# NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

## CURRICULUM & SYLLABUS

## OF

### FIRST YEAR COURSES OF BACHELOR OF TECHNOLOGY, DUAL DEGREE AND INTEGRATED MSC

## 2023 ONWARD ADMISSION BATCH

- Curriculum Recommended by the members of UGAC in a meeting held on 19/08/2023 in the presence of the Chairman, Senate at the Senate Room, S. N. Roy Memorial Building

- Approved by the Chairman, Senate on 19/08/2023 and shall be placed for ratification in the 71st Senate meeting

# CURRICULUM

## GROUP – 1

## FIRST SEMESTER

| Semester - I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC01 | Mathematics - I | 3 | 1 | 0 | 4 | 4 |
| 2 | CSC01 | Computer Programming | 2 | 1 | 0 | 3 | 3 |
| 3 | XEC01 | Engineering Mechanics | 2 | 1 | 0 | 3 | 3 |
| 4 | XEC02 | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 | 3 |
| 5 | ESC01 | Ecology and Environment | 2 | 0 | 0 | 2 | 2 |
| 6 | CYC01 | Engineering Chemistry | 3 | 0 | 0 | 3 | 3 |
| 7 | CSS51 | Computer Programming Laboratory | 0 | 0 | 3 | 2 | 3 |
| 8 | XES52 | Basic Electrical and Electronics Engineering Laboratory | 0 | 0 | 3 | 2 | 3 |
| 9 | CYS51 | Engineering Chemistry Laboratory | 0 | 0 | 2 | 1 | 2 |
| | | **TOTAL** | **15** | **3** | **8** | **23** | **26** |

## SECOND SEMESTER

| Semester - II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC02 | Mathematics - II | 3 | 1 | 0 | 4 | 4 |
| 2 | CSC02 | Data Structure and Algorithms | 2 | 1 | 0 | 3 | 3 |
| 3 | PHC01 | Engineering Physics | 2 | 1 | 0 | 3 | 3 |
| 4 | HSC01 | Professional Communication | 2 | 0 | 2 | 3 | 4 |
| 5 | CSS52 | Data Structure and Algorithms Laboratory | 0 | 0 | 3 | 2 | 3 |
| 6 | XES51 | Engineering Graphics | 0 | 1 | 3 | 3 | 4 |
| 7 | PHS51 | Engineering Physics Laboratory | 0 | 0 | 2 | 1 | 2 |
| 8 | XXS51 | Extra Academic Activities | 0 | 0 | 2 | 1 | 2 |
| | | TOTAL | 9 | 4 | 12 | 20 | 25 |

# GROUP – 2

## FIRST SEMESTER

| Semester - I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC01 | Mathematics - I | 3 | 1 | 0 | 4 | 4 |
| 2 | CSC01 | Computer Programming | 2 | 1 | 0 | 3 | 3 |
| 3 | XEC01 | Engineering Mechanics | 2 | 1 | 0 | 3 | 3 |
| 4 | PHC01 | Engineering Physics | 2 | 1 | 0 | 3 | 3 |
| 5 | HSC01 | Professional Communication | 2 | 0 | 2 | 3 | 4 |
| 6 | CSS51 | Computer Programming Laboratory | 0 | 0 | 3 | 2 | 3 |
| 7 | XES51 | Engineering Graphics | 0 | 1 | 3 | 3 | 4 |
| 8 | PHS51 | Engineering Physics Laboratory | 0 | 0 | 2 | 1 | 2 |
| 9 | XXS51 | Extra Academic Activities | 0 | 0 | 2 | 1 | 2 |
| | | **TOTAL** | **11** | **5** | **12** | **23** | **28** |

## SECOND SEMESTER

| Semester - II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC02 | Mathematics - II | 3 | 1 | 0 | 4 | 4 |
| 2 | CSC02 | Data Structure and Algorithms | 2 | 1 | 0 | 3 | 3 |
| 3 | XEC02 | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 | 3 |
| 4 | ESC01 | Ecology and Environment | 2 | 0 | 0 | 2 | 2 |
| 5 | CYC01 | Engineering Chemistry | 3 | 0 | 0 | 3 | 3 |
| 6 | CYS51 | Engineering Chemistry Laboratory | 0 | 0 | 2 | 1 | 2 |
| 7 | CSS52 | Data Structure and Algorithms Laboratory | 0 | 0 | 3 | 2 | 3 |
| 8 | XES52 | Basic Electrical and Electronics Engineering Laboratory | 0 | 0 | 3 | 2 | 3 |
| | | **TOTAL** | **13** | **2** | **8** | **20** | **23** |

