,4THED.,PRENTICEHALL,1998.*
- *IANSNEDDON,ELEMENTSOFPARTIALDIFFERENTIALEQUATIONS,MCGRAWHILL, 1964.*
- *MANISHGOYALANDN.P.BALI,TRANSFORMSANDPARTIALDIFFERENTIALEQUATIONS, UNIVERSITY SCIENCE PRESS, SECOND EDITION, 2010.*

COMPLEXVARIABLES

MODULE4A:COMPLEXVARIABLE–DIFFERENTIATION(8LECTURES)

DIFFERENTIATION, CAUCHY-RIEMANN EQUATIONS, ANALYTIC FUNCTIONS, HARMONIC FUNCTIONS, FINDING HARMONIC CONJUGATE; ELEMENTARY ANALYTIC FUNCTIONS (EXPONENTIAL, TRIGONOMETRIC, LOGARITHM) AND THEIR PROPERTIES; CONFORMAL MAPPINGS, MOBIUS TRANSFORMATIONS AND THEIR PROPERTIES.

MODULE4B:COMPLEXVARIABLE-INTEGRATION(8LECTURES)

CONTOUR INTEGRALS, CAUCHY-GOURSAT THEOREM (WITHOUT PROOF), CAUCHY INTEGRAL FORMULA (WITHOUT PROOF), LIOUVILLE'S THEOREM AND MAXIMUM-MODULUS THEOREM(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.

MODULE4C:APPLICATIONSOFCOMPLEXINTEGRATIONBYRESIDUES:(4LECTURES)

EVALUATIONOFDEFINITEINTEGRALINVOLVINGSINEANDCOSINE.EVALUATIONOF CERTAIN IMPROPER INTEGRALS USING THE BROMWICH CONTOUR.

TEXTBOOKS/REFERENCES:

- *ERWINKREYSZIG,ADVANCEDENGINEERINGMATHEMATICS,9THEDITION,JOHNWILEY & SONS, 2006.*
- *J.W.BROWNANDR.V.CHURCHILL,COMPLEXVARIABLESANDAPPLICATIONS,7TH ED., MC- GRAW HILL, 2004.*
- *VEERARAJANT.,ENGINEERINGMATHEMATICSFORFIRSTYEAR,TATAMCGRAW-HILL, NEW DELHI, 2008.*
- *N.P.BALIANDMANISHGOYAL,ATEXTBOOKOFENGINEERINGMATHEMATICS, LAXMI PUBLICATIONS, REPRINT, 2010.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 35TH EDITION, 2000.*

NUMERICALMETHODS

MODULE5A:NUMERICALMETHODS–1(12LECTURES)

SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS – BISECTION METHOD, NEWTON-RAPHSON METHODANDREGULA-FALSIMETHOD.FINITEDIFFERENCES, RELATION BETWEEN OPERATORS, INTERPOLATION USING NEWTON'S FORWARD AND BACKWARD DIFFERENCE FORMULAE. INTERPOLATION WITH UNEQUAL INTERVALS: NEWTON'S DIVIDED DIFFERENCE AND LAGRANGE'S FORMULAE. NUMERICAL DIFFERENTIATION, NUMERICAL INTEGRATION: TRAPEZOIDAL RULE AND SIMPSON'S 1/3RD AND 3/8 RULES.

MODULE5B:NUMERICALMETHODS–2(10LECTURES)

ORDINARY DIFFERENTIAL EQUATIONS: TAYLOR'S SERIES, EULER AND MODIFIED EULER'S METHODS. RUNGE- KUTTA METHOD OF FOURTH ORDER FOR SOLVING FIRST AND SECOND ORDER EQUATIONS. MILNE'S AND ADAM'S PREDICATOR-CORRECTOR METHODS. PARTIAL DIFFERENTIAL EQUATIONS: FINITE DIFFERENCE SOLUTION TWO DIMENSIONAL LAPLACE EQUATION AND POISSION EQUATION, IMPLICIT AND EXPLICIT METHODS FOR ONE DIMENSIONALHEATEQUATION(BENDER-SCHMIDTANDCRANK-NICHOLSONMETHODS),FINITE DIFFERENCE EXPLICIT METHOD FOR WAVE EQUATION.

TEXTBOOKS/REFERENCES:

- *P.KANDASAMY,K.THILAGAVATHY,K.GUNAVATHI,NUMERICALMETHODS,S.CHAND & COMPANY, 2ND EDITION, REPRINT 2012.*
- *S.S.SASTRY,INTRODUCTORYMETHODSOFNUMERICALANALYSIS,PHI,4THEDITION, 2005.*
- *ERWINKREYSZIG,ADVANCEDENGINEERINGMATHEMATICS,9THEDITION,JOHNWILEY & SONS, 2006.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 35TH EDITION, 2010.*

OPERTIES. PRINCIPLES FOR COMBINATION OF ATOMIC ORBITALS TO FORM MOLECULAR ORBITALS. FORMATIONOFHOMOANDHETERODIATOMICMOLECULESANDPLOTSOFENERGYLEVEL DIAGRAM OF MOLECULAR ORBITALS. COORDINATION NUMBERS AND GEOMETRIES, ISOMERISM INTRANSITIONALMETALCOMPOUNDS,CRYSTALFIELDTHEORYANDTHEENERGYLEVEL DIAGRAMS FOR TRANSITION METAL IONS AND THEIR MAGNETIC PROPERTIES.

MODULE2:SPECTROSCOPICTECHNIQUESANDAPPLICATIONS(8LECTURES)

PRINCIPLESOFVIBRATIONALANDROTATIONALSPECTROSCOPYANDSELECTIONRULES FOR APPLICATION IN DIATOMIC MOLECULES. ELEMENTARY IDEA OF ELECTRONIC SPECTROSCOPY. UV-VIS SPECTROSCOPY WITH RELATED RULES AND ITS APPLICATIONS. FLUORESCENCE AND ITS APPLICATIONS IN MEDICINE. BASIC PRINCIPLE OF NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATION. BASICS OF MAGNETIC RESONANCE IMAGING.

MODULE3:INTERMOLECULARFORCESANDPROPERTIESOFGASES(4LECTURES)

IONIC,DIPOLARANDVANDERWAALSINTERACTIONS.EQUATIONSOFSTATEOFIDEAL AND REAL GASES, DEVIATION FROM IDEAL BEHAVIOUR. VANDER WAAL GAS EQUATION.

MODULE 4: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA & WATER CHEMISTRY (8 LECTURES)

THERMODYNAMIC FUNCTIONS: ENERGY, ENTHALPY ENTROPY AND FREE ENERGY. EQUATIONS TO INTERRELATE THERMODYNAMIC PROPERTIES. FREE ENERGY, EMF. AND CELL

POTENTIALS,THENERNSTEQUATIONANDAPPLICATIONS.CORROSION.USEOFFREE ENERGY CONSIDERATIONSINMETALLURGYTHROUGHELLINGHAMDIAGRAMS.SOLUBILITY EQUILIBRIA.

WATER CHEMISTRY, HARD AND SOFT WATER. PARAMETERS OF QUALITY OF WATER TO BEUSEDINDIFFERENTINDUSTRIESASFORDRINKINGWATER.CALCULATIONOFHARDNESS OFWATERINALLUNITS.ESTIMATIONOFHARDNESSUSINGEDTAANDALKALINITYMETHOD. REMOVAL OF HARDNESS BY SODA LIME AND ION EXCHANGE METHOD INCLUDING ZEOLITE METHOD

MODULE5:PERIODICPROPERTIES(4LECTURES)

EFFECTIVE NUCLEAR CHARGE, PENETRATION OF ORBITALS, VARIATIONS OF S, P, D ANDFORBITALENERGIESOFATOMSINTHEPERIODICTABLE,ELECTRONICCONFIGURATIONS, ATOMIC AND IONIC SIZES, IONIZATION ENERGIES, ELECTRON AFFINITY AND ELECTRONEGATIVITY, POLARIZABILITY, ACID, BASE, PRINCIPLE OF HSAB THEORY, OXIDATION STATES,HYBRIDIZATION ANDMOLECULAR GEOMETRIES.

MODULE6:STEREOCHEMISTRY(4LECTURES)

REPRESENTATIONSOF3-DSTRUCTURES,STRUCTURALISOMERSANDSTEREOISOMERS, CONFIGURATIONSANDSYMMETRYANDCHIRALITY,ENANTIOMERS,DIASTEREOMERS,OPTICAL ACTIVITY, ABSOLUTE CONFIGURATIONS AND CONFORMATIONAL ANALYSIS.

MODULE7:ORGANICREACTIONSANDSYNTHESISOFADRUGMOLECULE(4LECTURES)

INTRODUCTION TO INTERMEDIATES AND REACTIONS INVOLVING SUBSTITUTION, ADDITION, ELIMINATION, OXIDATION- REDUCTION, DIELS ELDER CYCLIZATION AND EPOXIDE RING OPENINGS REACTIONS. SYNTHESIS OF A COMMONLY USED DRUG MOLECULE LIKE ASPIRIN.

SUGGESTEDTEXTBOOKS

- *UNIVERSITYCHEMISTRY,BYB.H.MAHAN*
- *CHEMISTRY:PRINCIPLESANDAPPLICATIONS,BYM.J.SIENKOANDR.A.PLANE*
- *FUNDAMENTALSOFMOLECULARSPECTROSCOPY,BYC.N.BANWELL*

- *ENGINEERINGCHEMISTRY(NPTELWEB-BOOK),BYB.L.TEMBE,KAMALUDDINANDM. S.KRISHNAN*
- *PHYSICALCHEMISTRY,BYP.W.ATKINS*
- *ORGANICCHEMISTRY:STRUCTUREANDFUNCTIONBYK.P.C.VOLHARDTANDN.E. SCHORE, 5TH EDITION*
- *HTTP://BCS.WHFREEMAN.COM/VOLLHARDTSCHORE5E/DEFAULT.ASP*

COURSEOUTCOMES

THE CONCEPTS DEVELOPED IN THIS COURSE WILL AID IN QUANTIFICATION OF SEVERAL CONCEPTS IN CHEMISTRY THAT HAVE BEEN INTRODUCED AT THE 10+2 LEVELS IN SCHOOLS. TECHNOLOGY IS BEING INCREASINGLY BASED ON THE ELECTRONIC, ATOMIC AND MOLECULAR LEVEL MODIFICATIONS.

QUANTUM THEORY IS MORE THAN 100 YEARS OLD AND TO UNDERSTAND PHENOMENA AT NANOMETER LEVELS, ONE HAS TO BASE THE DESCRIPTION OF ALL CHEMICAL PROCESSES AT MOLECULAR LEVELS. THE COURSE WILL ENABLE THE STUDENT TO: ANALYSE MICROSCOPIC CHEMISTRY IN TERMS OF ATOMIC AND MOLECULAR ORBITALS AND INTERMOLECULAR FORCES. RATIONALISE BULK PROPERTIES AND PROCESSES USING THERMODYNAMIC CONSIDERATIONS. DISTINGUISHTHERANGESOFTHEELECTROMAGNETICSPECTRUMUSEDFOREXCITIN G
DIFFERENTMOLECULARENERGYLEVELSINVARIOUSSPECTROSCOPICTECHNIQUES RATIONALISEPERIODICPROPERTIESSUCHASIONIZATIONPOTENTIAL,ELECTRONEG ATIVITY, OXIDATION STATES AND ELECTRONEGATIVITY.LIST MAJOR CHEMICAL REACTIONS THAT ARE USED IN THE SYNTHESIS OF MOLECULES.

CHEMISTRYLABORATORY

CHOICEOF10-12EXPERIMENTSFROMTHEFOLLOWING

- DETERMINATIONOFSURFACETENSIONANDVISCOSITY
- THINLAYERCHROMATOGRAPHY
- IONEXCHANGECOLUMNFORREMOVALOFHARDNESSOFWATER
- DETERMINATIONOFCHLORIDECONTENTOFWATER
- COLLIGATIVEPROPERTIESUSINGFREEZINGPOINTDEPRESSION
- DETERMINATIONOFTHERATECONSTANTOFAREACTION
- DETERMINATIONOFCELLCONSTANTANDCONDUCTANCEOFSOLUTIONS
- POTENTIOMETRY-DETERMINATIONOFREDOXPOTENTIALSANDEMFS
- SYNTHESISOFAPOLYMER/DRUG
- SAPONIFICATION/ACIDVALUEOFANOIL
- CHEMICALANALYSISOFASALT
- LATTICESTRUCTURESANDPACKINGOFSPHERES
- MODELSOFPOTENTIALENERGYSURFACES
- CHEMICALOSCILLATIONS-IODINECLOCKREACTION
- DETERMINATIONOFTHEPARTITIONCOEFFICIENTOFASUBSTANCEBETWEEN TWO IMMISCIBLE LIQUIDS
- ADSORPTIONOFACETICACIDBYCHARCOAL
- USEOFTHECAPILLARYVISCOSIMETERSTOTHEDEMONSTRATEOFTHEISOELE CTRIC

POINTASTHEPHOFMINIMUMVISCOSITYFORGELATINSOLSAND/ORCOAGULATION OF THE WHITE PART OF EGG.

LABORATORYOUTCOMES

THECHEMISTRYLABORATORYCOURSEWILLCONSISTOFEXPERIMENTS ILLUSTRATINGTHEPRINCIPLESOFCHEMISTRYRELEVANTTOTHESTUDYOFSCIENCEAND ENGINEERING. THE STUDENTS WILL LEARN TO: ESTIMATE RATE CONSTANTS OF REACTIONS FROM CONCENTRATION OF REACTANTS/PRODUCTS AS A FUNCTION OF TIME MEASURE MOLECULAR/SYSTEMPROPERTIESSUCHASSURFACETENSION,VISCOSITY,CONDUCTANCEOF SOLUTIONS,REDOXPOTENTIALS,CHLORIDECONTENTOFWATER,ETCSYNTHESIZE ASMALL DRUG MOLECULE AND ANALYSE A SALT SAMPLE

ESC	ProgrammingforProblemSolving	L:3	T:0	P:4	Credit:5

MODULE1:INTRODUCTIONTOPROGRAMMING(6LECTURES)

INTRODUCTIONTOCOMPONENTSOFACOMPUTERSYSTEM(DISKS,MEMORY,PROCESSOR, WHEREAPROGRAMISSTOREDANDEXECUTED,OPERATINGSYSTEM,COMPILERSETC).IDEA OFALGORITHM:STEPSTOSOLVELOGICALANDNUMERICALPROBLEMS.REPRESENTATIONOF ALGORITHM: FLOWCHART/PSEUDO CODE WITH EXAMPLES. FROM ALGORITHMS TO PROGRAMS; SOURCE CODE, VARIABLES (WITH DATA TYPES) VARIABLES AND MEMORY LOCATIONS, TYPE CASTING/TYPE CONVERSION, RUN TIME ENVIRONMENT (STATIC, DYNAMIC LOCATION), STORAGECLASSES(AUTO,REGISTER,STATIC,EXTERN),SYNTAXANDLOGICALERRORSIN COMPILATION, OBJECT AND EXECUTABLE CODE.

MODULE2:OPERATORS(3LECTURES)

ARITHMETICEXPRESSIONS/ARITHMETICOPERATORS/ RELATIONALOPERATORS/LOGICAL OPERATORS/BITWISE OPERATORS AND PRECEDENCE

MODULE3:CONDITIONALBRANCHINGANDLOOPS(5LECTURES)

WRITING AND EVALUATION OF CONDITIONALS AND CONSEQUENT BRANCHING, ITERATION AND LOOPS

MODULE4:ARRAYS(4LECTURES)

ARRAY DECLARATION & INITIALIZATION, BOUND CHECKING ARRAYS (1-D, 2-D), CHARACTER ARRAYS AND STRINGS.

MODULE5:BASICALGORITHMS(6LECTURES)

SEARCHING (LINEAR SEARCH, BINARY SEARCH ETC.), BASIC SORTING ALGORITHMS (BUBBLE,INSERTIONANDSELECTION),FINDINGROOTSOFEQUATIONS,NOTIONOFORDER OF COMPLEXITY THROUGH EXAMPLE PROGRAMS (NO FORMAL DEFINITION REQUIRED)

MODULE6:FUNCTION(4LECTURES)

INTRODUCTION&WRITINGFUNCTIONS,SCOPEOFVARIABLESFUNCTIONS(INCLUDING USING BUILT IN LIBRARIES), PARAMETER PASSING IN FUNCTIONS, CALL BY VALUE, PASSING ARRAYS TO FUNCTIONS: IDEA OF CALL BY REFERENCE

MODULE7:RECURSION(5LECTURES)

RECURSION,ASADIFFERENTWAYOFSOLVINGPROBLEMS.EXAMPLEPROGRAMS,SUCH AS FINDING FACTORIAL, FIBONACCI SERIES, REVERSE A STRING USING RECURSION, AND GCD OF TWO NUMBERS, ACKERMAN FUNCTION ETC. QUICK SORT OR MERGE SORT.

