TKR COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)
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B.TECH – MECHANICAL ENGINEERING
Course Structure R-20

SEMESTER I

S.No.	Class	Course Code	Name of the Subject	L	T	P	C
1	BS	CBSM7	Linear Algebra & Applied Calculus	3	1	0	4
2	BS	CBSP3	Engineering Physics	3	1	0	4
3	ES	CESCP1	C Programming for Problem Solving	3	0	0	3
4	ES	CESEG1	Engineering Graphics	1	0	4	3
5	BS	CBSP4	Engineering Physics Lab	0	0	3	1.5
6	ES	CESCP2	C Programming for Problem Solving Lab	0	0	3	1.5
7	ES	CESFL	Fuels & Lubricants Lab	0	0	4	2
8	MC	MC001	Sports	0	0	0	Satisfactory
			Total Credits				19

Mandatory Course: SPORTS

The Students need to participate in any physical activity such as sports, marathon, conducted by any college or any organization, students should produce participation certificate for clearing this course.

SEMESTER II

S.No.	Class	Course Code	Name of the Subject	L	T	P	C
1	BS	CBSM16	Differential Equations & Vector Calculus	3	1	0	4
2	BS	CBSC3	Engineering Chemistry	3	1	0	4
3	ES	CESEM1	Engineering Mechanics	3	1	0	4
4	HS	CHSE1	English	2	0	0	2
5	ES	CESEW2	Engineering Workshop	1	0	3	2.5
6	BS	CBSC4	Engineering Chemistry Lab	0	0	3	1.5
7	HS	CHSE2	English Language & Communication Skills Lab	0	0	2	1
8	MC	MC002	Yoga	0	0	0	Satisfactory
			Total Credit				19

Mandatory Course: YOGA

The student should undergo yoga meditation course offered by any organization or conducted by any college. Student should produce the completion certificate for clearing this course.

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MECHANICAL ENGINEERING

B.Tech I Semester **L/T/P/C**
3 /1/ 0/ 4

LINEAR ALGEBRA & APPLIED CALCULUS (CBSM7)

Course Objectives:

To learn:
1. Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
2. Concept of Eigen values and Eigen vectors and to reduce the quadratic form to canonical form.
3. Evaluation of double integrals.
4. Geometrical approach to the mean value theorems and their application to the mathematical problems and evaluation of improper integrals using Beta and Gamma functions.
5. Partial differentiation, concept of total derivative and finding maxima and minima of function of two and three variables.

Course Outcomes:

After learning the contents of this paper the student must be able to
CO1: Discuss the matrix representation of a set of linear equations and to analyse the solution of the system of equations.
CO2: Reduce the quadratic form to canonical form using orthogonal transformations.
CO3: Demonstrate problem Solving for applications of multiple Integrals in solving engineering Problems.
CO4: Evaluating double integrals and applying them to compute the areas of regions.
CO5: Evaluate the extreme values of functions of two variables with/ with out constraints.
CO6: Solve the applications on the mean value theorems and Evaluation of improper integrals using Beta and Gamma function.

UNIT I
Matrices & System of Equations

Types of matrices **-** rank of a matrix by Echelon form and normal form- inverse of nonsingular matrices by Gauss-Jordan method - system of linear equations- solving system of homogeneous and non homogeneous equations- Gauss elimination method.

UNIT II
Eigen Values and Eigen Vectors

Eigen values and Eigen vectors and their properties - Cayley-Hamilton theorem(without proof)finding inverse and powers of a matrix by Cayley -Hamilton theorem- diagonalization of a matrix – linear transformation and orthogonal transformation - quadratic forms and nature of the quadratic forms- reduction of quadratic form to Canonical forms by orthogonal transformation.

UNIT III
Double Integrals and Applications

Evaluation of double Integrals (Cartesian and polar coordinates) - change of order of integration (only Cartesian form)- change of variables (Cartesian to polar) for double integrals-applications of double integrals to evaluate surface areas of curves (only in Cartesian Coordinates).

UNIT IV
Calculus

Mean value theorems-Roll's Theorem-Lagrange's mean value theorem with their geometrical interpretation and applications-Cauchy's mean value Theorem-Taylor's Series definition of improper integral: Beta and Gamma functions and their applications.