# DETAILED SYLLABUS

## Index

# DETAILED SYLLABUS

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| MAC01 | MATHEMATICS - I | PCR | 3 | 1 | 0 | 4 | 4 |
| Pre-requisites | | Basic concepts of function, limit, differentiation and integration. | | | | | |
| Course Outcomes | • CO1: learn the fundamentals of differential calculus of single and several variables.<br>• CO2: learn the basic concepts of convergence of infinite series.<br>• CO3: understand the basic concepts of integral calculus along with its various applications.<br>• CO4: acquire the theoretical knowledge of vector calculus and its engineering applications. | | | | | | |
| Topics Covered | **Functions of Single Variable:** Review of limit, continuity and differentiability. Mean value theorems: Rolle's Theorem, Lagrange's Mean Value Theorem (MVT), Cauchy's MVT, Taylor's theorem, Taylor's and Maclaurin's series. (8)<br>**Functions of several variables:** Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Homogeneous function, Euler's theorem and its converse, Exact differential, Jacobian, Taylor's & Maclaurin's series, Maxima and Minima, Necessary and sufficient condition for maxima and minima (no proof). (11)<br>**Sequences and Series:** Real sequences and their convergence, Series of positive terms, Necessary and sufficient condition for convergence, p-series, geometric series, Comparison test, D Alembert's ratio test, Cauchy's root test, Alternating series, Leibnitz's rule, Absolute and conditional convergence. (6)<br>**Integral Calculus:** Review of the idea of integration as a limit of a sum, Mean value theorems of integral calculus, Area and length in Cartesian and polar co-ordinates, Volume and surface area of solids of revolution in Cartesian and polar forms, Improper integrals and their convergence, Beta and Gamma functions. (12)<br>**Multiple Integrals:** Evaluation of double and triple integrals, Change of order of integration, Change to better coordinates, Area and volume by double integration, Volume by triple integration. (10)<br>**Vector Calculus:** Vector valued functions and its differentiability, Line integral, Surface integral, Volume integral, Gradient, Curl, Divergence, Green's theorem in the plane (including vector form), Stokes' theorem, Gauss's divergence theorem and their engineering applications. (9) | | | | | | |
| Text Books, and/or reference material | **Text Books:**<br>1. Kreyszig, E., Advanced Engineering Mathematics: 10th edition, Wiley India Edition, 2010.<br>2. Murray, D.A., Differential and Integral Calculus, FB & C Limited, 2018.<br>3. Marsden, J. E; Tromba, A. J.; Weinstein: Basic Multivariable Calculus, Springer, 2014.<br>4. Murray Spiegel, Schaum's Outline of Vector Analysis, Tata McGraw Hill .1980 ,Education<br>**Reference Books:**<br>1. Tom Apostal, Calculus-Vol-I & II, Wiley Student Edition, 2011.<br>2. Thomas and Finny: Calculus and Analytic Geometry, 11th Edition, Addison Wesley. | | | | | | |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAC01 | CO1 | 2 | 3 | 2 | 3 | 1 | 1 | - | - | 1 | 1 | 1 | 2 |
| | CO2 | 2 | 3 | 2 | 3 | - | 1 | - | - | 1 | 1 | 2 | 2 |
| | CO3 | 2 | 3 | 2 | 3 | - | 1 | 1 | - | - | 2 | 2 | 2 |
| | CO4 | 3 | 3 | 2 | 3 | 1 | 1 | - | 1 | - | 2 | 1 | 2 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CSC01** | **COMPUTER PROGRAMMING** | PCR | 2 | 1 | 0 | 3 | 3 |
| Pre-requisites | | Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| Basic knowledge of computer. | | CT+MT+EA | | | | | |
| Course Outcomes | • CO1: To understand basics of computer programming, program flow, and programming constructs.<br>• CO2: Develop concepts on basic and complex data types, conditional and iterative statements.<br>• CO3: Exercise the concepts of user defined functions to solve real time problems.<br>• CO4: Inscribe C programs that use Pointers to access arrays, strings and functions.<br>• CO5: Exercise user defined data types including structures and unions to solve problems. | | | | | | |
| Topics Covered | **Introduction to C**: Phases of developing a running computer program in C. (2L)<br>Data types, size and values. Char, Unsigned and Signed data types. Number systems and representations. Constants, Overflow. (3L)<br>Data concepts in C: Constants, Variables, Expressions, Operators, and operator precedence in C. (2L)<br>Statements: Declarations, Input-Output Statements, Compound statements, Selection Statements. (2L)<br>Conditions, Logical operators, Precedences. Repetitive statements, While construct, Do-while Construct, For construct. (3L)<br>Arrays. Strings. Multidimensional arrays and matrices. (3L)<br>**Pointers:** Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer types, Pointers and strings. String operations in C. (6L)<br>Dynamic memory allocation. (2L)<br>**Modular Programming:** Functions: The prototype declaration, Function definition. (3L)<br>Function call: Passing arguments to a function, by value, by reference. Scope of variable names. Recursive function calls, Tail recursion. (4L)<br>Sorting problem: Sorting in arrays with an example of Bubble sort. Sorting in strings. (3L)<br>Search problem: Linear search and binary search. (2L) | | | | | | |

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| | **More Data-types in C:** Structures in C: Motivation, examples, declaration, and use. Operations on structures. Passing structures as function arguments. type defining structures. (4L)<br>File input-output in C. Streams. Input, output and error streams. Opening, closing and reading from files. Programming for command line arguments. (3L) |
| Text Books, and/or reference material | **Text Books:**<br>1. P. Deitel, H. Deitel. C How to Program. Pearson Education India, 7th Ed.<br>2. B. W. Kernighan, Dennis M. Ritchie. The C Programming. Prentice Hall Software Series, 2nd Ed.<br>**Reference Books:**<br>1. P. Dey and M. Ghosh. Computer fundamentals and programming in C. Oxford press, 2013.<br>1. Y. Kanetkar. Let Us C. BPB Publications, Sixteenth edition, 2017. |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSC01 | CO1 | 2 | 2 | 1 | - | 1 | 2 | - | - | - | - | - | - |
| | CO2 | 3 | 2 | 1 | - | 1 | 1 | 1 | - | - | - | - | - |
| | CO3 | 2 | 2 | 1 | - | - | 2 | - | - | - | - | - | - |
| | CO4 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | - |
| | CO5 | 3 | 1 | 2 | - | 1 | 2 | - | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P)# | Total Hours | |
| **XEC01** | **ENGINEERING MECHANICS** | PCR | 2 | 1 | 0 | 3 | 3 |
| Pre-requisites | | Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| | | CT+MT+EA | | | | | |
| Course Outcomes | • CO1: Acquire knowledge of mechanics and ability to draw free body diagrams.<br>• CO2: Apply knowledge of mechanics for solving special problems like truss and frame analysis.<br>• CO3: Ability to calculate centroid, moments of inertia for various shapes.<br>• CO4: Learn momentum and energy principles.<br>• CO5: Knowledge on virtual Work Principle and its application | | | | | | |
| Topics Covered | Engineering Mechanics; measurement and SI units. [1]<br>Vectors and force as a vector; Resultant of a system of forces on a particle; free body diagram and conditions of equilibrium of a particle; problems on particles; equilibrium of particles in space. [2]<br>Resultant of a system of forces and couples on a rigid body; conditions of equilibrium of a rigid body; free body diagrams of rigid bodies subjected to different types of constraints; simple space problems of rigid bodies. [4]<br>Coefficients of static and kinetic friction; problems involving friction; theories of friction on square threaded power screw and flat belt. [5]<br>Simple trusses; analysis of trusses by method of joints and method of sections. [5]<br>Centre of gravity and centre of mass; centroids of lines, curves and areas; first | | | | | | |