MODULE8:STRUCTURE/UNION(3LECTURES)

STRUCTURES, ACCESSING STRUCTURE ELEMENTS, WAY OF STORAGE OF STRUCTURE ELEMENT,DEFININGSTRUCTURESANDARRAYOFSTRUCTURES,BASICDEFINITIONOFUNION, COMPARISON B/W STRUCTURE & UNION WITH EXAMPLE

MODULE9:POINTERS(5LECTURES)

IDEAOFPOINTERS,DEFININGPOINTERS,USEOFPOINTERSINSELF-REFERENTIAL STRUCTURES, NOTION OF LINKED LIST (NO IMPLEMENTATION), POINTER TO POINTER, POINTER TO ARRAY, POINTER TO STRINGS, ARRAY OF POINTER, POINTER TO FUNCTION, POINTER TO STRUCTURE.

MODULE10:FILEHANDLING

(ONLYIFTIMEISAVAILABLE,OTHERWISESHOULDBEDONEASPARTOFTHELAB)

SUGGESTEDTEXTBOOKS

- *BYRONGOTTFRIED,SCHAUM'SOUTLINEOFPROGRAMMINGWITHC,MCGRAW-HILL*
- *E.BALAGURUSWAMY,PROGRAMMINGINANSIC,TATAMCGRAW-HILL*

SUGGESTEDREFERENCEBOOKS

- *BRIANW.KERNIGHANANDDENNISM.RITCHIE,THECPROGRAMMINGLANGUAGE, PRENTICE HALL OF INDIA*
- *YASHWANTKANETKAR,LETUSC,BPBPUBLICATION*

THESTUDENTWILLLEARN

- TOFORMULATESIMPLEALGORITHMSFORARITHMETICANDLOGICALPROBLEMS.
- TOTRANSLATETHEALGORITHMSTOPROGRAMS(INCLANGUAGE).
- TOTESTANDEXECUTETHEPROGRAMSANDCORRECTSYNTAXANDLOGICALERRORS.
- TOIMPLEMENTCONDITIONALBRANCHING,ITERATIONANDRECURSION.
- TODECOMPOSEAPROBLEMINTOFUNCTIONSANDSYNTHESIZEACOMPLETEPROGRAM USING DIVIDE AND CONQUER APPROACH.
- TO USE ARRAYS, POINTERS AND STRUCTURES TO FORMULATE

ALGORITHMS AND PROGRAMS.

- TO APPLY PROGRAMMING TO SOLVE MATRIX ADDITION AND MULTIPLICATION PROBLEMS AND SEARCHING AND SORTING PROBLEMS.
- TOAPPLYPROGRAMMINGTOSOLVESIMPLENUMERICALMETHODPROBLEMS,NAMELY ROT FINDING OF FUNCTION, DIFFERENTIATION OF FUNCTION AND SIMPLE INTEGRATION.

LABORATORYPROGRAMMINGFORPROBLEMSOLVING

[THELABORATORYSHOULDBEPRECEDEDORFOLLOWEDBYATUTORIALTOEXPLAINTHE APPROACH OR ALGORITHM TO BE IMPLEMENTED FOR THE PROBLEM GIVEN.]

TUTORIAL1:PROBLEMSOLVINGUSINGCOMPUTERS:
LAB1:FAMILIARIZATIONWITHPROGRAMMINGENVIRONMENT

TUTORIAL2:VARIABLETYPESANDTYPECONVERSIONS:
LAB2:SIMPLECOMPUTATIONALPROBLEMSUSINGARITHMETICEXPRESSIONS

TUTORIAL 3: BRANCHING AND LOGICAL EXPRESSIONS: LAB3:PROBLEMSINVOLVINGIF-THEN-ELSESTRUCTURES

TUTORIAL4:LOOPS,WHILEANDFORLOOPS:
LAB4:ITERATIVEPROBLEMSE.G.,SUMOFSERIES

TUTORIAL5:1DARRAYS:SEARCHING,SORTING:
LAB 5: 1D ARRAY MANIPULATION
TUTORIAL6:2DARRAYSANDSTRINGS
LAB6:MATRIXPROBLEMS,STRINGOPERATIONS

TUTORIAL7:FUNCTIONS,CALLBYVALUE:
LAB7:SIMPLEFUNCTIONS

TUTORIAL8:NUMERICALMETHODS(ROOTFINDING,NUMERICALDIFFERENTIATION, NUMERICAL INTEGRATION):
LAB8:PROGRAMMINGFORSOLVINGNUMERICALMETHODSPROBLEMS

TUTORIAL9:RECURSION,STRUCTUREOFRECURSIVECALLS LAB 9: RECURSIVE FUNCTIONS

TUTORIAL10:POINTERS,STRUCTURESANDDYNAMICMEMORYALLOCATION LAB 10: POINTERS AND STRUCTURES

TUTORIAL11:FILEHANDLING:
LAB11:FILEOPERATIONS

LABORATORYOUTCOMES

- TOFORMULATETHEALGORITHMSFORSIMPLEPROBLEMS
- TOTRANSLATEGIVENALGORITHMSTOAWORKINGANDCORRECTPROGRAM

- TOBEABLETOCORRECTSYNTAXERRORSASREPORTEDBYTHECOMPILERS
- TO BE ABLE TO IDENTIFY AND CORRECT LOGICAL ERRORS ENCOUNTERED AT RUN TIME
- TOBEABLETOWRITEITERATIVEASWELLASRECURSIVEPROGRAMS
- TOBEABLETOREPRESENTDATAINARRAYS,STRINGSANDSTRUCTURESAN D MANIPULATE THEM THROUGH A PROGRAM
- TOBEABLETODECLAREPOINTERSOFDIFFERENTTYPESANDUSETHEMIN DEFINING SELF- REFERENTIAL STRUCTURES.
- TOBEABLETOCREATE,READANDWRITETOANDFROMSIMPLETEXTFILES.

ESC	WorkshopManufacturingPractices	L:1	T:0	P:4	Credit:3

LECTURES&VIDEOS:(10HOURS)[L:1;T:0;P:0(1CREDIT)]

DETAILEDCONTENTS:

1. MANUFACTURINGMETHODS-CASTING,FORMING,MACHINING,JOINING,ADVANCED MANUFACTURING METHODS (3 LECTURES)
2. CNCMACHINING,ADDITIVEMANUFACTURING(1LECTURE)
3. FITTINGOPERATIONS&POWERTOOLS(1LECTURE)
4. CARPENTRY(1LECTURE)
5. PLASTICMOULDING,GLASSCUTTING(1LECTURE)
6. METALCASTING(1LECTURE)
7. WELDING(ARCWELDING&GASWELDING),BRAZING,SOLDERING(2LECTURE)

SUGGESTEDTEXT/REFERENCEBOOKS:

- *HAJRACHOUDHURYS.K.,HAJRACHOUDHURYA.K.ANDNIRJHARROYS.K.,"ELEMENTS OF WORKSHOP TECHNOLOGY", VOL. I 2008 AND VOL. II 2010, MEDIA PROMOTERS AND PUBLISHERS PRIVATE LIMITED, MUMBAI.*
- *KALPAKJIAN S. AND STEVEN S. SCHMID, "MANUFACTURING ENGINEERING AND TECHNOLOGY", 4TH EDITION, PEARSON EDUCATION INDIA EDITION, 2002.*
- *GOWRI P. HARIHARAN AND A. SURESH BABU,"MANUFACTURING TECHNOLOGY – I" PEARSON EDUCATION, 2008.*
- *ROY A. LINDBERG, "PROCESSES AND MATERIALS OF MANUFACTURE", 4TH EDITION, PRENTICE HALL INDIA, 1998.*
- *RAOP.N.,"MANUFACTURINGTECHNOLOGY",VOL.IANDVOL.II,TATAMCGRAWHILL HOUSE, 2017.*

COURSEOUTCOMES:

- *UPON COMPLETION OF THIS COURSE, THE STUDENTS WILL GAIN KNOWLEDGE OF THE DIFFERENT MANUFACTURING PROCESSES WHICH ARE COMMONLY EMPLOYED IN THE INDUSTRY, TO FABRICATE COMPONENTS USING DIFFERENT MATERIALS.*

WORKSHOPPRACTICE:(60HOURS)[L:0;T:0;P:4(2CREDITS)]

1. MACHINESHOP(10HOURS)ANDFITTINGSHOP(8HOURS)
2. CARPENTRY(6HOURS)
3. WELDINGSHOP(8HOURS)(ARCWELDING4HRS+GASWELDING4HRS)
4. CASTING(8HOURS)ANDSMITHY(6HOURS)
5. PLASTICMOULDING&GLASSCUTTING(6HOURS)
6. 3-DPRINTINGOFDIFFERENTMODELS(8HOURS)

EXAMINATIONSCOULDINVOLVETHEACTUALFABRICATIONOFSIMPLECOMPONENTS, UTILIZING ONE OR MORE OF THE TECHNIQUES COVERED ABOVE.

LABORATORYOUTCOMES

- UPON COMPLETION OF THIS LABORATORY COURSE, STUDENTS WILL BE ABLE TO FABRICATE COMPONENTS WITH THEIR OWN HANDS.
- THEYWILLALSOGETPRACTICALKNOWLEDGEOFTHEDIMENSIONALACCURA

CIESAND DIMENSIONAL TOLERANCES POSSIBLE WITH DIFFERENT MANUFACTURING PROCESSES.

- BY ASSEMBLING DIFFERENT COMPONENTS, THEY WILL BE ABLE TO PRODUCE SMALL DEVICESOFTHEIRINTEREST.BYASSEMBLINGDIFFERENTCOMPONENTS,THEYWILL BE ABLE TO PRODUCE SMALL DEVICES OF THEIR INTEREST.

HSMC	English	L:2	T:0	P:2	Credit:3

DETAILEDCONTENTS

1. **VOCABULARYBUILDING**
   - A. THECONCEPTOFWORDFORMATION
   - B. ROOTWORDSFROMFOREIGNLANGUAGESANDTHEIRUSEINENGLISH
   - C. ACQUAINTANCEWITHPREFIXESANDSUFFIXESFROMFOREIGNLANGUAGESIN ENGLISH TO FORM DERIVATIVES.
   - D. SYNONYMS,ANTONYMS,ANDSTANDARDABBREVIATIONS.
   - E. AFFIXES,ACRONYMS

2. **BASICWRITINGSKILLS**
   - A. SENTENCESTRUCTURES
   - B. USEOFPHRASESANDCLAUSESINSENTENCES
   - C. IMPORTANCEOFPROPERPUNCTUATION
   - D. KINDSOFSENTENCES
   - E. USEOFTENSE,USEINCONTEXTANDCOHERENCEOFTENSEINWRITING
   - F. USEOFVOICE–ACTIVE/PASSIVEINSENTENCES
   - G. USEOFSPEECH–DIRECTANDINDIRECTSPEECH
   - H. FRAMINGQUESTIONS-DIRECT,USINGMODALVERBS

3. **IDENTIFYINGCOMMONERRORSINWRITING**
   - A. SUBJECT-VERBAGREEMENT
   - B. NOUN-PRONOUNAGREEMENT
   - C. MISPLACEDMODIFIERS
   - D. ARTICLES
   - E. PREPOSITIONS
   - F. REDUNDANCIES
   - G. CLICHÉS
   - H. COMMONENGLISHERRORS

4. **NATUREANDSTYLEOFSENSIBLEWRITING**
   - A. DESCRIBING
   - B. DEFINING
   - C. CLASSIFYING
   - D. PROVIDINGEXAMPLESOREVIDENCE
   - E. WRITINGINTRODUCTIONANDCONCLUSION
   - F. ORGANISINGPRINCIPLEOFPARAGRAPHSINDOCUMENTS
   - G. ARGUMENT,DESCRIBING/NARRATING/PLANNING,DEFINING,CLASSIFYING
   - H. LEXICALRESOURCES,USINGSUITABLELANGUAGEREGISTER
   - I. COHERENCE,WRITINGINTRODUCTION,BODYANDCONCLUSION,TECHNIQUESFOR WRITING PRECISELY,GRAMMAR AND ACCURACY

5. **WRITINGPRACTICES**
   - A. COMPREHENSION
   - B. FORMALLETTERWRITING/APPLICATION/REPORTWRITING/ WRITINGMINUTESOF MEETINGS
   - C. ESSAYWRITING
   - D. FORMALEMAILWRITING
   - E. RESUME/CVWRITING,COVERLETTER,
   - F. STATEMENTOFPURPOSE

6. **ORALCOMMUNICATION**

(THISUNITINVOLVESINTERACTIVEPRACTICESESSIONSINLANGUAGELAB)

LISTENINGCOMPREHENSION

A. PRONUNCIATION,INTONATION,STRESSANDRHYTHM
B. COMMONEVERYDAYSITUATIONS:CONVERSATIONSANDDIALOGUES
C. COMMUNICATIONATWORKPLACE
D. INTERVIEWS
E. FORMALPRESENTATIONS
F. ACQUAINTINGSTUDENTSWITHIPASYMBOLS
G. PHONETICS(BASIC)
H. SOUNDS–VOWELS,CONSONANTS
I. CLEARINGMOTHERTONGUEINFLUENCE
J. CLEARINGREDUNDANCIESANDCOMMONERRORSRELATEDTOINDIANISMS
K. GROUPDISCUSSION
L. EXPRESSINGOPINIONS
M. COHERENCEANDFLUENCYINSPEECH

7. **READINGSKILLS**

A. READINGCOMPREHENSION,
B. PARAGRAPHREADINGBASEDONPHONETICSOUNDS/INTONATION

8. **PROFESSIONALSKILLS**

A. TEAMBUILDING
B. SOFTSKILLSANDETIQUETTES

9. **ACQUAINTANCEWITHTECHNOLOGY-AIDEDLANGUAGELEARNING**

A. USEOFCOMPUTERSOFTWARE(GRAMMARLY,GINGER…)
B. USEOFSMARTPHONEAPPLICATIONS(DUOLINGO,BUSUU…)

10. **ACTIVITIES**

A. NARRATIVECHAIN
B. DESCRIBING/NARRATING
C. WRITINGESSAYSINRELAY
D. PEER/GROUPACTIVITIES
E. BRAINSTORMINGVOCABULARY
F. CUE/FLASHCARDSFORVOCABULARY
G. DEBATES

SUGGESTEDREADINGS:

- PRACTICALENGLISHUSAGE.MICHAELSWAN.OUP.1995.
- REMEDIALENGLISHGRAMMAR.F.T.WOOD.MACMILLAN.2007
- ONWRITINGWELL.WILLIAMZINSSER.HARPERRESOURCEBOOK.2001
- STUDYWRITING.LIZHAMP-LYONSANDBENHEASLY.CAMBRIDGEUNIVERSITY PRESS. 2006.
- COMMUNICATIONSKILLS.SANJAYKUMARANDPUSHPLATA.OXFORDUNIVERSITY PRESS. 2011.
- EXERCISESINSPOKENENGLISH.PARTS.I-III.CIEFL,HYDERABAD.OXFORD UNIVERSITY PRESS

COURSEOUTCOMES

THESTUDENTWILLACQUIREBASICPROFICIENCYINENGLISHINCLUDINGREADING AND LISTENING COMPREHENSION, WRITING AND SPEAKING SKILLS.

101
Civil

Semester III (Second year]
Branch/Course Civil Engineering

Sl. No.	Category	Code	Course Title	Hours per week			Credits
				L	**T**	**P**	
1	Engineering Science Courses	ESC202	Basic Electronics	1	0	2	2
2	Basic Science courses	BSC109	Biology for Engineers	2	0	2	3
3	Engineering Science Courses	ESC203	Computer-aided Civil Engineering Drawing	1	0	2	2
4	Engineering Science Courses	ESC205	Engineering Mechanics	4	0	0	4
5	Professional Core courses	PCC-CE206	Surveying & Geomatics	2	0	2	3
6	Basic Science courses	BSC201	Mathematics-III (Probability, Theory & Statistics)	2	0	0	2
7	Humanities and Socia l Sciences including Management courses	HSMC201	Humanities-I (Effective Technical Communication)	3	0	0	3
8	Humanities and Socia l Sciences including Management courses	HSMC251	Introduction to Civil Engineering	2	0	0	2
9	Internship and Industrial Visit	INTC201	Internship				4
						Total credits	**25**

101 CE

ESC202	Basic Electronics	1L:0T:2P	2 credits

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Civil Engineering applications. Lab should be taken concurrently. This course emphasizes more on the laboratory/practical use of the knowledge gained from the course lectures.