UNIT V
Multivariable Calculus (Partial Differentiation and Applications)

Partial Differentiation- Euler's theorem-total derivative-Jacobian-functional dependence and independence-maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

Text Books:

1. B.S.Grewal- Higher Engineering Mathematics- Khanna Publishers- 36th Edition-2010
2. Higher Engineering Mathematics by B V Ramana-Tata McGraw-Hill-2010

Reference Books:

1. N.P. Bali and Manish Goyal- A text book of engineering Mathematics- Laxmi Publications-Reprint-2008.
2. Advanced Engineering Mathematics by S.R.K. Iyengar R.K. Jain – Narosa Publications.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C
3/ 1/ 0/ 4**

ENGINEERING PHYSICS (CBSP3)

Course Objectives:

The objectives of this course
1. To study the differential equations of transverse and longitudinal waves on string
2. To understand the phenomena's exhibited by light and its applications
3. To understand fundamental phenomena involved in working of lasers and Fiber optics

Course Outcomes:

On completion of the course student will able to
1. Learn about transverse and longitudinal wave equation on strings.
2. Realise the applications of interference, diffraction and polarization phenomena.
3. Know the working of different types of lasers and fiber optic cables.

Unit I
Waves and Harmonic Oscillations

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, heavy, critical and light damping, energy decay in a damped harmonic oscialltor. Quality factor, mechanical and electrical oscillators, mechanical and electrical impedance, steady state motion of forced damped harmonic oscillator.

Unit II
Waves in One Dimension

Transverse wave equation on a string, the wave equation on a string, reflection and transmission of waves at a boundary, impedance matching, longitudinal wave equation, acoustics waves, standing sound waves, transmission of sound and transmission loss, Sabines formula and absorption coefficient.

Unit III
Interference of Waves

Huygens'principle, superposition of waves, interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Unit IV
Diffraction

Phenomena of diffraction**,** types of diffraction, Farunhofer diffraction at a single slit, diffraction grating and resolving power of a grating, circular aperture, Rayleigh criterion. Diffraction of X-Rays with crystal planes, Bragg's law, Laue and Powder method.

Unit V
Laser and Fiber Optics

Lasers: Interaction of radiation with matter, Einstein's coefficients; population inversion, Properties of lasers, different types of lasers: He-Ne, ruby laser.

Fibre Optics: Introduction, total internal reflection, acceptance angle- Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, applications of optical fibres.

Text Books:

1. I.G.Main,"Vibrations and waves in physics", CambridgeUniversityPress,1993.
2. H.J.Pain,"The physics of vibrations and waves",Wiley,2006.
3. E.Hecht,"Optics",PearsonEducation,2008.

Reference Books:

1. A.Ghatak,"Optics",McGraw Hill Education, 2012.
2. O.Svelto,"Principles of Lasers",SpringerScience&BusinessMedia,2010.
3. S.L Gupta& D.L. Gupta, Unified physics.
4. Fundamentals of Acoustics, Kinter & Frey, John Willey & Sons.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C**
                                                                                            3/0/0/3

C PROGRAMMING FOR PROBLEM SOLVING (CESCP1)

Course Objective:

The course is designed to provide complete **knowledge** of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes:

Upon completion of course the student will be able to

1. Demonstrate the basic knowledge of computer hardware and software.
2. Write algorithms for solving problems.
3. Draw flow charts for solving problems.
4. Code a given logic in C programming language.
5. Gain knowledge in using C language for solving problems.

UNIT I
Introduction to Computers Data Representation

Number Systems, Computer Languages, Algorithms. Introduction to C Language: Data types, Operators, Expressions, Statements-Selection Statements – if and Switch Statements, Repetition (Loop) statements.

UNIT II
Arrays

One and two dimensional arrays, multidimensional arrays, inter function communication Arrays applications- linear search, binary search, bubble sort, Implementation of stacks and queues.
Functions: Scope and Extent, storage classes, recursive functions

UNIT III
Pointers

Introduction, Pointers for inter function communication, arrays of pointers, pointer arithmetic and arrays, passing an array to a function, memory allocation functions, pointers to functions, pointers to pointers.
Strings: Concepts, String Input/ Output functions, arrays of strings, string manipulation functions.