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| | moment of area; second moment of area; polar moment of inertia; radius of gyration of an area; parallel axis theorem; mass moment of inertia. [4]<br>Path, velocity, acceleration; rectilinear and curvilinear motion; motion of system of particles; introduction to the concept of plane kinematics of rigid bodies. [6]<br>Newton's second law of motion; dynamic equilibrium and D'Alembert's principle; linear momentum; angular momentum; rectilinear and curvilinear motion; principles of work–energy and impulse–momentum; impact of system of particles; introduction to the concept of plane kinetics of rigid bodies. [12]<br>Principle of Virtual Work, Solution of Problems on Mechanics using Principle of Virtual Work [3] |
| Text Books, and/or reference material | 1) S P Timoshenko and D H Young, Engineering Mechanics, 5th Edition<br>2) J L Meriam and L G Kraige, Engineering Mechanics, 5th Edition, Wiley India<br>3) F P Beer and E R Johnston, Vector Mechanics for Engineers<br>4) I H Shames, Engineering Mechanics |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XEC01 | CO1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 |
| | CO2 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 |
| | CO3 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 |
| | CO4 | 1 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| | CO5 | - | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | 1 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **PHC01** | **Engineering Physics** | **PCR** | **2** | **1** | **0** | **3** | **3** |
| **Pre-requisites:** | | Course Assessment methods: (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| NIL | | CT+MT+EA | | | | | |
| Course Outcomes | • CO1: To realize and apply the fundamental concepts of physics such as superposition principle, simple harmonic motion to real world problems.<br>• CO2: Learn about the quantum phenomenon of subatomic particles and its applications to the practical field.<br>• CO3: Gain an integrative overview and applications of fundamental optical phenomena such as interference, diffraction and polarization.<br>• CO4: Acquire basic knowledge related to the working mechanism of lasers and signal propagation through optical fibers. | | | | | | |
| Topics Covered | **Harmonic Oscillations** - Linear superposition principle, Superposition of two perpendicular oscillations having same and different frequencies and phases, Free, Damped and Forced vibrations, Equation of motion, Amplitude resonance, Velocity resonance, Quality factor, sharpness of resonance, [8]<br>**Wave Motion**: Longitudinal waves, Transverse waves, Wave equation, phase velocity and group velocity, Maxwell's equations, Electro-magnetic waves in free space. [3]<br>**Introductory Quantum Mechanics** - Inadequacy of classical mechanics, Blackbody | | | | | | |

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| | radiation, Planck's quantum hypothesis, de Broglie's hypothesis, Heisenberg's uncertainty principle and applications, Schrodinger's wave equation and applications to simple problems: Particle in a one-dimensional box, Simple harmonic oscillator, Tunnelling effect. [8]<br>**Interference & Diffraction** - Huygens' principle, Young's experiment, Superposition of waves, Conditions of sustained Interference, Concepts of coherent sources, Interference by division of wavefront, Interference by division of amplitude with examples, The Michelson interferometer and some problems; Fraunhofer diffraction, Single slit, Multiple slits, Resolving power of grating. [13]<br>**Polarisation** - Polarisation, Qualitative discussion on Plane, Circularly and elliptically polarized light, Malus law, Brewster's law, Double refraction (birefringence) - Ordinary and extra-ordinary rays, Optic axis etc.; Polaroid, Nicol prism, Retardation plates and analysis of polarized lights. [5]<br>**Laser and Optical Fiber** - Spontaneous and stimulated emission of radiation, Population inversion, Einstein's A & B co-efficient, Optical resonator and pumping methods, He-Ne laser. Optical Fibre– Core and cladding, Total internal reflection, Calculation of numerical aperture and acceptance angle, Applications. [5] |
| **Text Books, and/or reference material** | **TEXT BOOKS**:<br>1. The Physics of Vibrations and Waves, H. John Pain, Willy and Sons<br>2. A Text Book of Oscillations and Waves, M. Goswami and S. Sahoo, Scitech Publications<br>3. Engineering Physics, H. K. Malik and A. K. Singh, McGraw-Hill.<br><br>**REFERENCE BOOKS**:<br>1. Vibrations and Waves in Physics, Iain G. Main, Cambridge University Press<br>2. Quantum Physics, R. Eisberg and R. Resnick, John Wiley and Sons<br>3. Fundamental of Optics, Jankins and White, McGraw-Hill<br>4. Optics, A. K. Ghatak, Tata McGraw-Hill<br>5. Waves and Oscillations, N. K. Bajaj, Tata McGraw-Hill<br>6. Lasers and Non-linear Optics, B. B. Laud, New Age International Pvt Lt |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHC01 | CO1 | 3 | 2 | 1 | 1 | 1 | - | - | 1 | - | - | - | 1 |
| | CO2 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 1 |
| | CO3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 |
| | CO4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | - | 1 | - | 1 | 1 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CYC01** | **Engineering Chemistry** | PCR | 3 | 0 | 0 | 3 | 3 |
| Pre-requisites | | Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| None | | CT+MT+EA | | | | | |