What Will I Learn?

a) Know broadly the concepts and functionalities of the electronic devices, tools and instruments
b) Understand use, general specifications and deployabilities of the electronic devices, and assemblies
c) Confidence in handling and usage of electronic devices, tools and instruments in engineering applications

Proposed Syllabus (All modules to provide only broad overview)

Module1: *Diodes and Applications* covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto- Electronic Devices – LEDs,

Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2*: Transistor Characteristics* covering, Bipolar Junction Transistor (BJT) –

Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect

Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3*: Transistor Amplifiers and Oscillators* covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non- Sinusoidal type Oscillators;

Module 4*: Operational Amplifiers and Applications* covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

Practicals:

Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread

Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;

Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and

Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator,

Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

Module 4: Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators; Module 5: Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and Monostable Multivibrators;

Module 6: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial- Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; (15 Sessions)

Text/Reference Books:

1. David. A. Bell (2003), *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall, India
2. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
3. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals* by Pearson Education, 4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), *Basic Electronics – A Text-Lab. Manual,* TMH
5. R. T. Paynter (2009), *Introductory Electronic Devices & Circuits, Conventional Flow Version,* Pearson

BSC109	Biology (Biology for Engineers)	3L:0T:0P	3 credits

[3 credit course; 2 (one hour) lectures and one (one hour) tutorial per week. Only lecture hours are shown]

Module 1. *(2 hours)- Introduction*

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. *(3 hours)- Classification*

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S. cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3. *(4 hours)-Genetics*
Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"

Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. *(4 hours)-Biomolecules*
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. *(4 Hours). Enzymes*
Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. *(4 hours)- Information Transfer*
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. *(5 hours). Macromolecular analysis*

Purpose: How to analyses biological processes at the reductionistic level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. *(4 hours)- Metabolism*

Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis

of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9. *(3 hours)- Microbiology*
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Module 10: *Plant Physiology* covering, Transpiration; Mineral nutrition *(3 Lectures)*

Module 10B: *Ecology* covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; *(3 Lectures)*

References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
   Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

ESC203	Computer-aided Civil Engineering Drawing	1L:0T:2P	2 credits

The students will be able to

a) Develop Parametric design and the conventions of formal engineering drawing
b) Produce and interpret 2D & 3D drawings
c) Communicate a design idea/concept graphically/ visually
d) Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
e) Get a Detailed study of an engineering artifact

ProposedSyllabus (No. of lectures shown within brackets)

Module 1:*INTRODUCTION***;** Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of

drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.(2)

Module 2:*SYMBOLS AND SIGN CONVENTIONS*: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards (2)

Module 3: *MASONRY BONDS:*English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall (1)

Module 4: *BUILDING DRAWING*: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity (7)

Module 5:*PICTORIAL VIEW*: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM) (3) Total 15 sessions

It may be advisable to conduct Theory sessions along with Lab demonstrations.

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows. 09
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a description of the Facility in about 500 -700 words. 06
3. RCC framed structures 09
4. Reinforcement drawings for typical slabs, beams, columns and spread footings. 09
5. Industrial buildings - North light roof structures - Trusses 06
6. Perspective view of one and two storey buildings 06

Total L: 15 + P: 45=60

Text/Reference Books:

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw- Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian. Sikka, V.B. (2013), A Course in Civil Engineering Drawing,

S.K.Kataria& Sons,

ESC205	Engineering Mechanics	4L:0T:0P	4 credits

The objective of this Course is to provide an introductory treatment of *Engineering Mechanics* to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behaviour of materials under various load conditions. Lab should be taken concurrently

What Will I Learn?

a) Confidently tackle equilibrium equations, moments and inertia problems
b) Master calculator/computing basic skills to use to advantage in solving mechanics problems.
c) Gain a firm foundation in Engineering Mechanics for furthering the career in Engineering

Proposed Syllabus

Module 1*: Introduction to Engineering Mechanics covering,* Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Module 2*: Friction covering,* Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3*: Basic Structural Analysis covering,* Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4*: Centroid and Centre of Gravity covering,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module 5*: Virtual Work and Energy Method*- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 6*: Review of particle dynamics*- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Module 7:*Introduction to Kinetics of Rigid Bodies covering,* Basic terms, general principles in

dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module 8:*Mechanical Vibrations covering,* Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics 8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

PCC-CE206	Surveying and Geomatics	2L:0T:2P	3 credits

Course Objectives

With the successful completion of the course, the student should have the capability to: a) describe the function of surveying in civil engineering construction,

b) Work with survey observations, and perform calculations,
c) Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
d) Be familiar with the principals of recording accurate, orderly, complete, and logical field notes from surveying operations, whether recorded manually or with automatic data collection methods,
e) Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
f) Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check levelling measurements,
g) Effectively communicate with team members during field activities; identify appropriate safety

procedures for personal protection; properly handle and use measurement instruments. Be able to identify hazardous environments and take measures to insure one's personal and team safety,

h) Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments,
i) Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for a closed traverse,
j) Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and mapping,
k) Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
l) Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
m) Calculate, design and layout horizontal and vertical curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Proposed Syllabus:

Module 1: *Introduction to Surveying (8 hours):* Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

*Triangulation and Trilateration (6 Hours)***:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation network- Signals. Baseline - choices - instruments and accessories - extension of base lines corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

Module 2: Curves (6 hours) Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Module 3: *Modern Field Survey Systems (8 Hours)*: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications,

Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

Module 4: *Photogrammetry Surveying (8 Hours)*: Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Module 5: *Remote Sensing (9 Hours)*: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Text/Reference Books:

1 Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.

2 Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011

3 Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4 Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.

5 Anji Reddy, M., Remote sensing and Geographical information system, B.S.

Publications, 2001.

6 Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

BSC202	Mathematics III (PDE, Probability & Statistics)	2L:0T:0P	2 credits

Objectives:

(1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering

(2) To provide an overview of probability and statistics to engineers

Contents:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. **(14 hours)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.**(12 hours)**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.**(12 hours)**

Course Outcomes:
Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi

   Publications, Reprint, 2010.

3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

HSMC201	**Humanities – I (Effective Technical Communication)**	**3L:0T:0P**	**3 credits**

Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Text/Reference Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.

5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)

HSMC251	Introduction to Civil Engineering	2L:0T:0P	2 credits

When the students enter the college to pursue a degree in Civil Engineering and as well pursue a career in Civil Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamourous avenues for advancement, the Civil Engineering student should realize the solid foundations available in this

mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

This course is designed to address the following:

- to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering
- to motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Proposed Syllabus

What is Civil Engineering/ Infrastructure, History of Civil Engineering, Overview of ancient & modern civil engineering marvels, current national planning for civil engineering/ infrastructure projects, scope of work involved in various branches of Civil Engineering – Architecture & Town planning, Surveying & Geomatics, Structural Engineering, Construction Management, Construction materials, Hydrology and Water Resources Engineering, Hydraulic Engineering, Environmental Engineering &Sustainability, Pavement Engineering and construction, Traffic & Transportation Engineering and Management, Geotechnical Engineering, Ocean Engineering, Building Energy Efficiency, Basics of

Contract Management, Professional Ethics, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering,

Modules

1. **Basic Understanding**: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career
2. **History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers
3. **Overview of National Planning for Construction and Infrastructure Development**; Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works;

4. **Fundamentals of Architecture & Town Planning**: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities
5. **Fundamentals of Building Materials**: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes
6. **Basics of Construction Management & Contracts Management**: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management
7. **Environmental Engineering & Sustainability**: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction;
8. **Geotechnical Engineering**: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling
9. **Hydraulics, Hydrology &Water Resources Engineering**: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects
10. **Ocean Engineering**: Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures
11. **Power Plant Structures**: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects
12. **Structural Engineering**: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;
13. **Surveying & Geomatics**: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;
14. **Traffic &Transportation Engineering**: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.
15. **Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; NonDestructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs.
16. **Computational Methods, IT, IoT in Civil Engineering:** Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …)
17. **Industrial lectures**: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning;
18. **Basics of Professionalism**: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction

ORGANISATION OF COURSE (2-1-0)

S. No.	Module [No of Lectures within brackets]	Tutorials
1	Basic Understanding (1)	Develop a matrix of various disciplines and possible roles for engineers in each
2	History of Civil engineering (1)	Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each
3	Overview of National planning for Construction and Infrastructure Development (1)	Develop a Strategic Plan for Civil Engineering works for next ten years based on past investments and identify one typical on-going mega project in each area
4	Architecture & Town Planning (1)	Identify ten best civil engineering projects with high aesthetic appeal with one possible factor for each; List down the possible systems required for a typical Smart City
5	Building Materials (2)	Identify three top new materials and their potential in construction; Visit a Concrete Lab and make a report
6	Construction Management, Contracts management (2)	Identify 5 typical construction methods and list their advantages/ positive features
7	Environmental Engineering & Sustainability (2)	Environmental Engineering & Sustainability: Sustainability principles, Sustainable built environment, water treatment systems, good practices of wastewater management. examples of Solid and hazardous waste management, Air pollution and control
8	Geotechnical Engineering (2)	List top five tunnel projects in India and their features; collect and study geotechnical investigation report of any one Metro Rail (underground) project; Visit a construction site and make a site visit report
9	Hydraulics, Hydrology &Water Resources Engineering (1)	Identify three river interlinking projects and their features; visit a Hydraulics Lab and make a report
10	Ocean Engineering, Ports & Harbours (1)	Identify 5 typical ports in India and list the structures available in them; Visit a related/similar facility, if possible in nearby place and make a report
11	Power Plant Structures (1)	Collect the typical layout for a large thermal power plant and a large hydro power plant and identify all the structures and systems falling in them.
12	Structural Engineering (3)	Identify 5 unique features for typical buildings,

		bridges, tall structures and large span structures; Visit Structures Testing Lab/facility and make a report
13	Surveying & Geomatics (1)	Collect visual representations prepared by a Total Station and LIDAR and compare; Study typical Google street map and Google Earth Map and study how each can facilitate the other
14	Traffic & transportation (1)	Investments in transport infrastructure; Developments and challenges; Intelligent Transport Systems; Smart Cities, Urban Transport; Road Safety; Sustainable and resilient highway design principles; Plan a sustainable transport system for a city; Identify key features/components in the planning and design of a green field highway/airport/port/railway and the cost – economics.
15	Repairs & rehabilitation of Structures (1)	Collect the history of a major rehabilitation project and list the interesting features

16	Computational Methods, IT, IoT in Civil Engineering (2)	Visit an AutoCad lab and prepare a report; Identify ten interesting software systems used in Civil Engg and their key features
17	Industrial lectures (2)	For each case study list the interesting features
18	Basics of Professionalism (3)	List 5 cases of violation of professional ethics and list preventive measures; Identify 5 interesting projects and their positive features; Write 400 word reports on one ancient monument and a modern marvel of civil engineering
	TOTAL NO LECTURES =30	**15**

Text/Reference Books:

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract
2. The National Building Code, BIS, (2017)
3. RERA Act, (2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R.(1979), Law of Contract, Oxford University Press
9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.

11. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency
13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
14. Bare text (2005), Right to Information Act
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House 18. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd
18. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
19. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
20. Engineering Ethics, National Institute for Engineering Ethics, USA
21. www.ieindia.org
22. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
23. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri -CEIBS
24. CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm
25. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
26. Contract &Agreements , http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
27. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
28. Business & Personal Law. Chapter 7. "How Contracts Arise", http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
29. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
30. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.html
ContractTypes/Pricing Arrangements Guideline- 1.4.G (11/04/02), http://www.sandia.gov/policy/14g.pdf

IV SEMESTER
Branch/Course Civil Engineering (101)

sr. no.	CODE	Course Title	L	T	P		Credit
1		Mechanical Engineering	2	1	0		3
2		Engineering Geology	2	0	2		3
3		Disaster Preparedness & Planning	1	1	0		2
4		Introduction to Fluid Mechanics	3	0	2		4
5		Introduction to Solid Mechanics	3	0	0		3
6		Structural Analysis	3	1	0		4
7		Materials, Testing & Evaluation	1	1	2		3
8		Civil Engineering - Societal & Global Impact	2	0	0		2
9		Open Elective-I (Humanities) MOOC	2	0	0		2
10		Management I (Organizational Behaviour)	3	0	0		0
			TOTAL				26

CIVIL ENGINEERING
IV SEMESTER
Branch Code - 101

ESC209	Mechanical Engineering	2L:1T:0P	3 credits

Module 1: Basic Concepts- Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for
Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady-Flow

Module 3: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines,

reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.

Module 4: Properties Of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

Module 5: Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second- law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, air standard assumptions, gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.

Module 6: Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.

Module 7: Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor- compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/Reference Books:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.
2. Cengel, Thermodynamics – An Engineering Approach *Tata McGraw Hill, New* Delhi. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley.
3. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of

Engineering
4. Thermodynamics: John Wiley & Sons.
5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall.
6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.

PCC-CE202	Engineering Geology	2L:0T:2P	3 credits

The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation. Engineering geologists are applied geoscientists with an awareness of engineering principles and practice—they are not engineers.

Proposed Syllabus:

Module 1: Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

Module 2: Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture

and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module3: Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module 4: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module 5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

Module 6: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging
.Rock Quality Designation. Rock mass description.

Module 7: Geology of dam and reservoir site- Required geological consideration

for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Module 8: Rock Mechanics- Sub surface 9nvestigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.

Practicals:

1. Study of physical properties of minerals.
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.
5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.

Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

PCC-CE203	**Disaster Preparedness& Planning**	**1L:1T:0P**	**2 credits**

	Management		

The overall aim of this course is to provide broad understanding about the basic concepts of Disaster Management with preparedness as a Civil Engineer. Further, the course introduces the various natural hazards that can pose risk to property, lives, and livestock, etc. and understanding of the social responsibility as an engineer towards preparedness as well as mitigating the damages.

The objectives of the course are i) To Understand basic concepts in Disaster Management ii) To Understand Definitions and Terminologies used in Disaster Management iii) To

Understand Types and Categories of Disasters iv). To Understand the Challenges posed by Disasters

vi) To understand Impacts of Disasters Key Skills

Proposed Syllabus

Module 1: Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Module 2:Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module 3: Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module 4: Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Postdisaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module 5: Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)

2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

PCC-CE204	Introduction to Fluid Mechanics	3L:0T:2P	4 credits

The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyse engineering problems involving fluids – such as

those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

Module 1: Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Module 2: Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Module 3: Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Module 4: Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation

: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced;

Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber *Number and Euler Number; Buckingham's* π-Theorem.

Module5: Laminar Flow-Laminar flow through :circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity

Module6: Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model

Studies to fluid flow problem. Dynamic Similitude- Definitions of ReynoldsNumber, Froude Number, MachNumber, Weber *Number and EulerNumber.*

Module7: Flow through Pipes:Loss of head through pipes,Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line,Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem

Module8: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram

Lab Experiments

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli's Theorem
6. Venturimeter
7. Orifice meter
8. Impacts of jets
9. Flow Visualisation -Ideal Flow
10. Length of establishment of flow
11. Velocity distribution in pipes
12. Laminar Flow

Text/Reference Books:

1. Fluid Mechanics and Machinery, C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

PCC-CE205	Introduction to Solid Mechanics	3L:0T:0P	3 credits

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behaviour is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

Proposed Syllabus

Module1: *Simple Stresses and Strains*- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

Module 2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module 3: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of

concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module 4: *Flexural Stresses-Theory of simple bending* – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.
Module 5: *Shear Stresses- Derivation of formula* – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.
Module 6: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.
Module 7: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.
Module 8: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

List of Experiments:

- Tension test
- Bending tests on simply supported beam and Cantilever beam.
- Compression test on concrete
- Impact test
- Shear test
- Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation,
- Determination of torsion and deflection,
- Measurement of forces on supports in statically determinate beam,
- Determination of shear forces in beams,
- Determination of bending moments in beams,
- Measurement of deflections in statically determinate beam,
- Measurement of strain in a bar
- Bend test steel bar;
- Yield/tensile strength of steel bar;

Text/Reference Books:

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall

6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.

Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

PCC-CE208	Structural Analysis	3L:1T:0P	4 credits

Analysis of indeterminate structures by force methods, flexibility coefficients, Energy methods: Principle of minimum potential energy, principle of virtual work, Castigliano's theorems, Reciprocal theorem, unit load method, Influence line and Rolling loads, beam, frames and arches, Muller- Breslau Principles and its applications to determinate and indeterminate structures.

Analysis of Beams and Frames: Moment Area method, Slope deflection method, Three Moment Equation, Moments distribution methods, effect of symmetry and ant symmetry, sway correction, Lateral load analysis: Portal and Cantilever methods, Matrix method of structural analysis, Displacement/Stiffness methods.

Text books:

1. C.S. Reddy, Basic Structural Analysis, Second Edition, Tata McGraw Hill, 2005.
2. R.C. Hibbeler, Structural Analysis, Pearson Education, 6th edition, 2009.
3. C.K. Wang, Intermediate Structural Analysis, Tata McGraw Hill, 1984.

PCC-CE207	Materials, Testing & Evaluation	1L:1T:2P	3 credits

The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.