UNIT IV
User Defined Data Types Structure and Unions

Initialization, accessing structures, operations on structures. Complex structures-Nested structures, structures containing arrays, structures containing pointers, arrays of structures, structures and functions, Passing structures through pointers, self-referential structures, unions, bit fields, C programming examples, command–line arguments, pre-processor commands.

UNIT V
Input and Output

Concept of a file, streams, text files and binary files, file input/output functions (standard library input/output functions for files), error handling, positioning functions (fseek, rewind and ftell).

Text Books:

1. Computer Science: A Structured Programming Approach Using C, B. A. Forouzan and R. F. Gilberg,Third Edition, Cengage Learning.
2. Programming in C. P. Dey and M Ghosh, Second Edition, Oxford University Press.

Reference Books:

1. The C Programming Language, B.W. Kernighan and Dennis M. Ritchie, Second Edition, Pearson education.
2. Programming with C, B. Gottfried, 3rd edition, Schaum's outlines, McGraw Hill Education (India) Pvt Ltd.
3. C From Theory to Practice, G S. Tselikis and N D. Tselikas, CRC Press.
4. Basic computation and Programming with C, Subrata Saha and S. Mukherjee, Cambridge University Press.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C**
                                                                        1/ 0/ 4/ 3
ENGINEERING GRAPHICS (CESEG1)

Course Objectives:

This subject aims to
1. The student will be able to understand importance of dimensioning in large scale drawings used as design initiation in manufacturing and will be able to understand the significance of different kinds of pencils used for drawing different types of lines.
2. The subject will ensure the student to learn basics of drawing like conics, scales etc.
3. The student will be able to understand in detail about the coordinate system the topics to be able to locate the points in all the 4 quadrants.
4. The student will be introduced to topics like lines, planes and solids and their position w.r.t. HP and VP in simple position, inclined to one and both reference planes.
5. The student will also be introduced to topics like development of surfaces, perspective views, Isometric projections, orthographic projections.

Course Outcomes:

(Upon completion of the course the graduate will be able
1. To draw lines, curves and show dimensions as per BIS standards.
2. For a given four quadrant system, able to find the position of an object in any one of the four quadrants with respect to observer, object and the reference planes and to construct the projections for points, lines and planes.
3. To prepare sectional views of a 3D object for understanding internal construction details.
4. To develop 3D Solids and able to visualize the object in simple and in section.
5. To construct Top View, Front View and Side View for a given three-dimensional object.

UNIT I
Introduction to Engineering Drawing

Principles of Engineering Graphics and their Significance, Usage of Instruments, Conic Sections- (Ellipse, Parabola, Hyperbola and Rectangular Hyperbola) General method only. Cycloid, Epicycloid and Hypocycloid Involutes.

UNIT II
Orthographic Projections

Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both principal planes.

Projections of Planes: Projections of Plane regular geometric figures inclined One and to both principal planes, Regular planes such as square, rectangle, Rhombus, triangle, pentagon, Hexagon, Circle, Semi circle.

Unit III
Projections of Regular Solids
Projections of Regular Solids axis parallel, perpendicular and inclined to reference Planes. The regular solids are prisms, pyramids, Cone and cylinder.

UNIT IV
Section of Solids

Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views
Development of Surfaces: Development of Surfaces of Right Regular Solids – Prisms, Pyramid, Cylinder and Cone.

UNIT V
Isometric Projections

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Plane Figures, Simple & Compound solids- Conversion of Isometric Views to Orthographic Views and Vice-versa.

Text Books:

1. Engineering Drawing / Basant Agrawal and Mc Agrawal/ Mc Graw Hill.
2. Engineering Drawing: Gopala Krishna, Subhas Stores.

Reference Books:

1. Engineering Drawing / N.S. Parthasarathy and Vela Murali/ Oxford.
2. Engineering Drawing N.D. Bhatt / Charotar.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C**
                                                                             0 /0/3/1.5

ENGINEERING PHYSICS LAB (CBSP4)

Course Objectives:

The objectives of this course,

1. To apply the theoretical knowledge of Physics on the experimental instruments.
2. To improve the experimental knowledge in the later studies.
3. To understand the basic need of experiments.
4. To know how to measure the different physical quantities.
5. To acquire ability to use instrumentation techniques.
6. To train the students to develop techniques based on the physics principles related to various devices or components.