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| Course Outcomes | • CO1: Students will get the knowledge of fundamentals as well industrial applications of polymer, petroleum products, organometallic compounds and others.<br>• CO2: Students will be able to elucidate the structure of different organic compounds and to analyze the structure-property correlation.<br>• CO3: Students will be aware on the role played by different metals in biological systems and also the ecological impact of metals.<br>• CO4: Students will be able to understand and analyze thermodynamical, kinetic as well as electrochemical aspects of chemical systems and apply the understanding in the technical field. |
| Topics Covered | **ORGANIC CHEMISTRY**<br>i. **Polymer chemistry and polymer engineering:** Fundamental concept on polymer chemistry; synthesis and application of important polymers, Rubber and plastic materials; vulcanization, structure-property correlation: Concept of Molecular weight of polymer, Glass transition temperature. Engineered polymer: Thermally stable, flame retardant, Conducting polymer. (5L)<br>ii. **Petroleum Engineering and oil refinery:** Origin of petroleum, separation principle and techniques of distillation of crude oil, thermal and catalytic cracking of petroleum, uses of different fractions, knocking, anti-knock compounds, octane number and cetane number. High octane and Aviation fuel. Bio-diesel. (3L)<br>iii. **Structure elucidation of organic compounds by modern spectroscopic methods:** Application of UV-Visible (Lambert-Beers law), concept of chromophore, auxochrome, hypso-, hyper-, bathochromic, red shift. FT-IR spectroscopy and Mass spectroscopy (including instrumentation). (4L)<br><br>**INORGANIC CHEMISTRY**<br>i. **Coordination Chemistry:** Crystal Field Theory of octahedral and tetrahedral complexes, colour and magnetic properties, LMCT, MLCT, IVCT. Isomerism and stereochemistry.(5L)<br>ii. **Bioinorganic Chemistry:** Metal ions in biological systems: Fe, Cu (2L)<br>iii. **Industrial applicationof Organometallic complexes:** π-acid ligands, stabilization of metal low oxidation state and 18 electron rules, metal carbonyls and nitrosyls, metal-alkene complexes, Various catalytic cycles of industrial importance. (4L)<br>iv. **Environmental Chemistry:** Metal toxicity (As, Hg, Pb and Cd) and its remediation (1L)<br><br>**PHYSICAL CHEMISTRY**<br>i. **Chemical Thermodynamics:** 2nd law of thermodynamics: Concept of thermodynamic engine (Carnotand reverse Carnot cycle), entropy, free energy. Temperature and pressure dependence of entropy and free energy. Change in phase: phase diagram of single component system. Cryogenics: Joule Thomson experiment. (5L)<br>ii. **Chemical Kinetics:**Rate expression of Reversible reaction, parallel reaction,and Consecutive reaction with proper examples. Temp effect on reaction rate.(3L)<br>iii. **Catalysis:** Types of catalysis, Rate expression for Catalysed reaction, Acid-base and Enzyme catalysis.(2L)<br>iv. **Electrochemistry:**EMF, Nernst Equation, Application of electrochemistry in chemical processes. Electrochemical cell, Fuel cell, Li-ion battery (3L). |
| Text Books, and/or reference | Suggested Text Books:<br>(i) Physical Chemistry by P. Atkins, Oxford<br>(ii) A guidebook to mechanism in Organic chemistry: Peter Sykes; Pearson Edu.<br>(iii) Inorganic Chemistry Part-I & II, R. L. Dutta, The new book stall |

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| material | Suggested Reference Books:<br>**Organic Chemistry**:<br>(i) Basic stereochemistry of organic molecules: S. Sengupta; Oxford University press<br>(ii) Engineering Chemistry: Wiley<br>(iii) Elementary Organic Spectroscopy: William Kemp, ELBS with Macmillan<br>**Inorganic Chemistry:**<br>(i) Inorganic Chemistry: Principle structure and reactivity, J. E. Huheey, E. A. Keiter and R. L. Keiter, Pearson Education<br>(ii) Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life: An Introductionand Guide, 2nd Edition, Wolfgang Kaim, Brigitte Schwederski, Axel Klein.<br>(iii) Inorganic Chemistry Fourth Edition, Shriver & Atkins, Oxford<br>**Physical Chemistry:**<br>(i) Physical Chemistry by G.W Castellan<br>(ii) Physical Chemistry by P. C. Rakshit |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CYC 01 | CO1 | 1 | 2 | - | - | - | - | - | - | - | - | - | - |
| | CO2 | 1 | - | - | - | - | - | 2 | - | - | - | - | - |
| | CO3 | 1 | 2 | 1 | 1 | 1 | - | - | - | - | - | - | - |
| | CO4 | - | 1 | - | - | 2 | - | 1 | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P)# | Total Hours | |
| **ESC01** | **Ecology and Environment** | PCR | 2 | 0 | 0 | 2 | 2 |
| Pre-requisites | | Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| NIL | | CT+MT+EA | | | | | |
| Course Outcomes | • CO1: Understand the importance of environment and ecosystem.<br>• CO2: Understand the fundamental aspect of pollutant tracking and its implementation in natural and anthropogenic pollution of air and water system.<br>• CO3: Understand the scientific basis of local and as well as global issues.<br>• CO4: Apply of knowledge to develop sustainable solution. | | | | | | |
| Topics Covered | **UNIT – I: INTRODUCTION (2)**<br>Multidisciplinary nature of Environmental Studies: Definition, Scope, and Importance.<br><br>**UNIT–II: FUNDAMENTALS OF ECOLOGY (9)**<br>Definition, Components of Environment; Fundamentals of Ecology and Ecosystem; Components and Classification of Ecosystem; Energy flow in Ecosystem: Tropic level, Food Chain, Food Web, Ecological Pyramid; Biogeochemical cycles: Carbon, Nitrogen, Sulphur, Phosphorus, and Water Cycle; Biosphere and Biodiversity; Conservation.<br><br>**UNIT–III: FUNDAMENTALS OF ENVIRONMENT (10)**<br>**Environmental Pollution:** Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Solid Wastes, and Natural hazards: | | | | | | |

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| | Floods, earthquakes, cyclones, and landslides.<br>**Environmental Issues:** Climate change and global warming; acid rain; and ozone layer depletion.<br>**Environment Quality:** Ambient air quality standards, Water quality parameters and standards: pH, Turbidity, Hardness, Sulphate, Phosphates, Iron, Dissolved Oxygen, BOD, and COD.<br><br>**UNIT– IV: NATURAL RESOURCES (3)**<br>Mineral Resources, Energy Resources: Conventional and Non-Conventional.<br><br>**UNIT- V- GREEN TECHNOLOGY & ENVIRONMENTAL ETHICS (4)**<br>Sustainability: Carbon Sequestration, Green building practices, Green computing; Carrying capacity; and Environment Protection Acts/laws. |
| Text Books, and/or reference material | 1. A Basic Course in Environmental Studies. Deswal & Deswal. Pub. Dhanpat Rai & Sons<br>2. Ecology. Odum. Pub. Oxford & IBH<br>3. Environmental Engineering. Peany et.al. Pub. McGraw Hill<br>4. A Text Book of Environmental Engg. Venugpal Rao. Pub. PHI<br>5. A Basic Course in Environmental Studies. Deswal & Deswal. Pub. Dhanpat Rai & Sons<br>6. Environmental Studies. Bharucha. Pub. University of Press<br>7. Environmental Chemistry and Pollution, S. S. Dara & D. D. Mishra, S. Chand Publishing |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ESC01 | CO1 | 3 | - | - | - | - | - | 2 | - | - | - | - | - |
| | CO2 | 1 | - | - | - | - | - | 2 | - | - | - | - | - |
| | CO3 | 2 | - | - | - | - | - | 2 | - | - | - | - | - |
| | CO4 | 1 | - | 3 | - | - | 2 | 1 | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| HSC01 | Professional Communication | PCR | 2 | 0 | 2 | 4 | 3 |
| **Pre-requisites** | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| None | | CT+EA | | | | | |
| **Course Outcomes** | • CO1: Learners will acquire linguistic proficiency in terms of improvement in their listening, speaking, reading, and writing skills.<br>• CO2: Learners will acquire better communicative ability.<br>• CO3: The course will help learners improve their social connectivity skill. | | | | | | |
| **Topics Covered** | Vocabulary<br>1. Word Formation, Use of Prefixes and Suffixes (1)<br>2. Synonyms, Antonyms (1)<br>3. Prefixes and Suffixes from Foreign Languages, Words from Foreign | | | | | | |