- Make measurements of behavior of various materials used in Civil Engineering.
- Provide physical observations to complement concepts learnt
- Introduce experimental procedures and common measurement instruments, equipment, devices.
- Exposure to a variety of established material testing procedures and techniques
- Different methods of evaluation and inferences drawn from observations

The course reviews also the current testing technology and examines force applications systems, force measurement, strain measurement, important instrument considerations, equipment for environmental testing, and computers applications for materials testing provide an introductory treatment of *basic skills in material engineering towards (i) selecting material for the design, and (ii) evaluating the mechanical and structural properties of material, as well as the knowledge necessary for a civil engineer.* The knowledge acquired lays a good foundation for analysis and design of various civil engineering structures/systems in a reliable manner.

What will I learn?

- Different materials used in civil engineering applications
- Planning an experimental program, selecting the test configuration, selecting the test specimens and collecting raw data
- Documenting the experimental program including the test procedures, collected data, method of interpretation and final results
- Operating the laboratory equipment including the electronic instrumentation, the test apparatus and the data collection system
- Measuring physical properties of common structural and geotechnical construction materials
- Interpreting the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values
- Observing various modes of failure in compression, tension, and shear
- Observing various types of material behavior under similar loading conditions

Proposed Syllabus

Module 1: *Introduction to Engineering Materials covering,* Cements, M-Sand, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these

Module 2: *Introduction to Material Testing covering,* What is the " Material Engineering" ?; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics

Module 3: *Standard Testing & Evaluation Procedures covering,* Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.

Tutorials *from the above modules covering*, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

Practicals:

- Gradation of coarse and fine aggregates
- Different corresponding tests and need/application of these tests in design and quality control
- Tensile Strength of materials & concrete composites
- Compressive strength test on aggregates
- Tension I - Elastic Behaviour of metals & materials
- Tension II - Failure of Common Materials
- Concrete I - Early Age Properties
- Concrete II - Compression and Indirect Tension
- Compression – Directionality
- Consolidation and Strength Tests
- Tension III - Heat Treatment
- Torsion test
- Hardness tests (Brinnel's and Rockwell)
- Tests on closely coiled and open coiled springs
- Theories of Failure and Corroboration with Experiments
- Concrete Mix Design as per BIS

Text/Reference Books:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materialsused for Civil Engineering applications
4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
6. American Society for Testing and Materials (ASTM), *Annual Book of ASTM Standards* (post 2000)
7. Related papers published in international journals

HSMC252	**Civil Engineering – Societal &**	**2L:0T:0P**	**2 credits**

	Global Impact		

The course is designed to provide a better understanding of the impact which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realise the impact which this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.

The course covers:

- Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels
- Awareness of the impact of Civil Engineering for the various specific fields of human endeavour
- Need to think innovatively to ensure Sustainability

Module 1: Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

Module 2: Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Module 3: Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic,

Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

Module 4: Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and nonstationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

Module 5: Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

Module 6: Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

Module 7A: *Population Dynamics* covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity; *(3 Lectures)*

Module 8B*: Environmental Management* covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification,
International Treaties; Environmental Impact Assessment- Case studies

(International Airport, thermal power plant); *(3 Lectures)*

Module 9A*: Molecular Genetics* covering, Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept; *(3 Lectures)*

Module 9B*: Biotechnology* covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture,

medicine and health; Recombinant DNA Technology- Techniques and applications; *(3 Lectures)*

Module 10A: *Biostatistics* covering, Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor) *(4 Lectures)*

ORGANISATION OF COURSE (2-0-0)

S. No.	Module	No of Lectures	Details
1	Introduction	3	
2	Understanding the Importance of Civil Engineering	3	
3	Infrastructure	8	
4	Environment	7	
5	Built Environment	5	
6	Civil Engineering Projects	4	
	TOTAL	**30**	

Text/Reference Books:

1. *Žiga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130

9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.
10. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63
11. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research**.** Water Resources Management.
Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.
12. Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30
13. Butler D., Davies J. (2011). Urban Drainage. Spon. 3rd Ed.
14. Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.
15. Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
16. Charles J A. (2009) Robert Rawlinson and the UK public health revolution. Proc ICE Eng History and Heritage. 162 Nov. Issue EH4. p 199-206

Semester V (Third year]Branch/CourseCivilEngineering

VSEMESTER						
Branch/CourseCivilEngineering-101						
sr. no.	CODE	CourseTitle	L	T	P	Credit
1		MechanicsofMaterials	3	0	0	3
2		HydraulicEngineering	2	0	2	3
3		Analysisand DesignofConcreteStructure	2	1	0	3
4		GeotechnicalEngineering-I	3	0	2	4
5		Hydrology&WaterResourcesEngineering	2	0	2	3
6		Environmental Engineering-I	3	0	2	4
7		TransportationEngineering	3	0	2	4
8		EnvironmentalScience	3	0	0	0
9		SummerEntrepreneurship-II	0	0	12	6
			TOTAL CREDIT			30

Civil EngineeringV Semester

PCC-CE301	MechanicsofMaterials	3L:0T:0P	3credits

TheobjectiveofthisCourseistointroducetocontinuummechanicsandmaterialmodelingof engineering materials based on first energy principles: deformation and strain; momentumbalance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.Theoverarching themeisaunifiedmechanisticlanguageusingthermodynamics,whichallows understanding, modelling and design of a large range of engineering materials. Thesubject of mechanics of materials involves analytical methods for determining the strength,stiffness (deformation characteristics), and stability of the various members in a structuralsystem. The behavior of a member depends not only on the fundamental laws that govern theequilibriumofforces,butalsoonthemechanicalcharacteristicsofthematerial.Thesemechanical characteristicscomefromthelaboratory,wherematerialsaretestedunderaccurately known forces and their behavior is carefully observed and measured (learnt in theprevious course on Materials, Testing & Evaluation). For this reason, mechanics of materialsisa blendedscienceof experiment andNewtonian postulatesof analyticalmechanics.

WhatwillIlearn?

- Understandthedeformationandstrainsunderdifferentloadactionandresponseintermsofforces and moments
- Understandthebehaviourunderdifferentloadingactions
- Applicationofengineeringprinciplesto calculate thereactions,forcesand moments
- Understandtheenergymethodsusedtoderivetheequationstosolveengineeringproblems
- Makeuseofthecapabilitiesto determinethe forcesand momentsfordesign

ProposedSyllabus

Module 1: Deformation and Strain covering description of finite deformation, Infinitesimaldeformation; Analysis of statically determinate trusses; Stability of dams, retaining walls andchimneys;Stress analysisofthin, thick and compoundcylinder;

Module 2: Generalized state of stress and strain: Stress and strain tensor, Yield criteria andtheoriesoffailure;Tresca,Von-Mises,Hillcriteria,Heigh-Westerguard'sstressspace.

Module3: MomentumBalanceandStressescoveringForcesandMomentsTransmittedbySlender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, StressStates/ FailureCriterion

Module 4: Mechanics of Deformable Bodies covering Force-deformation Relationships andStaticIndeterminacy,UniaxialLoadingandMaterialProperties,TrussesandTheirDeformation s,StaticallyDeterminateandIndeterminate Trusses,

Module5: Force-Stress-EquilibriumcoveringMultiaxialStressandStrain
Module 6: Displacement – Strain covering Multiaxial Strain and Multiaxial Stress-strainRelationships

Module 7: Elasticity and Elasticity Bounds covering Stress-strain-temperature Relationshipsand Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress,Failureof Materials,

Module 8: Bending: Stress and Strains; Deflections and Torsion covering Pure Bending,Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and StaticallyIndeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energymethods, Variational Methods; Strain energy, elastic, complementary and total strain energy,Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energytheorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unitloadmethod fordeflection, Application to problemsof beams and frames.

Module 9: Structural stability; Stability of columns, Euler's formula, end conditions andeffective length factor, Columns with eccentric and lateral load; Plasticity and Yield Designcovering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and YieldDesign

Text/ReferenceBooks:

1. Norris,C.H.andWilber,J.B.andUtku,S."ElementaryStructuralAnalysis"McGrawHill,Tokyo, Japan.
2. Timoshenko,S.andYoung,D.H.,"ElementsofStrengthofMaterials",DVNC,NewYork,USA.
3. Kazmi,S.M.A.,'SolidMechanics"TMH,Delhi,India.
4. Hibbeler,R.C.MechanicsofMaterials.6thed.EastRutherford,NJ:PearsonPrenticeHall,2004
5. Crandall,S.H.,N.C.Dahl,andT.J.Lardner.AnIntroductiontotheMechanicsofSolids.2nd ed. New York, NY: McGraw Hill, 1979
6. Gere,J.M.,andS.P.Timoshenko.MechanicsofMaterials.5thed.Boston:PWSKentPublishing, 1970.
7. Ashby,M.F.,andD.R.H.Jones.EngineeringMaterials,AnIntroductiontotheirPropertiesand Applications. 2nd ed.ButterworthHeinemann.
8. Collins,J.A.FailureofMaterialsinMechanicalDesign.2nded.JohnWiley&Sons,1993.
9. Courtney,T. H.MechanicalBehaviorofMaterials.McGraw-Hill,1990.
10. Hertzberg,R.W.DeformationandFractureMechanicsofEngineeringMaterials.4thed.JohnWiley&Sons, 1996.
11. Nash,W.A.StrengthofMaterials.3ded.Schaum'sOutlineSeries,McGraw-Hill,1994.

PCC-CE302	HydraulicEngineering	2L:0T:2P	3credits

Objectives:
To introduce the students to various hydraulic engineering problems like open channel flowsand hydraulic machines. At the completion of the course, the student should be able to relatethetheoryandpracticeofproblemsin hydraulicengineering

Module 1: Boundary LayerAnalysis-Assumption andconcept ofboundary layertheory.Boundary-layerthickness,displacement,momentum&energythickness,laminarandTurbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries.Localandaveragefrictioncoefficients.SeparationandControl.

Module 2: Introduction to Open Channel Flow-Comparison between open channel flow andpipe flow, geometrical parameters of a channel, classification of open channels, classificationofopenchannelflow, VelocityDistributionofchannelsection.

Module 3: Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation,Characteristics of uniformflow,Chezy'sformula,Manning'sformula.FactorsaffectingManning's Roughness Coefficient " n.Most economical section of channel. Computation ofUniformflow, Normaldepth.

Module4: Non-UniformFlow-Specificenergy,Specificenergycurve,criticalflow,dischargecurveSpecificforceSpecificdepth,andCriticaldepth.ChannelTransitions.Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, ParshallFlume,BroadCrestedWeir.Measurementof Velocity-Currentmeter,Floats,Hot-wireanemometer.GraduallyVariedFlow-DynamicEquationofGraduallyVariedFlow,Classification of channel bottom slopes, Classification of surface profile, Characteristics ofsurface profile. Computation of water surface profile by graphical, numerical and analyticalapproaches.DirectStepmethod,GraphicalIntegrationmethodandDirectintegrationmethod.

Module5: HydraulicJump-Theoryofhydraulicjump,Elementsandcharacteristicsofhydraulic jumpinarectangular Channel,length andheightof jump,location of jump,Types,applications andlocation of hydraulic jump. Energy dissipation and other uses, surgeasamovinghydraulicjump.Positiveandnegativesurges.

Module6: ComputationalFluidDynamics:Basicequationsoffluiddynamics,Gridgeneration, Introduction to in viscid incompressible flow, Boundary layer flow as applicableto C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web basedmodelinginwaterresourcesengineering.

PracticalWork:

1. FlowVisualization
2. StudiesinWindTunnel
3. BoundaryLayer
4. FlowaroundanAerofoil/circularcylinder
5. UniformFlow
6. VelocityDistributioninOpenchannelflow
7. VenturiFlume
8. StandingWaveFlume
9. GraduallyVariedFlow

10. HydraulicJump
11. FlowunderSluiceGate
12. Flowthroughpipes
13. Turbulentflowthroughpipes
14. Flowvisualization
15. Laminarflowthroughpipes
16. Majorlosses/Minorlossesinpipe

Text/ReferenceBooks:

1. HydraulicsandFluidMechanics,P.M.ModiandS.M.Seth,StandardBookHouse
2. TheoryandApplicationsofFluidMechanics,K.Subramanya,TataMcGrawHill.
3. OpenchannelFlow,K.Subramanya,TataMcGrawHill.
4. OpenChannelHydraulics,VenTeChow,TataMcGrawHill.
5. Burnside,C.D., " Electromagnetic DistanceMeasurement,"BeekmanPublishers,1971.

PCC-CE303	Analysisand design Of Concrete structure	2L:1T:0P	3credits

Objectives:
This course aims at providing students with a solid background on principles of structuralengineering design. Students will be exposed to the theories and concepts of both concreteandsteeldesignandanalysisbothattheelementandsystemlevels.Hands-ondesignexperience and skills will be gained and learned through problem sets and a comprehensivedesign project. An understanding of real-world open-ended design issues will be developed.Weeklyrecitations and project discussionswill be held besideslectures.

Module 1: Introduction- concepts of energy principles, safety, sustainable development inperformance; what makes a structure; principles of stability, equilibrium; what is a structuralengineer,roleofengineer,architect,user,builder;whatarethefunctions'whatdotheengineersdesign,first principles ofprocess ofdesign

Module 2: Introduction to reinforced concrete structures, Basic material properties: stress-strainrelation of concreteand reinforcingsteel

Module 3:, Planning and Design Process; Materials, Loads, and Design Safety; Behaviourand Properties of Concrete and Steel; Wind and Earthquake LoadsDesign philosophy:assumptionsand codeofpractice,

Module 4: Theory of singly reinforced members in bending, Design of simply supported andcontinuousbeams with rectangular and flanged section,

Module 5: Limit state of collapse in shear, Design for bond, Design of one-way and two-wayslabsystems

Module 6: Design of columns under uniaxial and biaxial bending, Design of footings andstaircase

Text/ReferenceBooks:

1. Nilson,A.H.Designof ConcreteStructures.13thedition.McGrawHill,2004
2. McCormac,J.C.,Nelson,J.K.Jr.,StructuralSteelDesign.3rdedition.PrenticeHall,N.J., 2003.
3. Galambos,T.V.,Lin,F.J.,Johnston,B.G.,BasicSteelDesignwithLRFD,PrenticeHall,1996
4. Segui,W.T.,LRFDSteelDesign,2ndEd.,PWSPublishing,Boston.
5. Salmon,C.G.andJohnson,J.E.,SteelStructures:DesignandBehavior,3rdEdition,Harper& Row, Publishers, New York, 1990.
6. MacGregor,J.G.,ReinforcedConcrete:MechanicsandDesign,3rdEdition,PrenticeHall,New Jersey, 1997.
7. Nawy,E.G.,ReinforcedConcrete:AFundamentalApproach,5thEdition,PrenticeHall,New Jersey.
8. WangC-K.andSalmon,C.G.,ReinforcedConcreteDesign,6thEdition,AddisonWesley,New York.

9. Nawy,E.G.PrestressedConcrete:AFundamentalApproach,PrenticeHall,NJ,(2003).
10. RelatedCodesofPracticeofBIS
11. Smith,J.C.,StructuralAnalysis,HarporandRow, Publishers,NewYork.
12. W.McGuire,R.H.GallagherandR.D.Ziemian.“MatrixStructuralAnalysis",2ndEdition,John WileyandSons, 2000.
13. NBC,National BuildingCode,BIS(2017).
14. ASCE,MinimumDesignLoadsforBuildingsandOther Structures,ASCE 7-02,AmericanSocietyof Civil Engineers, Virginia, 2002.
15. S.U.PillaiandD. Menon,ReinforcedConcreteDesign,Tata McGraw-Hill,3rdedition, 2009.
16. P.C.Varghese,LimitStateDesignofReinforcedConcrete,PrenticeHallIndia,2nd edition, 2008

PCC-CE304	GeotechnicalEngineering -I	3L:0T:2P	4credits

Module 1: Introduction–Types of soils, their formation and deposition, Definitions: soilmechanics,soilengineering,rockmechanics,geotechnicalengineering.Scopeofsoilengineering.Comparisonanddifferencebetweensoilandrock.BasicDefinitionsandRelationships-Soilasthree-phasesystemintermsofweight,volume,voidsratio,andporosity.Definitions:moisturecontent,unit weights,degreeofsaturation,voidsratio,porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight,voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content,moisture content- specific gravity etc. Determination of various parameters such as: Moisturecontentbyovendrymethod,pycnometer,sandbathmethod,torsionalbalancemethod,nuclearmethod,alcoholmethodandsensors.Specificgravitybydensitybottlemethod, pycnometer method, measuring flask method. Unit weight by water displacementmethod,submerged weightmethod, core-cuttermethod, sand-replacement method.

Oncompletion of thismodule,thestudents mustbeableto:

- Understandthedifferenttypesofsoilbasedontheirformationmechanism;
- Understand the various phase diagrams and derive various phase relationships of thesoil; Perform various laboratory experiments to determine moisture content,specific gravity; Perform field experiments to estimate the field density of thesoil mass.

Module 2: Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil,consistencylimits-liquidlimit,plasticlimit,shrinkagelimit,plasticity,liquidityandconsistencyindices,flow&toughnessindices,definitionsofactivityandsensitivity.Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits.Classification of Soils-Introduction of soil classification: particle size classification, texturalclassification,unifiedsoilclassificationsystem,Indianstandardsoilclassificationsystem.