Course Outcomes:

On completion of the course student will able to

1. Compare the theory and correlate with experiments.
2. Design and Analyze experiments and result.
3. Apply appropriate techniques to perform the experiments.
4. Understand the physics behind various mechanical waves.
5. Understand the interaction of ordinary and the laser light to study the interference and diffraction properties.

List of Experiments:

All the experiments are compulsory

1. Melde's experiment-Determine the frequency of a vibrating bar or tuning fork using Melde's apparatus.
2. Coupled Oscillator- Determination of coupling constant of a coupled oscillator.
3. Compound pendulum- Determination of acceleration due to gravity.
4. LCR circuit – determination of resonance frequency and quality factor.
5. Newton rings – Determination of radius of curvature of plano-convex lens.
6. Diffraction grating- Determination of number of lines per inch of the grating.
7. Laser Source –Determination of the wavelength of laser diode using diffraction grating.
8. Fiber optics –Determination of bending losses in optical fibers and to determine the Numerical Aperture of a given fiber.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C**
                                                            0/0/3/1.5

C PROGRAMMING FOR PROBLEM SOLVING LAB (CESCP2)

Laboratory Objective:

To write programs in C using structured programming approach to solve the problems.

Laboratory Outcomes:

1. Ability to design and test programs to solve mathematical and scientific problems.
2. Ability to write structured programs using control structures and functions.

Experiments:
1. a) Write a C program to find the factorial of a positive integer.
    b) Write a C program to find the roots of a quadratic equation.
2. a) Write a C program to determine if the given number is a prime number or not.
    b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
3. a) Write a C program to construct a pyramid of numbers.
    b) Write a C program to calculate the following
    Sum: Sum=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
4. a) The Least Common Multiple (LCM) of two positive integers a & b is the smallest integer that is evenly divisible by both a and b. Write a C program that reads two integers and calls GCD (a, b) function that takes two integer arguments and returns their LCM. The lcm (a, b) function should calculate the least common multiple by calling the GCD (a,b) function and using the following relation: LCM (a,b) = ab / GCD (a,b)
    b) Write a C program that reads two integers n and r to compute the ncr value using the following relation: ncr (n,r) = n! / r! (n-r)! . Use a function for computing the factorial value of an integer.
5. a) Write C program that reads two integers x and n and calls a recursive function to compute xn.
    b) Write a C program that uses a recursive function to solve the Towers of Hanoi problem.
    c) Write a C program that reads two integers and calls a recursive function to compute ncr value.
6. a) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user using Sieve of Eratosthenes algorithm.
    b) Write a C program that uses non recursive function to search for a Key value in a given list of integers. Use linear search method.
7. a) Write a menu-driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
    b) Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers. Use binary search method.
8. a) Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.
    b) Write a C program that reads two matrices and uses functions to perform the following:
    i) Addition of two matrices
    ii) Multiplication of two matrices

9.   a) Write a C program that uses functions to perform the following operations:
        i) to insert a sub-string into a given main string from a given position.
        ii) to delete n characters from a given position in a given string
         b) Write a C program that uses a non-recursive function to determine if the given string is a palindrome or not.

10.   a) Write a C program to replace a substring with another in a given line of text.
         b) Write a C program that reads 15 names each of up to 30 characters, stores them in an array, and uses an array of pointers to display them in ascending (ie. alphabetical) order.

11.   a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.
        b) Write a C program to convert a positive integer to a roman numeral. Ex. 11 is converted to XI.

12.   a) Write a C program to display the contents of a file to standard output device.
        b) Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.

13.   a) Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command-line arguments.
        b) Write a C program to compare two files, printing the first line where they differ.

14.   a) Write a C program to change the nth character (byte) in a text file. Use fseek function.
        b) Write a C program to reverse the first n characters in a file. The file name and n are specified on the command line. Use f seek function.

15.   a) Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).
         b) Define a macro that finds the maximum of two numbers. Write a C program that uses the macro and prints the maximum of two numbers.

16.   a) Write a C Program to calculate the sum of n numbers entered by the user using malloc( ) and free() functions.
        b) Write a C Program to calculate the sum of n numbers entered by the user using calloc( ) and free() functions.