| | |
|---|---|
| | Languages (1)<br>4. Abbreviations and Acronyms (1)<br>5. Technical Vocabulary (1)<br>Grammar<br>1. Identifying Common Errors in Articles and Prepositions (1)<br>2. Common Errors in Noun-Pronoun Agreement and Subject-Verb Agreement (1)<br>3. Misplaced Modifiers and Tenses (1)<br>4. Redundancies and Clichés (1)<br>Reading<br>1. Reading and Its Importance, Techniques of Effective Reading (1)<br>2. Improving Comprehension Skills, Techniques for Good Comprehension (1)<br>3. Skimming and Scanning (1)<br>4. Comprehension, Intensive and Extensive Reading (2)<br>Writing<br>1. Sentence Structures, Phrases and Clauses, Punctuation (2)<br>2. Organising Principles of Paragraphs (2)<br>3. Formal Letters, Letters of Complaint, Requisition Letters, Job Application, and Résumé (2)<br>4. Nature and Style of Sensible Writing, Defining, Describing, Classifying, Providing Examples and Evidence (2)<br>5. Essay Writing (2)<br>6. Précis Writing (2)<br>7. Report Writing (2)<br>Oral Communication<br>1. Listening Comprehension (4)<br>2. Pronunciation, Intonation, Stress, and Rhythm (4)<br>3. Communication at the Workplace (4)<br>4. Everyday Conversation (4)<br>5. Group Discussion (4)<br>6. Interviews (4)<br>7. Formal Presentations (4) |
| **Text Books, and/or reference material** | **Text Book:**<br>1. English for Engineers –Sudharshana & Savitha (Cambridge UP)<br>**Reference Books:**<br>2. *English*—Kulbhushan Kumar (Khanna Book Publishing)<br>3. *Remedial English Grammar*—F. T. Wood (Macmillan) |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HSC01 | CO1 | 1 | -- | -- | 1 | -- | 1 | -- | 1 | 2 | 3 | 1 | -- |
| | CO2 | 1 | -- | -- | 1 | -- | 2 | -- | 2 | 2 | 3 | 2 | -- |
| | CO3 | -- | -- | -- | 1 | -- | 3 | -- | 3 | 3 | 3 | 2 | -- |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td>Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td><td></td></tr>
<tr><td>MAC02</td><td>MATHEMATICS - II</td><td>PCR</td><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="6">Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))</td></tr>
<tr><td colspan="2">Basic concepts of set theory, differential equations, and probability.</td><td colspan="6">CT+MT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">• CO1: learn the basic concepts of linear algebra and be able to apply the same to solve various engineering problems.<br>• CO2: understand fundamentals of ordinary differential equations and their applications.<br>• CO3: acquire the theoretical knowledge of Fourier Series, Fourier & Laplace transforms, and learn about their applications.<br>• CO4: learn the basic concepts of probability theory.</td></tr>
<tr><td>Topics Covered</td><td colspan="7">Introduction to Algebraic structures: Group, subgroup, ring, subring, integral domain, and field. (3)<br>Linear Algebra: Vector spaces over field, linear dependence and independence of vectors, linear span of a set of vectors, basis and dimension of finite dimensional vector space, elementary row/column operations, rank of a matrix, solutions of system of linear (homogeneous and non-homogeneous) equations, eigenvalues and eigenvectors, characteristic polynomials, Cayley-Hamilton theorem (without proof), Diagonalization of matrices. (15)<br>Ordinary Differential Equations (ODE): Review of first order ODE, Picard's theorem (Statement Only), ODE of first order and of the first degree (exact ODE, rules for finding integrating factors), ODE of first order and of the higher degree (ODE solvable for x, solvable for y; Clairaut's equation, singular solution), homogeneous and non-homogeneous linear ODE with constant coefficients and variable coefficients (Euler–Cauchy type), linear dependence of solutions, Wronskian determinant, Solution of simultaneous ODEs $(dx/P = dy/Q = dz/R;\ dx/dt = ax + by,\ dy/dt = cx + dy)$, properties of nonlinear ODEs, phase plane analysis. (18)<br>Fourier series: Piecewise smooth and periodic functions, Fourier series of a function in an interval, Dirichlet conditions, Convergence of Fourier series, Fourier sine and cosine series, Complex form of Fourier series. (4)<br>Fourier Transforms: Fourier Integral Theorem (statement only), Different forms of Fourier Integrals, Fourier Transform and its inversion formula, Properties of Fourier Transform, Convolution. (7)<br>Laplace Transforms: Laplace transforms and its Properties, Inverse Laplace transforms, Convolution theorem, Applications to ODE. (4)<br>Probability: Random variables and probability distributions (discrete and continuous), Binomial, Poisson, Uniform and Normal distributions. (5)</td></tr>
<tr><td>Text Books, and/or reference material</td><td colspan="7">Text Books:<br>1. Kreyszig, E., Advanced Engineering Mathematics: 10th edition, Wiley India Edition (2010).<br>2. Strang, G., Linear algebra and its applications (4th Edition), Thomson (2006).<br>3. Murray, D.A., Introductory Course in Differential Equations, Khosla Publishing House (2021).<br>4. Debnath, L., Integral Transforms and Their Applications, CRC Press (1995).<br>5. Baisnab, A.P., Jas, M., Elements of Probability and Statistics, McGraw Hill Education (2017).</td></tr>
</table>