Identification: field identification of soils, general characteristics of soil in different

groups.Oncompletion ofthis module, thestudents must be able to:

- Understandthe behaviour ofsoils based ontheirmoisturecontents;
- PerformlaboratoryexperimentstoestimatevariousAtterberglimitsandevaluateindex properties of soils;
- Classifyanysoils basedon theirparticle sizedistribution and index properties;

Module 3: Permeability of Soil - Darcy's law, validity of Darcy's law. Determination ofcoefficient of permeability: Laboratory method: constant-head method, falling-head method.Field method: pumping- in test, pumping- out test. Permeability aspects: permeability ofstratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, streamandpotentialfunctions, characteristicsof flownets, graphicalmethod toplot flownets.

Oncompletion ofthis module,thestudentmust beable to:

- Determinethe permeabilityof soils throughvarious laboratoryandfield tests;
- Analyticallycalculatethe effectivepermeabilityof anisotropicsoilmass;
- Determinetheseepagequantities andporewaterpressures belowthe ground;
- Graphicallyplot the equipotentiallines andflowlines ina seepageflow.

Module 4: Effective StressPrinciple-Introduction,effective stressprinciple,nature ofeffective stress, effect of water table. Fluctuations of effective stress, effective stress in soilssaturated bycapillaryaction, seepagepressure, quick sand condition.

Oncompletion ofthis module,thestudentmust beable to:

- Understandthephysicalsignificanceofeffectivestressanditsrelationwithporepressure;
- Plotvariousstressdistributiondiagramsalongthe depthofthesoilmass;
- Understandtheeffectofcapillaryactionandseepageflowdirectionontheeffectivestressat apoint in thesoil mass.

Module 5: Compaction of Soil-Introduction, theory of compaction, laboratory determinationof optimum moisture content and maximum dry density. Compaction in field, compactionspecificationsandfield control.

Oncompletion ofthis module,thestudentmust beable to:

- Performlaboratorytesttodeterminethemaximumdrydensityandoptimummoistureconten t ofthe soil;
- Variationincompactioncurvewithcompactioneffortandsoiltype;
- Determinethecompactiveeffortrequiredtoobtainnecessarydegreeofcompactionin-situ;
- Differentiateamongvariousfieldmethodsofcompactionandtheirusagebasedonthe typeof soil.

Module 6: Stresses in soils – Introduction, stresses due to point load, line load, strip load,uniformlyloadedcirculararea,rectangularloadedarea.Influencefactors,Isobars,Boussinesq' s equation, Newmark's Influence Chart. Contact pressure under rigid and flexiblearea, computation of displacements from elastic theory. On completion of this module, thestudentmust be able to:

- Analyticallycomputetheverticalstressinasemi-infinitesoilmassdueto□variousloadingconditions; Plot isobars duevarious loadingconditions.

PracticalWork: Listof testson-

1. FieldDensityusingCoreCutter method.
2. FieldDensityusingSandreplacementmethod.
3. NaturalmoisturecontentusingOvenDryingmethod.
4. Fieldidentificationof FineGrainedsoils.
5. Specific gravityofSoils.
6. GrainsizedistributionbySieveAnalysis.

7. GrainsizedistributionbyHydrometerAnalysis.
8. Consistencylimits byLiquid limit
9. ConsistencylimitsbyPlasticlimit
10. Consistencylimits byShrinkagelimit.
11. Permeabilitytest usingConstant-head test method.
12. Permeabilitytest usingFalling-head method.
13. Compactiontest:StandardProctortest.
14. Compactiontest:ModifiedProctortest.
15. Relativedensity.
16. ConsolidationTest.
17. TriaxialTest(UU)
18. Vanesheartest
19. DirectShearTest
20. UnconfinedCompressionStrengthTest.

Text/ReferenceBooks:

1. SoilMechanicsbyCraigR.F.,Chapman &Hall
2. Fundamentals of Soil EngineeringbyTaylor, John Wiley&Sons
3. AnIntroductiontoGeotechnicalEngineering,byHoltzR.D.andKovacs,W.D.,PrenticeHall, NJ
4. PrinciplesofGeotechnicalEngineering,byBraja M.Das,CengageLearning
5. PrinciplesofFoundation Engineering,byBrajaM.Das,CengageLearning
6. EssentialsofSoilMechanicsandFoundations:BasicGeotechnicsbyDavidF.McCarthy
7. SoilMechanicsinEngineeringPracticebyKarlTerzaghi,RalphB.Peck,andGholamrezaMesri.
8. GeotechnicalEngineering:PrinciplesandPracticesofSoilMechanicsandFoundationEngineering(Civiland EnvironmentalEngineering) byV.N.S. Murthy

PCC-CE305	Hydrology and Water Resources Engineering	2L:0T:2P	3credits

Module 1: Introduction - hydrologic cycle, water-budget equation, history of hydrology,worldwaterbalance, applications inengineering,sources of data.

Module 2: Precipitation - forms of precipitation, characteristics of precipitation in India,measurementofprecipitation,raingaugenetwork,meanprecipitationoveranarea,deptharea-duration relationships, maximum intensity/depth-duration-frequency relationship,ProbableMaximum Precipitation (PMP), rainfalldata inIndia.

Module 3: Abstractions from precipitation - evaporation process, evaporimeters, analyticalmethodsofevaporationestimation,reservoirevaporationandmethodsforitsreduction,evapotranspiration,measurementofevapotranspiration,evapotranspirationequations,potential evapotranspiration over India, actual evapotranspiration, interception, depressionstorage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltrationcapacity,classification ofinfiltrationcapacities, infiltration indices.

Module4: Runoff-runoffvolume,SCS-CNmethodofestimatingrunoffvolume,flowdurationcurve,flow-masscurve,hydrograph,factorsaffectingrunoffhydrograph,components of hydrograph, base flow separation, effective rainfall, unit hydrograph surfacewaterresources ofIndia,environmental flows.

Module5: Groundwaterandwellhydrology-formsofsubsurfacewater,saturatedformation, aquifer properties, geologic formations of aquifers, well hydraulics: steady stateflowinwells,equilibrium equationsforconfinedand unconfinedaquifers, aquifer tests.

Module 6: Water withdrawals and uses – water for energy production, water for agriculture,water for hydroelectric generation; flood control. Analysis of surface water supply, Waterrequirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta;Qualityofirrigationwater;Soil-waterrelationships,rootzonesoilwater,infiltration,consumptive use, irrigation requirement, frequency of irrigation; Methods of applying watertothefields:surface, sub-surface,sprinkler and trickle /drip irrigation.

Module 7: Distribution systems - canal systems, alignment of canals, canal losses, estimationofdesigndischarge.Designofchannels-rigidboundarychannels,alluvialchannels,Kennedy'sandLacey'stheoryofregimechannels.Canal outlets:non-modular,semi-modularandmodularoutlets.Waterlogging:causes,effectsandremedialmeasures.Liningofcanals, typesof lining.Drainageof irrigatedlands: necessity,methods.

Module 8: Dams and spillways - embankment dams: Classification, design considerations,estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams,causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams.Spillways: components of spillways, types of gates for spillway crests; Reservoirs-Types,capacityofreservoirs,yieldofreservoir,reservoirregulation,sedimentation,economicheight of dam, selectionof suitablesite.

Text/ReferenceBooks:

1. KSubramanya,EngineeringHydrology,Mc-GrawHill.
2. KNMuthreja,AppliedHydrology,TataMc-GrawHill.
3. KSubramanya,WaterResourcesEngineeringthroughObjectiveQuestions,TataMcGraw Hill.
4. GLAsawa,IrrigationEngineering,WileyEastern
5. LW Mays,WaterResourcesEngineering,Wiley.
6. JDZimmerman, Irrigation,JohnWiley&Sons
7. CSPOjha,RBerndtssonandPBhunya,EngineeringHydrology,Oxford.

Outcomes:

Atthe end ofthe course,studentsmust be inaposition to:

- Understandthe interactionamongvariousprocesses inthehydrologiccycle
- Applytheapplicationoffluidmechanicsanduseofcomputersinsolvingahostofproblemsin hydraulicengineering
- Studytypesandclassesofhydrologicsimulationmodelsanddesignproceduresforsafeandeffect ivepassageof flood flows for designofhydraulicstructures
- Understandthebasicaquiferparametersandestimategroundwaterresourcesfordifferenthydro-geologicalboundaryconditions
- Understandapplicationofsystemsconcept,advancedoptimizationtechniquestocoverthesocio -technical aspects in the fieldofwater resources
- Applytheprinciplesandapplicationsofremotesensing,GPSandGISinthecontexttohydrologic alextreme floodand droughtevents inwaterresourcesengineering

PCC-CE306	EnvironmentalEngineering-I	3L:0T:2P	4credits

Module1:Water:-SourcesofWaterandqualityissues,waterqualityrequirementfordifferent beneficial uses, Water quality standards, water quality indices, water safety plans,Water Supply systems, Need for planned water supply schemes, Water demand industrial andagricultural water requirements, Components of water supply system; Transmission of water,Distributionsystem,VariousvalvesusedinW/Ssystems,servicereservoirsanddesign.

Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection,advancedtreatments likeadsorption, ionexchange, membraneprocesses

Module2:Air-Compositionandpropertiesofair,Quantificationofairpollutants,Monitoringofairpollutants,Airpollution-Occupationalhazards,Urbanairpollutionautomobilepollution,Chemistryofcombustion,Automobileengines,qualityoffuel,operating conditions and interrelationship. Air quality standards, Control measures for Airpollution,construction and limitations

Module3:Noise-Basic concept,measurementandvariouscontrolmethods.

Module 4: Building Plumbing-Introduction to various types of home plumbing systems forwatersupplyandwastewaterdisposal,highrisebuildingplumbing,Pressurereducingvalves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, variouskindsof fixtures and fittings used.

PracticalWork:ListofExperiments

1. PhysicalCharacterizationofwater:Turbidity,ElectricalConductivity,pH
2. Analysisofsolidscontentofwater:Dissolved,Settleable,suspended,total,volatile,inorganicetc.
3. Alkalinityandacidity,Hardness:totalhardness,calciumandmagnesiumhardness
4. Analysisofions:copper, chlorideandsulfate
5. Optimumcoagulantdose
6. ChemicalOxygenDemand(COD)
7. DissolvedOxygen(D.O)andBiochemicalOxygenDemand(BOD)
8. BreakpointChlorination
9. Bacteriologicalqualitymeasurement:MPN,
10. AmbientAirqualitymonitoring(TSP, RSPM, SOx,NOx)
11. Ambientnoisemeasurement

Text/ReferenceBooks:

1. IntroductiontoEnvironmentalEngineeringandSciencebyGilbertMasters,PrenticeHall,New Jersey.
2. IntroductiontoEnvironmentalEngineeringbyP.AarneVesilind,SusanM.Morgan,Thompson/Brooks/Cole; Second Edition 2008.
3. Peavy,H.s,Rowe,D.R,Tchobanoglous,G. EnvironmentalEngineering,Mc-GrawHillInternational Editions, New York 1985.
4. MetCalfandEddy.WastewaterEngineering,Treatment,DisposalandReuse,TataMcGraw-Hill,New Delhi.

5. ManualonWaterSupplyandTreatment.
   MinistryofUrbanDevelopment,NewDelhi.
6. PlumbingEngineering.Theory,DesignandPractice,S.M.Patil,1999
7. IntegratedSolidWasteManagement,Tchobanoglous,Theissen&Vigil.McGrawHillPublic
   ation
8. ManualonSewerageandSewageTreatmentSystems,PartA,BandC.CentralPublicHealtha
   ndEnvironmentalEngineeringOrganization,MinistryofUrbanDevelopment.

PCC-CE307	TransportationEngineering	3L:0T:2P	4credits

Module 1: Highway development and planning-Classification of roads, road development inIndia,Current roadprojects inIndia;highwayalignmentand project preparation.

Module 2: Geometric design of highways-: Introduction; highway cross section elements;sightdistance,designofhorizontalalignment;designofverticalalignment;designofintersections,problems

Module 3:Traffic engineering & control- Traffic Characteristics, traffic engineering studies,trafficflowandcapacity,trafficregulationandcontrol;designofroadintersections;designofparkingfacilities; highwaylighting; problems

Module4:PavementmaterialsMaterialsusedinHighwayConstruction-Soils,Stoneaggregates,bituminousbinders,bituminouspavingmixes;Portlandcementandcement concrete:desirableproperties,tests,requirementsfordifferenttypesofpavements.Problems

Module 5: Design of pavements- Introduction; flexible pavements, factors affecting designand performance; stresses in flexible pavements; design of flexible pavements as per IRC;rigid pavements- components and functions; factors affecting design and performance of CCpavements;stressesinrigid pavements;designof concretepavementsasperIRC;problems

Text/ReferenceBooks:

1. Khanna,S.K.,Justo,C.E.GandVeeraragavan,A,'HighwayEngineering',Revised10thEdition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., 'Traffic EngineeringandTransportPlanning',KhannaPublishers.
3. ParthaChakraborty,'PrinciplesOfTransportationEngineering,PHILearning,
4. FredL.Mannering,ScottS.Washburn,WalterP.Kilareski,'PrinciplesofHighwayEngineeringand Traffic Analysis', 4th Edition, John Wiley
5. SrinivasaKumar,R,Textbook ofHighwayEngineering, UniversitiesPress,2011.
6. PaulH.WrightandKarenK.Dixon,HighwayEngineering,7thEdition,WileyStudentEdition, 2009.

MC 401	**EnvironmentalScience**	**3L : 0T:0P** **0Credits**	**(Mandatorynon-creditcourse)**

We as human being are not an entity separate from the environment around usrather we are a constituent seamlessly integrated and co-exist with the environment aroundus.We arenotanentitysoseparatefromtheenvironmentthatwecanthinkofmasteringand controlling it rather we must understand that each and every action of oursreflectsontheenvironmentandviceversa.AncientwisdomdrawnfromVedasaboutenvironment and its sustenance reflects these ethos. There is a direct application of thiswisdomeveninmoderntimes.Ideaofanactivitybasedcourseonenvironmentprotectionistosensitizethestudentsontheaboveissuesthroughfollowingtwotypeofactivities:

(a) AwarenessActivities:

i) Smallgroupmeetingsaboutwatermanagement,promotionofrecycleuse,generationoflesswaste,avoidingelectricitywaste
ii) Sloganmakingevents
iii) Postermakingevents
iv) Cyclerally
v) Lecturesfromexperts

(b) ActualActivities:

i) Plantation
ii) Giftingatreetoseeitsfullgrowth
iii) Cleanlinessdrive
iv) Driveforsegregationofwaste
v) Tolivesomebigenvironmentalistforaweekorsotounderstandhiswork
vi) Toworkinkitchengardenformess
vii) Toknowaboutthedifferentvarietiesofplants
viii) ShuttingdownthefansandACsofthecampusforanhourorso

Semester VI (Third year]
Branch/CourseCivilEnginee
ring

Course Code	CourseTitle	L	T	P	Credit	Branch
	ConstitutionofIndia/EssenceofIndianKnowledgeTraditional	3	0	0	0	101
	ConstructionEngineering&Management	2	1	0	3	101
	DesignofSteelStructure	3	0	0	3	101
	EngineeringEconomics,Estimation&Costing	2	0	2	3	101
	EnvironmentalEngineering-II	3	0	0	3	101
	GeotechnicalEngineering-II	3	0	0	3	101
	IndustrialVisit	0	0	2	1	101
	MOOCs/SWAYAM/NPTELCourses -2	2	0	0	2	101
	ProgramElective-I	3	0	0	3	101

Semester VI (Third year]
Branch/CourseCivilEnginer
ing

PCC-CE308	**Construction Engineering & Management**	**2L:1T:0P**	**3credits**

Module1: Basics of Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution;

Module 2: Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module 3: Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module 4: Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting&placing;Cranes,Hoistsandotherequipmentforlifting;Equipmentfortransportation of materials. Equipment Productivities

Module 5: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

Module 6: Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Commoncausesoftimeandcostoverrunsandcorrectivemeasures.BasicsofModernProject

management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Module 7: Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Module 8: Construction Costs: Make-up of construction costs; Classification of costs, timecosttrade-off in construction projects, compression and decompression.

Text/ReferenceBooks:

1. Varghese,P.C.,"BuildingConstruction",PrenticeHallIndia,2007.
2. NationalBuildingCode,BureauofIndianStandards,NewDelhi, 2017.
3. Chudley,R.,ConstructionTechnology,ELBSPublishers,2007.
4. Peurifoy,R.L.ConstructionPlanning,MethodsandEquipment,McGrawHill, 2011
5. Nunnally,S.W.ConstructionMethodsandManagement,PrenticeHall,2006
6. Jha,KumarNeeraj.,ConstructionProjectmanagement,Theory&Practice,PearsonEducation India, 2015
7. Punmia,B.C.,Khandelwal,K.K.,ProjectPlanningwithPERTandCPM,LaxmiPublications, 2016.