Text Books:

1. Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publishers.
2. Computer Programming using C in C, V. Rajaraman, PHI.
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
4. C++: The complete reference, H. Schildt, TMH Publishers.

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MECHANICAL ENGINEERING

B.Tech I Semester   **L/T/P/C**
                                                                     0/0/ 4/ 2

FUELS AND LUBRICANTS LAB (CESFL)

Course Objectives:

1. To develop an idea of fuel properties and their variation with temperature.
2. Determine kinematic viscosity and calorific values of fuel.
3. Understanding the ignition process of fuel.
4. Determine the properties of several fuels & Lubricants.

Course Outcomes:

1. Understand the calorific values of solid and gaseous fuels.
2. Analyse the flash and fire points of liquid fuels.
3. Observe the carbon reside for fuels.
4. Compare the Depth of penetration for different lubricants.

List of Experiments:

1. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Abels Apparatus
2. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Pensky Martens Apparatus
3. Carbon residue test: Liquid fuels.
4. Determination of Viscosity of Liquid lubricants and Fuels using: Saybolt   Viscometer
5. Determination of Viscosity of Liquid lubricants and Fuels using: Redwood Viscometer
6. Determination of Viscosity of Liquid lubricants and Fuels using: Engler   Viscometer
7. Determination of Calorific value: of Gaseous fuels using: Junkers Gas   Calorimeter.
8. Determination of Calorific value: Solid/Liquid/ fuels using: Bomb Calorimeter.
9. Drop point and Penetration Apparatus for Grease.
10. ASTM Distillation Test Apparatus.
11. Cloud and Pour point Apparatus.

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MECHANICAL ENGINEERING

B.Tech II Semester   L/T/P/C
                                                                                 3 /1/ 0/4

DIFFERENTIAL EQUATIONS & VECTOR CALCULUS (CBSM16)

Course Objectives:

To learn:
1. Methods of solving the differential equations of first and higher order.
2. Find general solution to linear, homogeneous and non homogeneous ODEs with constant coefficients.
3. Methods of solving linear and non-linear PDE.
4. The physical quantities involved in engineering field related to vector valued functions.
5. The basic properties of vector valued functions and their applications to line- surface and volume integrals.

Course Outcomes:

After learning the contents of this paper the student must be able to

CO1: Identify whether the given differential equation of first order is exact or not.
CO2: Solve higher differential equation and apply the concept of differential equation to real world problems.
CO3: Apply the methods to solve PDE of linear and non-linear.
CO4: Apply the knowledge to form PDE.
CO5: Compute derivatives of vector valued functions, gradient functions.
CO6: Evaluate the line- surface and volume integrals and converting them from one to another.

UNIT I
Ordinary Differential Equations of First Order and Applications

Exact- linear and Bernoulli's equations- Orthogonal Trajectories - Applications - Newton's law of Cooling- Law of natural growth and decay.

UNIT II
Second Order Ordinary Differential Equations

Second order linear differential equations with constant coefficients- Non-Homogeneous terms of the type e^{ax} - sin ax - cos ax- polynomials in x- $e^{ax}V(x)$ and $xV(x)$ - method of variation of parameters.

UNIT III
Partial Differential Equations

Introduction and formation of partial differential equations by elimination of arbitrary constants and arbitrary functions -solutions of first order linear (Lagrange) equations and non linear equations.

UNIT IV
Vector Differentiation

Vector point functions and scalar point functions- gradient- divergence and curl-directional derivatives-tangent plane and normal line-vector identities-Scalar potential functions-solenoidal and irrotational vectors.

UNIT V
Vector Integration

Line- surface and volume Integrals- theorems of Green- Gauss and Stokes (without proofs) and their applications.

Text Books:

1. B.S. Grewal- Higher Engineering Mathematics- Khanna Publishers- 36th Edition- 2010
2. Erwin Kreyszig- Advanced Engineering Mathematics- 9th Edition- John Wiley &   Sons- 2006

Reference Books:

1. Paras Ram- Engineering Mathematics- second Edition- CBS Publishes
2. S. L. Ross- Differential Equations- third Edition.- Wiley India- 1984.
3. R K Jain & S R K Iyengar - Advanced Engineering Mathematics -fifth Edition Narosa Publications.