| | |
|---|---|
| | **Reference Books:**<br>1. Kumaresan, S., Linear algebra - A Geometric approach, Chaukhamba Auriyantaliya (2017).<br>2. Ross, S.L., Differential Equations, 3rd Edition, Wiley Student Edition (2017).<br>3. Shivamoggi, A., Integral Transforms for Engineers, PHI (2003).<br>4. Grinstead, C.M., Snell, J.L., Introduction to probability, American Mathematical Society (2012). |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAC02 | CO1 | 3 | 3 | 2 | 1 | 2 | - | 2 | - | - | - | 1 | 2 |
| | CO2 | 3 | 3 | 2 | 2 | 2 | - | 2 | - | - | 1 | - | 2 |
| | CO3 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | - | 1 | 1 | 1 | 2 |
| | CO4 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | - | - | 2 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CSC02** | Data Structure and Algorithms | PCR | 2 | 1 | 0 | 3 | 3 |
| Pre-requisites | | Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA)) | | | | | |
| CSC01 (Computer Programming) | | CA+ MT + ET **[**CA: 15%, MT: 25%, ET: 60%**]** | | | | | |
| Course Outcomes | • CO1: Understanding the fundamental concepts of abstract data types, data structures, algorithms and time complexity analysis of algorithms.<br>• CO2: Implementation of different abstract data types (array, linked list, stack, queue, tree, graph).<br>• CO3: Implementation of different sorting and searching techniques along with their performance evaluation.<br>• CO4: Analysis of the suitability/compatibility of different data structures based on the types of applications.<br>• CO5: Design and development of algorithms for real-life applications.<br>• | | | | | | |
| Topics Covered | **Introduction:** Abstract Data Type (ADT), Data Structures, Concept of static and dynamic memory allocation, Algorithm, Analysis of time and space complexity of algorithms, Asymptotic notations: Big Oh, Big Omega and Big Theta notations, Impact of data structure on the performance of an algorithm. (6L)<br>**Array:** Array as an ADT, Single and multi-dimensional array, Memory representation (row major and column major) of array, Address calculation for array elements. (2L)<br><br>**Linked list:** Linked list as an ADT, Memory allocation and deallocation for a linked list, Linked list versus array, Types of linked lists: singly linked list, doubly linked list and circular linked list, Operations on linked list: creation, display, insertion and deletion (in different positions), Concatenation, Searching, Sorting, Applications of linked list: Representations and operations on polynomials, sparse matrices, etc., Array vs. Linked List. (6L) | | | | | | |

| | |
|---|---|
| | **Stack:** Stack as an ADT, Push and pop operations on stacks, Array implementation of stack, Linked list implementation of stack, Applications of stack: Recursion, Function call, Evaluation of postfix expression using stack, Conversion of infix to postfix using stack. (5L)<br>**Queue:** Queue as an ADT, Enqueue and dequeue operations, Array implementation of queue, Limitation of array implementation, Circular queue, Linked list implementation of queue, Priority queue. (4L)<br>**Binary Tree:** Binary Tree, Definition and properties, Representation of binary tree in memory: linked representation, array representation, Binary tree traversal (Preorder, Inorder and Postorder), Binary search tree, Heap (8L)<br>**Searching Algorithms:** Linear search and binary search. (2L)<br>Sorting Algorithms: Selection sort, Insertion sort, Quick sort, and Merge sort. (5L)<br>**Graphs Algorithms:** Graph representation using Adjacency matrix and Adjacency list, Breadth First Search and Depth First Search algorithms. (4L) |
| Text Books, and/or reference material | **Text Books:**<br>1. R. F. Gilberg and B. A. Forouzan, "Data Structures: A pseudocode approach with C", 2nd Edition, CENGAGE Learning.<br>2. A. V. Aho, J. D. Ullman and J. E. Hopcroft, “Data Structures and Algorithms”, Addition Wesley.<br>3. Lipschutz, “Data Structures (Schaum’s Outline Series)”, Tata Mcgraw Hill.<br>4. E. Horowitz, S. Sahni, S. Anderson-Freed, “Fundamentals of Data Structures in C”, Universities Press; Second edition (2008).<br>**Reference Books:**<br>1. Y. Langsam, M. J. Augenstein and A. N. Tanenbaum, "Data Structures using C and C++", Pearson, 2006.<br>2. Knuth, Donald E. The Art of Computer Programming. 3rd ed. Vols 1&2. Reading, MA: Addison-Wesley, 1997. ISBN: 0201896834. ISBN: 0201896842. ISBN: 0201896850.<br>3. Kleinberg and Eva Tardos. Algorithm Design. Addison-Wesley 2005 ISBN-13: 978-0321295354. |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSC02 | CO1 | 3 | - | 1 | 1 | 1 | - | - | - | - | - | - | - |
| | CO2 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 1 |
| | CO3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 1 |
| | CO4 | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | 1 |
| | CO5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **XEC02** | **Basic Electrical and Electronics Engineering** | PCR | 3 | 0 | 0 | 3 | 3 |
| Pre-requisites | | | Course Assessment methods | | | | |
| (10+2) level mathematics and physics | | | CT+MT+EA | | | | |