S. No	Module(NoofLecturesin brackets)	Tutorials
1	BasicsofConstruction(2)	
2	ConstructionPlanning(6)	Develop a WBD structure for the construction of one storeyed building; Develop a bar chart for the constructionofthisbuilding,includingfinishing activities,assumingreasonableactivitydurations.
3	ConstructionMethodsbasics (6)	Develop a CPM chart for a 5 span bridge on open foundations. Develop a comparative table for a 10-storeyedbuildingconstructedbyatleastthree differentmethods,listingtheirprosand cons.

4	ConstructionEquipmentBasics (3)	Develop a Gantt Chart for the constructionofa two storeyed precast framed structure, including open foundations, along with list of equipmentresources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to placing of concrete at 3mheightabovegroundlevel;showallequipment resourcesrequired,alongwithasitelayout.
5	Planning and Organizing Construction Site and Resources (4)	For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw S-curvesforconcreteplacingandblockworkdone overtheperiod.
6	ProjectMonitoringandControl (4)	Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq. m. plinth area.
7	ContractManagementbasics (3)	Assuming a 4 month delay in a constructioncontract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to actastheContractor.Onepersontoactas Arbitrator/Judge.
8	ConstructionCosts(2)	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximatecost of a 3 storey, 400 sqm plinth area building.
	Total:30Lectures	15Tutorials

PCC-CE309	EngineeringEconomics,Estimation& Costing	2L:0T:2P	3credits

Module 1:Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting,ApplicationofLinearProgramming.InvestmentAnalysis –NPV,ROI,IRR,PaybackPeriod, Depreciation, Time valueof money(present and future worth of cash flows).Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized,

Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5: Estimation / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Module 6: Specifications-Types, requirements and importance, detailed specifications forbuildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Module 8: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & FinalBill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

TermWorkAssignmentsmayinclude:

1. Derivinganapproximateestimateforamultistoriedbuildingbyapproximate methods.
2. Detailedestimateforthefollowingwiththerequiredmaterialsurveyforthesame.
    a. GroundplusthreestoriedRCCFramedstructurebuildingwithblockworkwalls
    b. bridgewithminimum2 spans
    c. factorybuilding
    d. roadwork
    e. crossdrainagework
    f. Groundplusthreestoriedbuildingwithload-bearingwallsgCostoffinishes,MEP works for (f) above
3. PreparationofvaluationreportinstandardGovernmentform.
4. Assignmentsonrateanalysis,specificationsandsimpleestimates.
5. Detailedestimateofminor structure.
6. PreparationofBarbendingschedule.

Text/ReferenceBooks:

1. MankiwGregoryN.(2002),PrinciplesofEconomics,Thompson Asia
2. V.Mote,S.Paul,G.Gupta(2004),ManagerialEconomics,TataMcGrawHill
3. Misra,S.K.andPuri(2009),IndianEconomy, Himalaya
4. PareekSaroj(2003),TextbookofBusinessEconomics,SunrisePublishers
5. MChakravarty,Estimating,CostingSpecifications&Valuation
6. JoyPK,HandbookofConstructionManagement,Macmillan7.B.S.Patil,Building& Engineering Contracts8. Relevant Indian Standard Specifications.
9. WorldBankApprovedContractDocuments.
10. FIDICContract Conditions.
11. ActsRelatedtoMinimumWages,Workmen’sCompensation,Contract,and Arbitration

12. TypicalPWDRateAnalysisdocuments.
13. UBSPublishers&Distributors,EstimatingandCostinginCivilEngineering:TheoryandPractice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

PCC-CE303	**DesignOfSteelStructure**	**3L:0T:0P**	**3credits**

Module 1: Introduction: Steel structures, material properties, Limit states and design philosophies; analysis and design methods, Loads, partial safety factors and load combinations, analysis of rooffor wind loads. Codes and standards. Section Classification: Plastic, compact, semi-compact, and slender sections.

Module 2: Connections: Structural fasteners - Rivets, bolts and welds, strength under combined stresses, Bolted and Welded Connections - Simple and Eccentric and Column bases.I
Module 3: Tension members: Design based on net section including shear lag effects and block shear, lug angles. Compression members:

Module 4: Design for flexural and flexural-torsional buckling, Effective lengthfactor: Sway and Non- sway frames, Local buckling, Built-up columns - Battens and lacings. Laterally Supported and Unsupported Beams:

Module 5: Design strength using shear-moment interaction; Built-up beams, Shear buckling strength, Plate girders and design of stiffeners, Lateral torsional buckling, Effect of restraints and effective length.

Module 6: Beam-Columns: Effect of axial load on flexure behaviour, P-M interaction and moment amplification, Flexural torsional buckling and Bi-axial bending.

Text/ReferenceBooks:

1. McCormac,J.C.,Nelson,J.K.Jr.,StructuralSteelDesign.3rdedition.PrenticeHall,N.J.,2003.
2. Galambos,T.V.,Lin,F.J.,Johnston,B.G.,BasicSteelDesignwithLRFD,PrenticeHall, 1996
3. Segui,W.T.,LRFDSteelDesign,2ndEd.,PWSPublishing,Boston.
4. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
5. RelatedCodesofPractice ofBIS
6. NBC,NationalBuildingCode,BIS(2017).
7. ASCE,MinimumDesignLoadsforBuildingsandOtherStructures,ASCE7-02,AmericanSociety of Civil Engineers, Virginia, 2002.
8. Subramanian,N.(2010).SteelStructures:DesignandPractice,OxfordUniversity Press.
9. Duggal,S.K.(2014).LimitStateDesign ofSteelStructures,McGrawHill.

PCC-CE304	GeotechnicalEngineering-II	3L:0T:0P	3credits

Module 1: Consolidation of Soil - Introduction, comparisonbetween compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

Oncompletionofthismodule,thestudentmustbeableto:

- Understandthebasicmechanismofconsolidationofsoil;
- Determinevariousconsolidationparametersofsoilthroughlaboratorytest; Evaluate ground settlements against time.

Module 2: Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters unconfined compression test, vane shear test On completion of this module, the student must be able to:

- Determinegraphicallyandanalyticallythestressstateinanyplaneofthesoilmass; Performvariouss hearstrengthtestsandappreciatethedifferentfieldconditionswhich they simulate;
- Understandthesignificanceofshearstrengthparametersinvariousgeotechnicalanalyses;
- Evaluatethestiffness ofsoilusingshearstrengthparameters

Module 3: Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. On completion of this module, the student must be able to:

- Differentiatevariousmodesofslopefailure;
- Evaluatefactorofsafetyofinfiniteslopesbasedondifferentgroundconditions;Understand various methods for computation of factor of safety for finite slopes.

Module 4: Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

Oncompletionofthismodule,thestudentmustbeableto:

- Specifyastrategyforsiteinvestigationtoidentifythesoildepositsanddeterminethedepth and spatial extent within the ground;
- Understand various site investigation techniques and their in-situ applications;Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, etc.

Module 5 Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation.

Text/ReferenceBooks:

1. SoilMechanicsbyCraigR.F.,Chapman & Hall

2. FundamentalsofSoilEngineeringbyTaylor,JohnWiley&Sons
3. AnIntroductiontoGeotechnicalEngineering,byHoltzR.D.andKovacs,W.D.,PrenticeHall,NJ
4. PrinciplesofGeotechnicalEngineering,byBrajaM.Das,CengageLearning
5. PrinciplesofFoundationEngineering,byBrajaM.Das,CengageLearning
6. EssentialsofSoilMechanicsandFoundations:BasicGeotechnicsbyDavidF.McCarthy
7. SoilMechanicsinEngineeringPracticebyKarlTerzaghi,RalphB.Peck,andGholamrezaMesri.
8. GeotechnicalEngineering:PrinciplesandPracticesofSoilMechanicsandFoundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy

PCC-CE306	EnvironmentalEngineering-II	3L:0T:0P	3credits

Module 1: Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollutiondue to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems,recycling of sewage – quality requirements for various purposes.

Module2: Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 3: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

PracticalWork:ListofExperiments

1. PhysicalCharacterizationofwater:Turbidity,ElectricalConductivity,pH
2. Analysisofsolidscontentofwater:Dissolved,Settleable,suspended,total,volatile, inorganic etc.
3. Alkalinityandacidity,Hardness:totalhardness,calciumandmagnesiumhardness
4. Analysisofions:copper,chlorideandsulfate
5. Optimumcoagulant dose
6. ChemicalOxygenDemand(COD)
7. DissolvedOxygen(D.O)andBiochemicalOxygenDemand (BOD)
8. BreakpointChlorination
9. Bacteriologicalqualitymeasurement:MPN,
10. AmbientAirqualitymonitoring(TSP,RSPM,SOx,NOx)
11. Ambientnoisemeasurement

Text/ReferenceBooks:

1. IntroductiontoEnvironmentalEngineeringandSciencebyGilbertMasters,PrenticeHall, New Jersey.
2. IntroductiontoEnvironmentalEngineeringbyP.AarneVesilind,SusanM.Morgan,Thompson

/Brooks/Cole; Second Edition 2008.
3. Peavy,H.s,Rowe,D.R,Tchobanoglous,G. EnvironmentalEngineering,Mc-GrawHill International Editions, New York 1985.
4. MetCalf and Eddy.Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
5. ManualonWaterSupplyandTreatment.MinistryofUrbanDevelopment,New Delhi.
6. PlumbingEngineering.Theory,DesignandPractice,S.M.Patil,1999
7. IntegratedSolidWasteManagement,Tchobanoglous,Theissen&Vigil.McGrawHill Publication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Concrete Materials. Examines the influence of constituent materials (cements, aggregates and admixtures) on the properties of fresh and hardened concrete; Recycled aggregates recovered from construction and demolition wastes; M-Sand; Light-weight aggregates; Use of Fly Ash in concrete; Fibre-reinforced concrete with various types of metallic and nonmetallic fibres; various types of concrete such as Self Compacting Concrete, High Performance Concrete, etc.; mix design; handling and placement of concrete; Effect of revibration of concrete; behavior of concrete under various types of loading and environment; test methods. Laboratory practice is an integral part of the course.

ESC212	Energy Science&Engineering	1L:1T:0P	2credits

TheobjectiveofthisCourseisto provide*anintroductiontoenergysystemsandrenewableenergy resources,withascientificexaminationoftheenergyfieldandan emphasisonalternativeenergy sources andtheirtechnologyandapplication.Theclasswillexploresociety'spresentneedsand futureenergydemands,examineconventionalenergysources andsystems,includingfossilfuelsand nuclearenergy,and thenfocus onalternatives,renewableenergysourcessuchassolar,biomass (conversions),windpower,waves andtidal,geothermal,oceanthermal,hydroandnuclear.Energy conservation methodswill beemphasized*fromCivilEngineeringperspective.The knowledge acquiredlaysagoodfoundationfordesignofvariouscivil engineeringsystems/ projectsdealing withtheseenergygenerationparadigmsinanefficientmanner.

ProposedSyllabus

Module1:Introductionto EnergyScience:Scientificprinciplesandhistoricalinterpretationtoplace energy useinthecontextofpressingsocietal,environmentalandclimateissues;Introductionto energysystemsandresources;IntroductiontoEnergy,sustainability&theenvironment

Module2:*EnergySources:*Overview ofenergysystems,sources,transformations,efficiency,and storage.Fossilfuels(coal,oil,oil-bearingshaleandsands,coalgasification)-past,present&future, Remedies&alternativesforfossilfuels-biomass,wind,solar,nuclear,wave,tidaland hydrogen; Sustainability andenvironmental trade-offsof different energysystems;possibilities for energy storageorregeneration(Ex. Pumpedstoragehydropowerprojects,superconductor-based energy storages,highefficiencybatteries)

Module 3: Energy&Environment:Energyefficiencyandconservation;introductiontocleanenergy technologiesanditsimportanceinsustainabledevelopment;Carbonfootprint,energyconsumption andsustainability;introductiontothe economicsofenergy;How the economicsystemdetermines productionandconsumption;linkagesbetweeneconomicandenvironmentaloutcomes;Howfuture energyusecan beinfluencedbyeconomic,environmental,trade,andresearchpolicy

Module 4: Civil Engineering Projects connected with the Energy Sources: Coal mining technologies,

Oilexplorationoffshoreplatforms, Undergroundandunder-seaoilpipelines, solar chimneyproject,waveenergycaissons,coastalinstallationsfortidalpower,windmilltowers;hydro powerstationsabove-groundandundergroundalongwithassociateddams,tunnels,penstocks,etc.; Nuclearreactorcontainmentbuildingsandassociatedbuildings,designandconstructionconstraints andtestingproceduresforreactorcontainmentbuildings;SpentNuclearfuelstorage anddisposal systems

Module 5: *Engineering for Energy conservation:* Concept of Green Building and Green Architecture;Greenbuildingconcepts(Greenbuildingencompasseseverythingfromthechoiceof buildingmaterialstowhereabuildingislocated,howitisdesignedandoperated);*LEEDratings;* Identificationofenergyrelatedenterprisesthatrepresentthe breathoftheindustryandprioritizing theseascandidates;Embodiedenergyanalysisanduseasa toolformeasuringsustainability.Energy AuditofFacilitiesandoptimizationofenergyconsumption.

S. No	Module	No of Lectures	Tutorial-tobederivedforeachmodule;typicalexamples givenbelow.
1	Introductionto EnergyScience	3	CompileaWorldmapshowingEnergy Reserves by source, TotalEnergyconsumption,Percapitaenergyconsumptionan
2	EnergySources	4	Compile a Word Map showing Alternative Energy source usage;CompileaProcessdiagramforaPumped Storage project;Collect detailsofatypicalNorthSeaoilplatform. CompileamapofIndiashowingexitingpotentialandutilized potentialforhydropower.Listtheprosandconsfor Thermal,
3	Energy &Environment	5	Study thefunctioning of anElectro StaticPrecipitatorina thermalpowerplant;studytheusesofcoarseandfineFlyAsh fromthermalpowerplants.Compilethe safetyprovisionsin design andconstructionofa reactorcontainmentbuilding
4	CivilEngg projects connected with EnergySources	10	Compileaprocessdiagramforatypicalundergroundhydro power project; Collect details of a model solar chimney project;collectdetailsofawaveenergyprojectatVizhinjam; CollectdetailsoftheKalpasar(Tidalenergy)project
5	Engineering for EnergyConservation	8	Drawatypicalgeometricalorientationofahouseinyourarea toavoid sun'sradiationin thebedroom intheevening; Identify typicalexamplesofIndian buildingshavingvarious LEED ratings;Listvariousbuildingmaterialswiththeir embodiedenergycontent. Do anEnergy Auditofyour
	TOTAL	**30**	**30**

Text/Reference Books:

1. Boyle,Godfrey(2004),RenewableEnergy(2ndedition).OxfordUniversityPress
2. Boyle, Godfrey, Bob Everett, and JanetRamage(Eds.) (2004), Energy Systems and Sustainability:Powerfora SustainableFuture.OxfordUniversityPress
3. Schaeffer,John (2007), RealGoods Solar LivingSourcebook: The CompleteGuideto RenewableEnergyTechnologiesandSustainableLiving,Gaiam
4. Jean-Philippe;Zaccour,Georges(Eds.),(2005),EnergyandEnvironmentSet:Mathematics ofDecisionMaking,Loulou,Richard;Waaub,XVIII,
5. Ristinen,RobertA.Kraushaar,Jack J. AKraushaar,Jack P. Ristinen,Robert A.(2006) EnergyandtheEnvironment,2ndEdition,JohnWiley
6. UNDP (2000),EnergyandtheChallengeofSustainability,WorldEnergyassessment
7. E H Thorndike(1976),Energy&Environment: APrimerforScientists andEngineers,

Addison-WesleyPublishingCompany

8. Relatedpaperspublishedininternationaljournals

Uponsuccessfulcompletionofthe course, the studentswillbeable to:

a) Listandgenerallyexplainthemainsourcesof energyandtheirprimaryapplications nationally andinternationally

b) Have basicunderstandingoftheenergysourcesandscientificconcepts/principlesbehind them

c) Understandeffectofusingthesesourcesontheenvironment andclimate

d) Describethechallengesandproblemsassociatedwiththeuseofvariousenergysources, includingfossilfuels, withregardtofuturesupplyandtheimpactontheenvironment. e) Listanddescribetheprimaryrenewableenergyresourcesandtechnologies.

f) To quantifyenergydemandsandmake comparisonsamongenergyuses,resources,and technologies.

g) Collectandorganizeinformationonrenewableenergytechnologiesasabasis forfurther analysisandevaluation.

h) Understand theEngineeringinvolvedinprojectsutilisingthesesources

Structural Analysis L-T-P: 3-1-0 Credits: 4

Detailed CourseOutline

Prerequisite: Students should have done basic course in mechanics of solid/strength of materials.

Objective: To provide basics to solve problems in structures.