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MECHANICAL ENGINEERING

B.Tech II Semester   **L/T/P/C**
                                                                                              3/ 1/ 0/4

ENGINEERING CHEMISTRY (CBSC3)

Course Objectives:

1. To make the students understand the basic concepts and skills in chemistry and thereby induce the concepts in engineering.
2. To orient the students in understanding the latest advancements in chemistry that are related to engineering field.
3. To inculcate the essence of atomic structure and water treatment methods in understanding the chemical bonding, material properties and importance of water purity for industrial and households.
4. To impart the basic knowledge electrochemistry and corrosion which are essential for the engineers and in industry.
5. To acquire the fuel and combustion their by estimating of calorific values of different fuels in realm.

Course Outcomes:

1. The course in overall gives the students deep understanding about materials and the chemical bonding in them. It further helps in understanding the properties of different materials which are important in engineering works.
2. The course helps in predicting the chemical reactions in different environmental conditions on engineering works.
3. The course enable the students to utilize the characterization techniques in determining the quality of material and the corrosion mechanism of engineering works.
4. The course helps in understanding the hardness and importance of water quality for engineering and day to day life.

Unit I
Molecular Structure and Theories of Bonding

Chemical bonding: Introduction to atomic and molecular orbitals. Linear combination of atomic orbital's (LCAO). Energy level diagram of homo-nucleus(N_2, O_2 and F_2) and hetro-nucleus(CO and HF). π-molecular orbital's of butadiene and benzene.

Crystal field theory (CFT): Salient features of CFT, crystal field splitting of transition metal ion d-orbital's in tetrahedral, octahedral and square planar geometries, calculation of crystal field splitting energy.

Bonding solids: Band structure of solids. The effect of doping on band structure in solids and electronic properties of materials.

Unit II
Water and its Treatment

Introduction: hardness of water; causes of hardness; types of hardness-temporary and permanent; units of hardness; estimation of hardness of water by complexometric method(EDTA).

Municipal water treatment: specifications of potable/municipal water; steps involved in treatment of municipal/potable water-disinfection of water by chlorination, ozonolysis and UV-treatment.

Boiler feed water treatment: Boiler troubles-scales, sledges and boiler corrosion; internal treatments of water for boiler feeding-calgon conditioning, phosphate conditioning and colloidal conditioning. External treatment of water-ion exchange process, desalination of water and reverse osmosis.

Unit III
Electrochemistry

Introduction: Electrolytic and electro chemical cells; electrode potential(E), standard electrode potential (E^o) and free energy(G & G^o); relation between free energy and electrode potential Nernst's equation to estimate the cell potential, Numerical problems.
Types of electrodes: Calomel, quinhydrone and glass electrode-determination of pH of a solution by using quinhydrone and glass electrode.
Electrochemical series and it's applications.
Batteries: primary (Lithium cell) and secondary batteries (Lead-acid storage battery and Lithium ion battery).
Fuel cells: H_2-O_2 and methanol-H_2 fuel cell and its applications.

Unit IV
Corrosion

Causes and effects of corrosion-theories of chemical and electrochemical corrosion-mechanism of electrochemical corrosion,
Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods-Catholic protection-Sacrificial anode and impressed current catholic methods. Surface coatings-metallic coatings-methods of application.

Unit V
Fuels & Combustion

Fuels: Classification soild fuels coal-analysis of coal-proximate and ultimate analysis and their significance.
Liquid fuels: petroleum and its refining-cracking-types-fixed bed catalytic cracking. Knocking-octane and cetane rating, synthetic petrol, Bergius and Fischer-Tropsch's process:

Gaseous fuels: constituents, characteristics and applications of natural gas, LPG and CNG. Analysis of flue gas by Orsat's apparatus-Numerical Problems.

Combustion: Definition, Calorific value of fuel-HCV, LCV; Determination of calorific value by Junker's gas calorimeter-theoretical calculation of Calorific value by Dulong's formula-Numerical problems on combustion.

Text Books:

1. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry by P. Rath, B. Ramadevi, Ch. V. R. Reddy & S. Chakroborty; Cengage publications.
3. Engineering Chemistry by M. Tirumal Chary, V. Laxminarayana & A. Shashikala; Pearson publications.

Reference Books:

1. Physical Chemistry, by P.W. Atkins.
2. Fundamentals of Molecular Spectroscopy, by C.N. Banwell.
3. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.