| | |
|---|---|
| Course Outcomes | CO1: Learn the fundamentals of electric circuits and analyze the circuits using laws and network theorems.<br>CO2: Gain the knowledge about magnetic circuits, electromagnetism and the basics of generation of alternating voltage.<br>CO3: Understand the behaviour of single phase and poly-phase AC circuits.<br>CO4: Understand the fundamentals of semiconductor devices.<br>CO5: Analyze the design and characteristics of transistor-based electronic circuits.<br>CO6: Evaluate operational amplifier-based circuits and logic gates. |
| Topics Covered | 1. Introduction to Electrical systems, Fundamentals of Electric Circuits: Ohm's laws, Kirchhoff's laws, Independent and Dependent sources, Analysis of simple circuits. (4)<br>2. Network theorems (DC): Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (5)<br>3. Magnetic circuits: Review of fundamental laws of electromagnetic induction, Self and mutual inductances, Solution of magnetic circuits. (3)<br>4. Generation of alternating voltage and current, E.M.F. equation, Average and R.M.S. value, Phase and phase difference, Phasor representation of alternating quantity, Behaviour of AC circuits, Resonance in series and parallel R-L-C circuits. (6)<br>5. Poly-phase system, Advantages of 3-phase system, Generation of 3-phase voltages, Voltage, current and power in a star and delta connected systems, 3-phase balanced and unbalanced circuits. (3)<br>6. Semiconductor Devices: Construction, working and V-I characteristics of diode, Zener diode, Zener diode as a voltage regulator, LED. (6)<br>7. Transistors: Introduction to BJT, FET, MOSFET; CMOS, working principle, and V-I characteristics of Transistors, biasing of BJT circuits-fixed bias, emitter bias, feedback bias, voltage divider bias, transistor as an amplifier. (8)<br>8. Operational amplifier: Introduction, applications: inverting, non-inverting amplifier, unity follower, integrator, differentiator, summing circuit .(4)<br>9. Introduction of logic gates, memory: ROM, RAM. (3) |
| Text Books, and/or reference material | **TEXT BOOKS**<br>1. Electrical & Electronic Technology by Hughes, Pearson Education India.<br>2. Introduction Electronic Devices & Circuit Theory, 11/e, 2012, Pearson: Boylestad & Nashelsky.<br>3. Electronics: Fundamentals and Applications By D. Chattopadhyay, P. C. Rakshit; New Age Int. Publication.<br>**REFERENCE BOOKS**<br>1. Advanced Electrical Technology by H. Cotton, Reem Publication Pvt. Ltd.<br>2. Electrical Engineering fundamentals by Vincent Deltoro, Pearson Edu. India.<br>3. The Art of Electronics 3e, by Paul Horowitz, Winfield Hill.<br>4. Electronics - Circuits and Systems, Fourth Edition by Owen Bishop.<br>5. Electronics Fundamentals: Circuits, Devices & Applications (8e) by Thomas L. Floyd & David M. Buchla. |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XEC02 | CO1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| | CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| | CO4 | 2 | 3 | 2 | 2 | - | 1 | - | - | - | - | - | 1 |
| | CO5 | 3 | 2 | 1 | 2 | 2 | 1 | - | - | 2 | - | - | 1 |
| | CO6 | 3 | 2 | 2 | 2 | 3 | - | - | - | 2 | - | - | 1 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CSS51** | **COMPUTER PROGRAMMING LABORATORY** | PCR | 0 | 0 | 3 | 3 | 2 |
| Pre-requisites | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| NIL | | CT+EA | | | | | |
| Course Outcomes | CO1: To understand the principle of operators, loops and branching statements.<br>CO2: Implementation of function, recursion, arrays, and pointers based several types of assignments.<br>CO3: To detail out the operations of strings.<br>CO4: To understand structure and union.<br>CO5: Application of C-programming to solve various types of problems. | | | | | | |
| Topics Covered | **List of Experiments:**<br>1. Programs on expression evaluation.<br>2. Programs on conditional statements and branching<br>3. Programs on iterations/loops.<br>4. Applications of Arrays<br>5. Programs on basics of functions and pointers.<br>6. Programs on string using array and pointers.<br>7. Programs on recursion.<br>8. Programs on structures, union.<br>9. Programs on File Operations.<br>10. Case Studies. | | | | | | |
| Text Books, and/or reference material | **Text Books:**<br>1. Y. Kanetkar, "Let Us C", BPB Publications, Sixteenth edition, 2017.<br>2. B. S. Gottfried, "Programming with C", McGraw Hill Education, 4th Ed., 2018.<br>3. E. Balagurusamy, "Computing Fundamentals and C Programming", McGraw Hill Education; Second edition, 2017.<br>**Reference Books:**<br>1. P. Dey and M. Ghosh, “Computer fundamentals and programming in C”, Oxford press, 2013.<br>2. R. Thareja, “Computer fundamentals and programming in C”, Oxford press, 2013.<br>3. Schaum’s Outline, Programming with C. | | | | | | |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSS51 | CO1 | 3 | 3 | 2 | - | - | 2 | - | - | - | - | - | - |
| | CO2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | - | - |
| | CO3 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | - |
| | CO4 | 2 | 3 | 2 | - | - | 2 | 1 | - | - | - | - | - |
| | CO5 | 3 | 3 | 3 | - | 1 | 2 | 1 | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| **Course Code** | **Title of the course** | Program Core (PCR) / Electives (PEL) | **Total Number of contact hours** | | | | **Credit** |
|---|---|---|---|---|---|---|---|
| | | | **Lecture (L)** | **Tutorial (T)** | **Practical (P)** | **Total Hours** | |
| **PHS51** | **Physics Laboratory** | PCR | **0** | **0** | **2** | **2** | **1** |
| **Pre-requisites** | | Course Assessment methods: (Continuous evaluation (CE) and end assessment (EA)) | | | | | |
| NIL | | CE+EA | | | | | |
| **Course Outcomes** | CO1: To realize and apply different techniques for measuring refractive indices of different materials.<br>CO2: To realize different types of waveforms in electrical signals using CRO.<br>CO3: To understand charging and discharging mechanism of a capacitor.<br>CO4: To understand interference, diffraction and polarization related optical phenomena.<br>CO5: To acquire basic knowledge of light propagation through fibers. | | | | | | |
| **Topics Covered** | 1. Find the refractive index of a liquid by a travelling microscope.<br>2. Determine the refractive index of the material of prism using spectrometer.<br>3. Determination of amplitude and frequency of electrical signals by oscilloscope.<br>4. To study the characteristics of RC circuits.<br>5. To study Brewster's law/Malus' law using laser light.<br>6. To study the diffraction of light by a grating.<br>7. To study the interference of light by Newton's ring apparatus.<br>8. To determine numerical aperture of optical fiber.<br>9. Determination of Planck constant. | | | | | | |
| **Text and/or reference material** | **SUGGESTED BOOKS**:<br>1) A Text Book on Practical Physics – K. G. Mazumdar and B. Ghosh<br>2) Practical Physics – Worsnop and Flint | | | | | | |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHS51 | CO1 | 3 | 2 | 1 | - | - | - | - | - | 2 | 1 | - | 1 |
| | CO2 | 3 | 2 | 1 | - | - | 1 | - | - | 2 | 1 | - | 1 |
| | CO3 | 3 | 1 | - | - | - | - | - | - | 2 | 1 | - | 1 |
| | CO4 | 3 | 2 | - | 1 | - | 1 | 1 | - | 2 | 1 | - | 1 |
| | CO5 | 3 | 2 | 1 | - | 1 | 1 | 1 | - | 2 | 1 | - | 1 |