1. MODULE-I Basic Introductory Concepts: Structural Systems, Elements, Joints, Stability, equilibrium, Compatibility, Indeterminacy, Types of Loading.Methods of analysis: Displacement Analysis of Statically Determinate Beams and Trusses Unit Load and energy methods, Moment Area and Conjugate Beam Methods. 10 Lectures

2. MODULE-II Influence Lines for Beams and Trusses under moving loads Mueller Breslau's Principle with applications and Energy theorems.Analysis of two and three hinged arches. 10 Lectures

3. MODULE-III Analysis of statically and kinematically indeterminate structure by Energy methods, Clapeyron's theorem; slope-deflection method, moment distribution method and Kani's method. 10 Lectures

4. MODULE-IV Analysis of statically Indeterminate Structures by the Direct Stiffness Method, Flexibility methods and approximate methods. 12 Lectures

Text Books: 1. Design of steel Structures- S.K. Duggal, Tata McGraw Hill, New Delhi. 2. Basic Structural Analysis - C.S. Reddy, Tata McGraw Hill, New Delhi. 3. Elementary Structural Analysis - Norris, Wilbur and Utku, McGraw Hill. 4. Intermediate Structural Analysis - C.K. Wang, McGraw-Hill. 5. Theory of Structures - Volumes 1 and 2, S P Gupta and G S Pandit, Tata McGraw Hill. 6. Structural Analysis - L.S. Negi& R.S. Jangid, Tata McGraw Hill. 7. Theory of Structures- B.C. Punima, Laxmi Publications.

Semester VII (FourthYear]
Branch/Course Civil Engineering

Course Code	Course Title	L	T	P	Credits	Branch			
100705	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	101	TH	0	0
1017xx	Open Elective- I	3	0	0	3	101	TH	70	30
101701	Professional Practice, Law & Ethics	2	0	0	2	101	TH	70	30
1017xx	Program Elective - III	3	0	0	3	101	TH	70	30
1017xx	Program Elective- II	3	0	0	3	101	TH	70	30
100709	Project-I	0	0	12	6	101	PR	30	20
100707	Summer Entrepreneurship - III	0	0	16	8	101	PR	30	20

101701	Professional Practice, Law & Ethics	2L:0T:0P	2 credits

Basic elements of civil engineering professional practice are introduced in this course. Roles of all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers - are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced. The course covers professional relations, civic responsibilities, and ethical obligations for engineering practice. The course also describes contracts management, and various legal aspects related to engineering. Further, the course familiarizes students with elementary knowledge of laws that would be of utility in their profession, including several new areas of law such as IPR, ADR.

The course is designed to address the following:

- To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
- To develop some ideas of the legal and practical aspects of their profession

Proposed Syllabus

Professional practice covering the respective roles of the various stakeholders in the profession of civil engineering and the factors governing the same; Professional ethics relating to civil engineering; Various aspects of contracts relating to construction and management of contracts; types of contractual and other disputes in the profession and methods of dispute resolution; legal

aspects relating to employment and service conditions of labour; intellectual property rights and their legal framework

Modules:

Module 1 A- Professional Practice – Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards)

Module 1 B- Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Module 2:*General Principles of Contracts Management: Indian Contract Act, 1972 and amendments* covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures &Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public- Private Partnerships; International Commercial Terms;

Module 3 ***:****Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system:* Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards;

Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; LokAdalats

Module 4 :*Engagement of Labour and Labour& other construction-related Laws:* Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

Module 5 : *Law relating to Intellectual property:* Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

ORGANISATION OF COURSE (2-0-0)

S. No	**Module**	**No of Lectures**	**Details**
1A	Professional Practice	2	
1B	Professional Ethics	2	
2	Contracts Management	18	
3	Dispute Resolution Mechanisms	5	
4	Labour; Labour& other Laws	2	
5	Intellectual Property Management	1	
	TOTAL	**30**	

Text/Reference Books:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. NeelimaChandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.

7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R. (1979), Law of Contract, Oxford University Press
9. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
11. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
12. Bare text (2005), Right to Information Act
13. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
14. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
15. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
16. Vee, Charles &Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss2,pp 117-127, MCB UP Ltd
17. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
18. Ethics in Engineering- M.W.Martin&R.Schinzinger, McGraw-Hill
19. Engineering Ethics, National Institute for Engineering Ethics, USA
20. www.ieindia.org
21. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
22. CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm
23. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
24. Contract&Agreements http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
25. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
26. Business & Personal Law. Chapter 7. "How Contracts Arise", http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
27. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
28. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.htmlContract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02), http://www.sandia.gov/policy/14g.pdf

100714	**Human Resource Development and Organizational Behavior**	**3L:0T:0P**	**3 Credits**

Module 1 **Lecture: 8 hrs.**

Introduction: HR Role and Functions, Concept and Significance of HR, Changing role of HR managers - HR functions and Global Environment, role of a HR Manager. Human Resources

Planning: HR Planning andRecruitment: Planning Process - planning at different levels - Job Analysis

Module 2 **Lecture: 8 hrs.**

Recruitment and selection processes - Restructuring strategies - Recruitment-Sources of Recruitment-Selection Process-Placement and Induction-Retention of Employees. Training and Development: need for skill upgradation - Assessment of training needs - Retraining and Redeployment methods and techniques of training employees and executives – performance appraisal systems.

Module 3 **Lecture: 8 hrs.**

Performance Management System: Definition, Concepts and Ethics-Different methods of Performance Appraisal- Rating Errors Competency management. Industrial Relations : Factors influencing industrial relations - State Interventions and Legal Framework - Role of Trade unions - Collective Bargaining - Workers; participation in management.

Module 4 **Lecture: 8hrs.**

Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.

Module 5 **Lecture: 8hrs.**

Leadership: Definition, Importance, Theories of Leadership Styles. Organizational Politics: Definition, Factors contributing to Political Behavior. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation - Bargaining Strategies, Negotiation Process.

Suggested books:

1. Gary Dessler, "Human Resource Management" - (8th ed.,) Pearson Education, Delhi.
2. Robbins, S. P., Judge & T. A., "Organizational Behavior", Pearson Education, 15th Edn.

Suggested reference books:

1. Decenzo& Robbins, Personnel Human Resource Management, 3rd ed., John Wiley & Sons (Pvt.) Ltd.
2. BiswajeetPatanayak, Human Resource Management, PHI, New Delhi
3. Luis R. Gomez, Mejia, Balkin and Cardy, Managing Human Resources PHI, New Delhi
4. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.
5. Shukla, Madhukar: Understanding Organizations - Organizational Theory & Practice in India, PHI

100713 (Common Paper)(CE,CS,IT)	**SoftSkills andInterpersonalCommunication**	**3L:0T:0P**	**3 Credits**

Detailed contents:

Module 1 **Lecture 8 hrs.**

Self-Analysis: Swot Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem.

Module 2 **Lecture 8 hrs.**

Creativity: Out of Box Thinking, Lateral Thinking.

Module 3 **Lecture 8 hrs.**

Attitude: Factors Influencing Attitude, Challenges and Lessons from Attitude, Etiquette; Motivation: Factors of Motivation, Self-Talk, Intrinsic & Extrinsic Motivators.

Module 4 **Lecture 8 hrs.**

Goal Setting: Wish List, Smart Goals, Blue Print for Success, Short Term, Long Term, Life Time Goals; Time Management: Value of Time, Diagnosing Time Management, Weekly Planner, To Do List, Prioritizing Work.

Module 5 **Lecture 8 hrs.**

Interpersonal Skills: Gratitude - Understanding the relationship between Leadership Networking & Team work. Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work - Necessity of Team Work Personally, Socially and Educationally.

Text Book:

1. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.

Reference

1. Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
2. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.

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100715 (Common Paper) (CE,CS,IT)	**Cyber Law and Ethics**	**3L:0T: 0P**	**3 credits**

Objectives of the course:

1. Discuss the structure of the legal system and how it enforces laws governing the Internet.
2. Evaluate the ethical responsibilities of Internet users, service providers, and content providers.
3. Examine the constitutional considerations concerning free speech and content controls inCyber Space.
4. Investigate a security breach and the legally required responses to a breach.

Detail contents

Module 1 **Lecture 8 hrs.**

Introduction: Computers and its Impact in Society, Overview of Computer and Web Technology, the Internet and online resources, Security of information, Introduction to ethical theory and its application to the Internet, Definition of Cyber Security. Search Engines, E – mails and WWW, E – commerce & M – commerce System Security, Government Regulation of the Internet.

Module 2 **Lecture 10 hrs.**

Cyber Crimes & Legal Framework: Distinction between Cyber Crime and Conventional Crime, Cyber Criminals and their Objectives, Kinds of Cyber Crime: Hacking, Digital Forgery, Cyber Stalking/Harassment, Identity Theft & Fraud, Cyber terrorism, Cyber Defamation, Computer Vandalism etc. Cyber Crimes against Individuals, Institution and State, Issues in Data and Software Privacy, Cyber Forensics.

Module 3 **Lecture 12 hrs.**

Introduction to Indian Cyber Law: Overview of General Laws and Procedures in India, Different offences under IT Act, Overview of Information Technology Act, 2000 and Information Technology (Amendment) Act, 2008. National Cyber Security Policy 2013, Offences in Cyber Space under the Indian Penal Code, 1860, Intellectual Property Issues in Cyber Space, Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues.

Module 4 **Lecture 10 hrs.**

Constitutional & Human Rights Issues in Cyberspace: Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace, Access to Internet, Right to Privacy, Right to Data Protection, Issues with cybercrime using social networking sites. Electronic Commerce, Digital Signatures - technical and legal issues. Electronic Contracts, Law relating to Hardware and Software Layout & Design.

Suggested reference books:

1. Jonathan Rosenoer, "Cyberlaw: the Law of the Internet" Springer-Verlag New York Inc.
2. PavanDuggal, "Cyber Law - An exhaustive section wise Commentary on the Information Technology Act along with Rules, Regulations, Policies, Notifications etc.", Universal Law Publishing.
3. Deborah E. Bouchoux, "Intellectual Property: The Law Of Trademarks, Copyrights, Patents, And Trade Secrets", Cenage Learning.
4. M. K. Bhandari, "Law Relating to Intellectual Property Rights", Central Law Publications.
5. VivekSood, "Cyber Law Simplified", McGraw Hill Education.
6. Prashant Mali, "Cyber Law & Cyber Crimes Simplified", Cyber Infomedia.

Course outcomes

After the completion of course, students can able to able to demonstrate a critical understanding of the Cyber law and Cyber-crime with respect to IT Act.

Pavement Design. Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements.Stresses and Deflections in Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads.Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC Prerequisite:

Building Construction Practice. Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection; Sub Structure Construction- Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation; Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors Erection of articulated structures, braced domes and space decks; Prerequisite:

Transport of water and wastewater. The objective of the course is to make students gain insight into how the water and wastewater gets transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems. WaterSupply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation. SanitarySewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety. Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance

Pipeline Engineering: The course should cover key issues for designing and operating pipelines for transmission and distribution of water; Analysis of flow in water transmission and water distribution systems (pump & gravity); optimal design and operation of systems for achieving different goals (including latest tools available for optimization); Extended period simulations, Software for WDN analysis and design, Rehabilitation of pipeline systems; Water auditing, online monitoring and control, leak and burst detection; transient analysis and surge protection; Appurtenances (valves / flow meters etc.); Selection of pipe material; Jointing details; Pipe laying and testing; Structural design for buried and surface mounted pipes

Pre-Requisite: Basic course in Hydraulic Engineering

Surface Hydrology. Study of descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; discusses principles of hydrologic processes and presents methods of analysis and their applications to engineering and environmental problems.

Prerequisite:

Masonry Structures. Introduction to analysis, design and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile, flexural, and shear behavior of masonry structural components. Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems.

Prerequisite:

Wood Structures. Mechanical properties of wood, stress grades and working stresses; effects of strength- reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued- laminated timber and plywood; behavior and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses, rigid frames, arches, and pole-type buildings; and prismatic plates and hyperbolic paraboloids.

Prerequisite:

Concrete Technology. Concrete; Properties of ingredients, tests, Production of concrete, mixing, compaction curing, Properties of fresh concrete; Defects in Concrete, Concrete additives.; Behavior of concrete in tension and compression, shear and bond, Influence of various factors on test results, Time dependent behavior of concrete -creep, shrinkage and fatigue; Concrete mix design; Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion, different method of mix design. Quality control, Behavior of concrete in extreme environment; temperature problem in concreting, hot weather, cold weather and under water conditions, Resistance to freezing, sulphate and acid attack, efflorescence, fire resistance; Inspection and testing of concrete- Concrete cracking, types of cracks, causes and remedies Non-destructive tests on concrete; Chemical tests on cement and aggregates; Special concrete; types and specifications, Fibre reinforced and steel Fibre reinforced

concrete, Polymer concrete, Use of admixtures; Deterioration of concrete and its prevention Repair and rehabilitation. Prerequisite:

Advanced Structural Analysis. Elasticity: Introduction, Components of strain and strain, Hooke's law, Plane stress and plane strain, Equations of equilibrium and compatibility, Boundary conditions, Two dimensional problems in rectangular and polar coordinates, Bending of simple and cantilever beams; Model Analysis: Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations; Introduction to Finite element method for structural analysis; Review of principle of virtual work, Ritz method, Discretization of domain, Basic element shape, Discretization process; Application of finite element method to one and two- dimensional plane stress strain elements.

Soil Mechanics-II. Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation. Prerequisite:

Reference books:

- Soil Mechanics by Craig R.F., Chapman & Hall
- Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
- On successful completion of this course, the students:
- Should be able design retaining wall subjected to various loads with the knowledge of earth pressure theories.
- Should be able to design sheet pile wall with different methods.
- Should get familiarized with different construction practices for excavation with advantages and disadvantages of each method.
- Should be able to determine the safety analysis for slopes with different methods proposed in the syllabus. Should get introduced with the commercial softwares for analyzing the stability of slopes and retaining walls.

Environmental impact assessment and life cycle analyses. Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

Groundwater Engineering: The main objective is to provide sufficient knowledge to the students about the groundwater hydrology, well hydraulics and well construction, geophysical explorations, groundwater quality and management of groundwater resources; Problems and perspectives regarding groundwater in India; Hydrogeology: Darcy's Equation; flow characteristics; general flow equations; unsaturated flow; Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic well losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: Construction; completion, development, protection and rehabilitation of wells; Groundwater quality; Groundwater Management: Basin management, investigations, conjunctive use, modeling, artificial recharge; Saline water intrusion

Structural Dynamics. Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multidegree-of-freedom systems; response spectrum concepts; simple inelastic structural systems; and introduction to systems with distributed mass and flexibility. Prerequisite:

Geographic Information Systems and Science. Investigation of geographic information systems (GIS) and science (GIScience) including theory and applications areas. A major portion of the course will be based on use of a current widely-used GIS computer software system. Aspects of geographic data entry and editing, spatial analysis, and map development and display will be considered. Relationship of GIS to the Global Positioning System (GPS) and satellite generated data will be addressed.

Prerequisite:

Civil Engineering Design-II. Innovation and creativity in conceptual design; sustainability; health and safety; investigative procedures. The use of analysis, synthesis and optimization in design; project planning, networks and graphs. Design of embankments, dams; drainage design; route location and alignment design of roads; assessment of natural hazard impacts and environmental impacts.

Prerequisite:

Public Transportation Systems: Public Transport: Definitions, modes of public transport and comparison, public transport travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, basic operating elements; Transit Network Planning: Planning Objectives, principles, considerations, transit lines – types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations; Transit Scheduling: Components of scheduling process, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling;Transit Agency and Economics: Organizational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure; Design of Facilities: Design of bus stops, design of terminals – principles of good layout, types of layout, depot location, twin depot concept, crew facilities and amenities.

Prerequisite:

Traffic Engineering and Management: Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection; Design Hourly Volume For Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept;Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections. Problems in Mixed Traffic flow; Case studies; Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions; Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects Of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies. Formulation of system models.
Prerequisite:

Foundation Engineering. Analysis and design of foundations, types of foundations, bearing capacity and settlement of foundations; ground movements due to construction; analysis and design of excavations, retaining walls, cuts & excavations and sheet piles, slopes and underground structures.

Prerequisite:

Reference books:

- A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.
- After successful completion of this course, the students would:
- Learn about types and purposes of different foundation systems and structures.
- Have an exposure to the systematic methods for designing foundations.
- Be able evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behaviour.
- Have necessary theoretical background for design and construction of foundation systems.

Structural Analysis by Matrix Methods. Analysis of truss and frame structures using flexibility and stiffness methods of matrix analysis; computer applications. Prerequisite:

Structural Mechanics. Beams under lateral load and thrust; beams on elastic foundations; virtual work and energy principles; principles of solid mechanics, stress and strain in three dimensions; static stability theory; torsion; computational methods. Prerequisite:

Reinforced Concrete. Study of the strength, behavior, and design of reinforced concrete members subjected to moments, shear, and axial forces; extensive discussion of the influence of the material properties on behavior.