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MECHANICAL ENGINEERING

B. Tech. II Semester   **L/T/P/C**
                                                                                 3/1/0/4

ENGINEERING MECHANICS (CESEM1)

Course Objectives:

The objectives of this course are to
1. To explain the importance of mechanics in the context of engineering and conservation equations.
2. To introduce the techniques for analyzing the forces in the bodies.
3. To explain the significance of centroid, centre of gravity and moment of inertia.
4. To apply the different principles to study the motion of a body, and concept of relative velocity and acceleration and describe the trajectory of a particle under projectile motion.
5. To identify the basic elements of a mechanical system and write their constitutive equations.

Course Outcomes:

At the end of the course, students will be able to
1. Draw free body diagrams and determine the resultant of forces and/or moments.
2. Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
3. Determine the centroid and second moment of area of sections.
4. Analyze statically determinate planar frames. Analyze the motion and calculate trajectory characteristics.
5. Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

UNIT I
Introduction to Engineering Mechanics

Basic concepts, 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.

UNIT II
Friction

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack, ladder friction.
Centroid – Introduction-Centroid of Lines-Areas- centroid of I, T, L, Z-sections;
Centre of Gravity - Centre of Gravity of bodies- standard sections – Theorem of Pappus.

UNIT III
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.
Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of standard sections.

UNIT IV
Kinetics of Rigid Bodies

Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies.

UNIT V
Mechanical Vibration

Definitions Concepts- Simple Harmonic motion- free vibrations-simple compound pendulum.
Virtual Work: Theory of Virtual Work- Application.

Text Books:

1. Engineering Mechanics: R.K.Bansal, Laxmi publications.
2. Engineering Mechanics: S.S.Bavakatti, New age International.
3. Engineering Mechanics Statics & Dynamics: N.H. DUBEY   McGraw Hill International Edition.

Reference Books:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition, 1983.
2. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers", TMH, 2004.
3. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
4. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
5. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
6. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

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MECHANICAL ENGINEERING

B.Tech II Semester   **L/T/P/C**
                                                                                    2/ 0/ 0/ 2

ENGLISH (CHSE1)

Course Objectives:

1. Improve the language proficiency of students in English with an emphasis on Vocabulary (Identify different types of words), Grammar (the structure and form of the language), Reading and Writing skills.
2. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
3. Develop study skills and communication skills in formal and informal situations.

Course Outcomes:

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT I
'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes and root words.
Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading.
Basic Writing Skills: Sentence Structures - Use of Phrases and Clauses in Sentences-Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT II
Letter/Report writing

Vocabulary: Synonyms, Antonyms.
Grammar: Identify Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb agreement. Tenses, Active and Passive Voice, Direct and Indirect Speech
Reading: Improving Comprehension Skills – Techniques for Good Comprehension **Writing:** Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT III
"Blue Jeans" from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Degrees of Comparison, Simple, Compound and Complex sentences.
Reading: Sub-skills of Reading- Skimming and Scanning
Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places process/experiment and Events.

UNIT IV
'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English, Idioms and phrases, one word substitutes.
Grammar: Redundancies and Clichés in Oral and Written Communication. **Reading**:
Comprehension- Intensive Reading and Extensive Reading
Writing: Writing Practices--Writing Introduction and Conclusion -Précis Writing.

UNIT V
'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage **Grammar:**
Common Errors in English,
Reading: Reading Comprehension-Exercises for Practice
Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports
Formats Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Prescribed Textbook:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

References:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

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ENGINEERING WORKSHOP (CESEW2)

Course Objectives:

1. To Study different hand operated power tools, uses and their demonstration to gain basic working knowledge required for the production of engineering product.
2. To provide hands on experience about use of different engineering materials, tools, equipment and processes those are common in the engineering field.
3. To develop a right attitude, team working, precision and safety at work place.
4. It explains the construction, function, use and application of different working tools, equipment and machines and various welding and joining processes.
5. To have practical exposure, Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

Course Outcomes:
1. Ability to design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.
2. Ability to design and model various basic prototypes in the trade of fitting such as Straight and L fit.
3. Ability to make various basic prototypes in the trade of T in smithy such as rectangular tray, Scoop.
4. Ability to perform various basic House Wiring techniques such as connecting one lamp with one switch, connecting two lamps with one switch, Series wiring.
5. Ability to design and model various basic prototypes in the trade of Welding such as Lap joint, Butt joint.

TRADES FOR EXERCISES: At least two exercises from each trade:
1. Machine shop
2. Carpentry shop
3. Fitting shop
4. Electronic / Electrical Wiring
5. Electronics
6. Welding shop (Arc welding and Gas welding)
7. Casting
8. Black Smithy, Tin-Smithy and Development of jobs carried out and soldering
9. Plastic moulding
10. Gas Cutting

TRADES FOR DEMONSTRATION & EXPOSURE
- Plumbing, Metal Cutting (Power Hack saw machine), Metal Cutting (Water Plasma), Power tools in construction, Foundry.

Text Books:
1.Workshop Practice / B. L. Juneja / Cengage.
2.Workshop Manual / K. Venugopal / Anuradha.

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ENGINEERING CHEMISTRY LAB (CBSC4)

Course Objectives:
1. To make the students understand the basic concepts and skills in chemistry and thereby induce the concepts in engineering.
2. To orient the students in understanding the latest advancements in chemistry that are related to engineering field.
3. To inculcate the essence of atomic structure and water treatment methods in understanding the chemical bonding, material properties and importance of water purity for industrial and households.
4. To impart the basic knowledge electrochemistry and corrosion which are essential for the engineers and in industry.
5. To acquire the fuel and combustion their by estimating of calorific values of different fuels in realm.

Course Outcomes:
1. The course in overall gives the students deep understanding about materials and the chemical bonding in them. It further helps in understanding the properties of different materials which are important in engineering works.
2. The course helps in predicting the chemical reactions in different environmental conditions on engineering works.
3. The course enable the students to utilize the characterization techniques in determining the quality of material and the corrosion mechanism of engineering works.
4. The course helps in understanding the hardness and importance of water quality for engineering and day to day life.

List of Experiments:
1. Bond length and bond angle calculation for benzene using Chem3D Pro. Software.
2. Drawing the structure benzene and graphene using ChemDraw Pro. Software.
3. Estimation of strength of HCl by conductometric titrations.
4. Determination of surface tension of a give liquid using stalagmometer.
5. Estimation of strength of HCl by Potentiometric titrations.
6. Verification of Lambert's and Beer's law using $KMnO_4$.
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.
8. Synthesis of Aspirin and Paracetamol.
9. Thin layer chromatography calculation of R_f values.
10. Determination of acid value of coconut oil.
11. Verification of Freundlich adsorption isotherm-adsorption of acetic acid on activated charcoal.
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Estimation of strength of acetic acid by conductometric titrations.
14. Estimation of Fe^{2+} amount present in unknown sample by $KMnO_4$ using potentiometric titration.
15. Determination of ion-exchange resin capacity using EDTA Method.
16. Determination of single electrode potential.

Text books:
1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co.,Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N.Delhi)

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ENGLISH LANGUAGE & COMMUNICATION SKILLS LAB (CHSE2)

Course Objectives:

1. To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. To improve the fluency of students in spoken English and neutralize their mother tongue influence.
5. To train students to use language appropriately for public speaking and interviews.

Course Outcomes:

1. Better understanding of nuances of English language through audio- visual experience and group activities.
2. Neutralization of accent for intelligibility.
3. Speaking skills with clarity and confidence which in turn enhances their employability skills.

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III

CALL Lab:

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).

Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.

ICS Lab:

Understand: How to make Formal Presentations,

Describing a picture

Practice: Formal Presentations-individual and team.

Exercise – IV

CALL Lab:

Understand: Listening for General Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Public Speaking – Exposure to Structured Talks.

Practice: Making a Short Speech – Extempore.

Exercise – V

CALL Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Introduction to Interview Skills.

Practice: Mock Interviews-Role Play.

Text Books:

1. A book entitled "***ELCS Lab Manual – A Workbook for CALL and ICS Lab Activities***" by Board of Editors: Hyderabad: Orient BlackSwan Pvt. Ltd. 2016. Print.

Reference :

1. Hart, Steve; Nair, Aravind R.; Bhambhani, Veena. "***EMBARK- English for undergraduates***" Delhi: Cambridge University Press. 2016. Print.