Prerequisite:

Structural Analysis-II. Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Application to simple problems of beams and frames; Flexibility matrix method; Application to simple problems of beams and frames; Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.

Prerequisite:

Decision and Risk Analysis. Development of modern statistical decision theory and risk analysis, and application of these concepts in civil engineering design and decision making; Bayesian statistical decision theory, decision tree, utility concepts, and multi-objective decision problems; modeling and analysis of uncertainties, practical risk evaluation, and formulation of risk-based design criteria, risk benefit trade-offs, and optimal decisions. Prerequisite:

Design of Concrete Structures-I. Study of the strength, behavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method, Rectangular and T-sections, Beams with reinforcement in compression, One-way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept, Development length of bars; Design of sections in torsion. Design of two-way slabs; Design of flat slab – direct method; Circular slab; Slab type staircase, Placement of reinforcement in slabs; Voided slab. Design of compression members, Short column, Columns with uniaxial and bi-axial bending; Long columns, use of design charts. Design of foundation; Wall footing, Isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable Prerequisite:

Environmental Fluid Mechanics. Incompressible fluid mechanics with particular emphasis on topics in analysis and applications in civil engineering areas; primary topics include principles of continuity, momentum and energy, kinematics of flow and stream functions, potential flow, laminar motion, turbulence, and boundary-layer theory. Prerequisite:

Unsteady Open Channel Flow: This course should discuss how to analyze for unsteady flows in open channels; Derivation of 1-D and 2-D shallow water flow equations; Consideration for non-hydrostatic pressure distribution; Basics of numerical methods: FiniteDifference and Finite Element Methods; Latest shock capturing Finite Volume methods for solving 1-D and 2-D shallow water flow equations; Dambreak flow; Flood routing in large channel networks, Flood routing in compound channels; Flood routing in channels with flood plains, Surface irrigation flow modeling

Pre-Requisite: Basic course in Hydraulic Engineering

Environmental Laws and Policy. Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment. International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

Rock Mechanics. Determination of physical properties of rocks, failure criterion, rock mass classification, stress around mine openings, strain and displacement of the rock mass, rock reinforcement and support, subsidence.

Prerequisite:

Reference books:

- Engineering Rock Mechanics: An Introduction to the Principles by J. A. Hudson and
- J. P. Harrison
- Rock Mechanics: For Underground Mining by Barry H.G. Brady Fundamentals of Rock Mechanics, 4th Edition, John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman

- On successful completion of this course the students will be able to:
- Define the properties (viz., physical, mechanical) of rocks and failure criterion of rock mass.
- Use engineering rock mass classification (RMR, Q-system, RQD)
- Analyse the stress distribution insitu and around an opening in underground structures (viz., mine openings, tunnels).
- Determine the relation between strain and displacement components of rockmass.
- Perform field Instrumentation techniques and laboratory studies. Understand the fundamentals of ground subsidence.

Earthquake Engineering. Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation - Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral; Multiple Degree of Freedom System; 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); Elements of Seismology; Causes of Earthquake - Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes; Response of Structures to Earthquake;Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes - Base

isolation techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures Prerequisite:

Transients in Closed Conduits: This course should cover key issues for understanding the unsteady flow in pipes (water hammer) and designing for surge protection**;** Differential equations for unsteady pipe flow; Characteristic method for solution; Formulation of boundary conditions; transients in pumping mains (power failure; pump start up); transients in penstocks of hydro-electric schemes; analysis for transient control using surge tanks; air chambers; air valves; pressure regulating valves etc.; Emphasis should be on development of computer programs for transient analysis; awareness about commercially available software for transient analysis

Pre-Requisite: Basic course in Hydraulic Engineering

Urban Hydrology and Hydraulics. Hydraulic analysis and design of urban, highway, airport, and small rural watershed drainage problems; discussion of overland and drainage channel flows; hydraulics of storm-drain systems and culverts; determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts.

Prerequisite:

Course Code	Paper Title	L	T	P	Credits	TH/ PR	ESE	IA
1018xx	Open Elective- II	3	0	0	3	TH	70	30
1018xx	Program Elective- IV	3	0	0	3	TH	70	30
1018xx	Program Elective- V	3	0	0	3	TH	70	30
1018xx	Program Elective- VI	3	0	0	3	TH	70	30
100801	Project-II	0	0	12	6	PR	30	20

Civil Engineering

Open Elective

101839	Metro Systems and Engineering	3L:0T:0P	3 credits

GENERAL: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

CIVIL ENGINEERING-Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

ELECTRONICS AND COMMUNICATION ENGINEERING- Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

MECHANICAL & TV + AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

ELECTRICAL: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

101838	**Economic Policies in India**	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 10 hrs.**

Framework of Indian Economy: National Income - Trends and Structure of National Income, Demographic Features and Indicators of Economic Growth, Development Rural-Urban Migration and issues related to Urbanization, Poverty debate and Inequality, Nature, Policy and Implications, Unemployment-Nature, Central and State Government's policies, policy implications, Employment trends in Organized and Unorganized Sector

Module 2 **Lecture 10 hrs.**

Development Strategies in India: Agricultural- Pricing, Marketing and Financing of Primary Sector, Economic Reforms- Rationale of Economic Reforms, Liberalization, Privatization and Globalization of the Economy, Changing structure of India's Foreign Trade, Role of Public Sector- Redefining the role of Public Sector, Government Policy towards Public Sector, problems associated with Privatization, issues regarding Deregulation-Disinvestment and future of Economic Reforms

Module 3 **Lecture 10 hrs.**

The Economic Policy and Infrastructure Development: Energy and Transport, Social Infrastructure- Education, Health and Gender related issues, Social Inclusion, Issues and policies in Financing Infrastructure Development, Indian Financial System- issues of Financial Inclusion, Financial Sector Reforms-review of Monetary Policy of R.B.I. Capital Market in India.

Module 4 **Lecture 10 hrs.**

The Economic Policy and Industrial Sector: Industrial Sector in Pre-reforms period, Growth and Pattern of Industrialization, Industrial Sector in Post-reform period- growth and pattern of Micro, Small, Medium Enterprises s, problems of India's Industrial Exports, Labor Market- issues in Labor Market Reforms and approaches to Employment Generation.

Text Books

1. Dhingra, Ishwar C. [2006],'Indian Economy,' Sultan Chand and Sons, New Delhi.
2. Datt, Ruddar and Sundaram, K.P.M. [Latest edition] ,'Indian Economy,' S. Chand and Co, New Delhi.

Reference Books

1. Brahmananda, P.R. and V.A. Panchmukhi. [2001], Ed. 'Development Experience in Indian Economy, Inter-state Perspective,' Bookwell, New Delhi.

2. Gupta,S.P. [1989],'Planning and Development in India: A Critique,' Allied Publishers Private Limited, New Delhi.

3. Bhagwati, Jagdish. [2004],'In Defense of Globalization,' Oxford University Press, U.K.

Urban Transportation Planning: Urban morphology - Urbanization and travel demand – Urban activity systems and travel patterns – Systems approach – Trip based and Activity based

approach - Urban Transportation Planning – Goals, Objectives and Constraints - Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning - UTP survey; Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models – Growth factor models, Gravity model and Opportunity modes; Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models - Utility functions - Logit models - Two stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior; Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems; Preparation of alternative plans - Evaluation techniques - Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

Prerequisite:

Geometric Design of Highways: Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors; Design Elements: Sight distances, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems; Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness; Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design Of Intersections: Characteristics and design considerations of at-grade intersections;; Rotary intersections; Grade separations and interchanges -; Design of Parking lots
Prerequisite:

Contracts Management. Contract Management – Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts, Parties to a Contract; Contract

Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods. Various Acts governing Contracts; Contract Administration and Payments- Contract Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods- Design, Supply and Installation Contracts, Contract Management in Consultancy,; Managing

Risks and Change- Managing Risks, Managing Change; Contract Closure and Review- Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management-

Contract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement

Physico-Chemical Processes for water and wastewater treatment. The Objective of this course is to provide an in depth understanding of physical and physico-chemical processes used for water and wastewater treatment systems and to provide capability to design such systems. Water purification in natural systems, physical processes, chemical processes and biological processes. Primary, secondary and tertiary treatment. Unit operations, unit processes. Aeration and gas transfer**.** Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects. Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters, mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, precoat filtration, design aspects. Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal; Adsorption, adsorption equilibria and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption. Ion Exchange-exchange processes, materials and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodyalisis

River Engineering: Knowledge about river behavior is essential for practicing hydraulic and water resources engineers. River Morphology (Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations etc.); Sediment Transport Mechanics (Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Sediment Transport Equations); Aggradation and Degradation; Local Scour at Bridge Piers and other Hydraulic Structures. Measurements in

Rivers (Stage measurements, Channel geometry, Discharge, Sediment samplers and suspended and bed load measurement), Physical river Models (fixed and movable bed models; sectional models, distorted Models), Mathematical models for aggradations, degradation and local scour, River Protection and Training Works (Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures), Design of river training and flood protection structures, Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration

Water Resources Field Methods. Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies. Planning field studies; instruments and protocols for surface-water, ground-water, and water-quality sampling; description of data quality. One-half-day laboratory field trips to streamflow monitoring stations and groundwater monitoring wells nearby.

Prerequisite:

Design of Concrete Structures-II. Design of continuous beams and building frames, Moment redistribution, Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, Detailing for earthquake resistant construction – ductility criteria; Water tank and staging; Introduction, Design criteria, Design of rectangular and circular water tank, Design of

Intze tank, Staging for overhead tank; Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert; Design of Masonry walls and columns; Prestressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders, Design of end block; Design of staircases; Design of cantilever and counterforte type retaining wall; All design steps/process to as per the most recent BIS code of practices Prerequisite:

Prestressed Concrete. Study of strength, behavior, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretensioned, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing.

Prerequisite:

Geotechnical Design. Subsurface site evaluation; integrated design of retaining walls, foundations, pavements, and materials for airports, highways, dams, or other facilities.Prerequisite:

Reference books:

- Analysis and Design of Substructures: Limit State Design by Swami Saran

Upon completion of the course, the student would be:

- Well acquainted with the various investigation specifications as per the infrastructure to be build on the proposed site.
- knowing about the properties of materials required for the constructing a desired infrastructure

familiar with design concepts of various foundation systems familiar with design of transportation facilities

Systems Engineering & Economics: Introduction to the formulation and solution of civil engineering problems. Major topics are: engineering economy, mathematical modeling, and optimization. Techniques, including classical optimization, linear and nonlinear programming, network theory, critical path methods, simulation, decision theory, and dynamic programming are applied to a variety of civil engineering problems. Prerequisite:

Intelligent Transportation Systems: Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS); ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Pavement Materials. Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements. Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders. Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests, Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. bituminous mix design methods and specifications. Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications; Superpave mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials. Prerequisite:

Basics of Computational Hydraulics. Derivation of governing equations for flow and transport in surface and sub-surface (saturated and unsaturated flow); Equations for reactive transport; Coupled surface and sub-surface flow models; Basics of finite difference, finite element and finite volume methods (consistency, stability, convergence, order of accuracy, computational efficiency); application of numerical methods for solving flow and transport equations, fully coupled and iteratively coupled models; Model simplification, Parameter estimation (Model calibration and validation), Computational Fluid Dynamics (CFD) software for three-dimensional turbulent flow modeling, Software for sub-surface flow simulation

Port and Harbour Engineering: Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile; Port facilities: Port

development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

Prerequisite:

Railway Engineering. Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers; ballast; subgrade and formation, rack fittings and fastenings, creep of rails, geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards; railway tunneling; signaling and interlocking; maintenance of railways and high speed trains.
Prerequisite:

Structural Geology. Description, classification, and origin of earth structures. Ways in which the continental crust can deform; link scales of structure from the field, outcrops, hand specimen, thin section by integrating analytical techniques with practical examples. Theoretical and meso to microscale analysis of structures developed through a linked series of lectures and practicals; practical 2D strain analysis; 3D strain concepts; incremental strain, kinematics and polyphase deformations; fold construction and classes; fault evolution and section balancing; fault rock microstructures; fault and fold mechanics, current concepts in plate tectonics, cross-section construction techniques, structural interpretation of seismic data, structural styles in different tectonic settings (thrust and fold belts, rifts, strike and slip, gravity tectonics, inversion), structural geology of reservoir units.

Prerequisite:

Reference books:

- Ghosh, S.K., Structural Geology: Fundamentals and Modern Developments, Elsevier; First edition

On successful completion of this course the students will be able to:

- Acquire knowledge on the geometry and type of structures present in earth.
- Understand and describe the features formed in rocks when subjected to stress.
- Understand the impact of structural geology to active tectonic settings
- Understand micro and macro scale deformation mechanisms (viz., brittle, ductile).

- Portray 2D and 3D strain analysis for various deformation behaviours.
- Interpret graphs and models used in structural geology to understand and demonstrate poly phase deformations.

Design of Steel Structures. Properties of materials; loads and stresses, Design of semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member, Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders; Introduction to Plastic analysis; Simple cases of beams and frames; All design steps/process to as per the most recent BIS code of practices Prerequisite:

Civil Engineering Design-I. Concept of design and its contribution to the quality of life; Civil Engineering Design, the role of geomatics, the environment, and scientific laws in design; Introduction to the design of buildings and Civil Engineering Infrastructure, site appraisal; Risk and vulnerability in design; Health and safety in Civil Engineering Design, environmental impact assessment; Civil Engineering drawing, CAD techniques, introduction to GIS techniques.

Prerequisite:

Hydraulic Modeling: The main objective of this course is to introduce various concepts which will help in designing physical hydraulic models. Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results); Role of instrumentation and data processing; Gravity dominated models (modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations); Gravity friction models: (pumped flow models, ship models, surge tank models); Friction dominated models; River models with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures; Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modelling.

Biological processes for contaminant removal. Understanding of basics of microbiology, metabolism and energetic, bio kinetic parameter, reactors and reactor analyses. Characterization

of waste. Aerobic, anaerobic and anoxic systems. Suspended and attached growth biological systems. Activated Sludge processand process modifications, Process design considerations, Treatment Ponds and aerated Lagoons, aerobic pond, facultative pond, anaerobic ponds, polishing ponds, constructed wet lands etc. Attached Growth Biological Treatment Systems, Trickling Filters, Rotating Biological Contactors, Activated Biofilters, Moving bed biological reactor (MBBR), Sequential Batch reactors (SBR), Membrane Biological Reactors (MBR) etc. Anaerobic processes, Process fundamentals, Standard, high rate and hybrid reactors, Anaerobic filters, Expanded /fluidized bed reactors, Upflow anaerobic sludge blanket reactors, Performance and design aspects, Expanded granular bed reactors, Two stage/phase anaerobic reactors. Sludge Digestion, anaerobic digestion, aerobic digestion

Rural water supply and onsite sanitation systems. Attributes of water supply systems, drinking water quality. Relationships between diseases and water quality, hygiene and sanitation. Need for water treatment. Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron.Onsite sanitation systems: Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets. Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.

Sustainable Construction Methods. Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls); Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity. Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam. Prerequisite:

Construction Engineering Materials. Design, production, application, specification, and quality control of construction materials unique to civil engineering. Stones, bricks, mortars, Plain, Reinforced &Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile

Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes Prerequisite:

Solid and hazardous waste management. Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal. Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

Bridge Engineering. General; classification of bridges, site selection, geometric and hydraulic design consideration, loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, extrados bridges; arch bridge; Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats; seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance; Prerequisite:

Design of Structural Systems. The whole structural design process including definition of functional requirements, selection of structural scheme, formulation of design criteria, preliminary and computer- aided proportioning, and analysis of response, cost, and value. Prerequisite:

Offshore Engineering. Introduction to offshore structures, codes of practice, offshore project management, deep water, offshore site investigations, geophysical methods; offshore sediment sampling, in-situ testing, geological aspects; development of design stratigraphies. Prerequisite:

Industrial Structures. Industrial steel building frames: Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents, Pressed steel tank, circular tank; Transmission and Communication towers: Types and configuration, Analysis and design; Chimneys; Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and temperature, temperature. Design of chimney; Silos and Bunkers; Jassen's theory, Airy's theory, Shallow and deep bins, Rectangular bunkers with slopping bottom, Rectangular bunkers with high side walls; Steel stacks; introduction, force acting on a steel stack, design consideration, design example of stacks; Concrete Shell Structures: Folded plate and cylindrical shell structures; Introduction, structural behaviour of long and short shells, beam and arch action, analysis and design of cylindrical shell structures, Analysis and design of folded plates; Machine foundations; introduction, machine vibration, structural design of foundation to rotary machines, impact machines, vibration characteristics, design consideration of foundation to impact machine, grillage, pile and raft foundation. Prerequisite:

Construction Cost Analysis. Introduction to the application of scientific principles to costs and estimates of costs in construction engineering; concepts and statistical measurements of the factors involved in direct costs, general overhead costs, cost markups and profits; and the fundamentals of cost recording for construction cost accounts and cost controls