**Correlation levels 1, 2 or 3 as defined below**: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CYS51** | **CHEMISTRY LABORATORY** | PCR | 0 | 0 | 2 | 2 | 1 |
| Pre-requisites | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| None | | CT+EA | | | | | |
| Course Outcomes | • CO1: To learn basic analytical techniques useful for engg applications.<br>• CO2: Synthesis and characterization methods of few organic, inorganic and polymer compounds of industrial importance.<br>• CO3: Learn chromatographic separation methods.<br>• CO4: Applications of spectroscopic measurements. | | | | | | |
| Topics Covered | 1. Experiments based on pH metry: Determination of dissociation constant of weak acids by pH meter.<br>2. Experiments based on conductivity measurement: Determination of amount of HCl by conductometric titration with NaOH.<br>3. Estimation of metal ion: Estimation of $Fe^{2+}$ by permangnomentry<br>4. Estimation of metal ion: Determ. of total hardness of water by EDTA titration.<br>5. Synthesis and characterization of inorganic complexes: e. g. $Mn(acac)_3$, $Fe(acac)_3$, cis-bis(glycinato)copper (II) monohydrate and their characterization by m. p. , FTIR etc.<br>6. Synthesis and charact. of organic compounds: e.g.Dibenzylideneacetone.<br>7. Synthesis of polymer: polymethylmethacrylate<br>8. Verification of Beer-Lamberts law and determination of amount of iron present in a supplied solution.<br>9. Chromatography: Separation of two amino acids by paper chromatography<br>10. Determination of saponification value of fat/ vegetable oil | | | | | | |
| | Suggested Text Books:<br>1. Vogel's Quantitative Chemical Analysis (6th Edition) Prentice Hall<br>2. Advanced Physical Chemistry Experiments: By Gurtu&Gurtu<br>3. Comprehensive Practical Organic Chemistry: Qualitative Analysis By V. K. Ahluwalia and S. Dhingra<br>Suggested Reference Books:<br>1. Practical Chemistry By R.C. Bhattacharya<br>2. Selected experiments in Physical Chemistry By N. G. Mukherjee | | | | | | |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CYS51 | CO1 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | - |
| | CO2 | - | 1 | - | 1 | 1 | 2 | - | - | - | - | - | - |
| | CO3 | 2 | - | - | 1 | 1 | - | - | - | - | - | - | - |
| | CO4 | - | 1 | - | 1 | 1 | - | - | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **XES51** | **ENGINEERING GRAPHICS** | PCR | 1 | 0 | 3 | 4 | 2.5 |
| Pre-requisites | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| NIL | | CT+EA | | | | | |
| Course Outcomes | • CO1: Ability of mental visualization of different objects<br>• CO2: Theoretical knowledge of orthographic projection to solve problems on one/two/three dimensional objects<br>• CO3: Able to read/interpret industrial drawing and to communicate with relevant people | | | | | | |
| Topics Covered | Graphics as language of communication; technical drawing tools and their up-keep; types of lines; construction of geometrical figures; lettering and dimensioning. [6]<br>Construction and use of scales; construction of curves of engineering importance such as curves of conic section; spirals, cycloids, involutes and different loci of points; use of equations for drawing some curves. [9]<br>Descriptive geometry: necessity and importance of orthographic projection; horizontal and vertical reference planes; coordinate of points; orthographic projection of points and lines situated in different quadrants, viz. 1st, 2nd, 3rd and 4th quadrants; traces of lines. First angle and third angle projection of lines and planes; views from top, front and left (or right); true length and true inclination of lines with planes of projections; primary auxiliary projection of points, lines and planes; auxiliary plan and auxiliary elevation. [9]<br>Projection of simple regular solids, viz. prisms, cubes, cylinders, pyramids, cones, tetrahedrons, spheres, hemi-spheres etc. [6]<br>Section of solids; section by perpendicular planes; sectional views; true shapes of sections. [6]<br>Dimensional techniques; international and national standards (ISO and BIS). [3]<br>Freehand graphics. [3] | | | | | | |
| Text and/or reference material | 1)… Engineering Drawing and Graphics – K Venugopal<br>2)… Engineering Drawing – N D Bhat<br>3)… Practical Geometry and Engineering Graphics – W Abbott | | | | | | |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **XES51** | CO1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| | CO2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| | CO3 | 1 | - | 1 | - | - | - | - | - | - | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **XES52** | **Basic Electrical and Electronics Laboratory** | PCR | 0 | 0 | 3 | 3 | 2 |
| Pre-requisites | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| NIL | | CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | CO1: Learn to analyse the electric circuits using network theorems.<br>CO2: Understand the characteristics of fluorescent lamp and compact fluorescent lamp.<br>CO3: Analyze the behaviour of single phase and three phase AC circuits.<br>CO4: Understand the application of electronics components, diode circuits as rectifier circuits and voltage regulators.<br>CO5: Evaluate and study the performance of the transistor as a switch.<br>CO6: Create inverting and non-inverting amplifier circuits using Op-Amp. |
| Labs Conducted. | 1. Verification of the network theorems (DC).<br>2. Study of the characteristics of fluorescent and compact fluorescent lamp.<br>3. Analysis of the three phase system for star and delta connected load.<br>4. Study of the series and parallel R-L-C circuit.<br>5. Identify and understand the use of different electronic and electrical instruments, various electronic components.<br>6. Study of half-wave and full-wave (bridge) rectifier with and without capacitor filter circuit. Zener diode as a voltage regulator.<br>7. Study the performance of a transistor as a switch through NOT gate.<br>8. Realization of Inverting and Non-inverting amplifier using Op-Amp. |
| Text Books, and/or reference material | **TEXT BOOK**<br>1. Handbook of Laboratory Experiments in Electronics and Electrical Engineering by A M Zungeru , J M Chuma, H U Ezea.<br>2. Experiments Manual for use with Electronic Principles (Engineering Technologies and the Trades) by Albert Paul Malvino Dr., David J. Bates, et al.<br>**REFERENCE BOOKS**<br>1. Laboratory Courses in Electrical Engineering ($5^{th}$ Edition) by S. G. Tarnekar, P. K. Kharbanda, S. B. Bodhke, S. D. Naik, D. J. Dahigaonkar (S. Chand Publications).<br>2. The Art of Electronics 3e, by Paul Horowitz, Winfield Hill.<br>3. Electronic Principles, by Albert Paul Malvino Dr. and David J. Bate. |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XES52 | CO1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| | CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 3 |
| | CO3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 3 |
| | CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| | CO5 | 3 | 2 | 1 | 2 | 2 | 1 | - | - | 2 | - | - | - |
| | CO6 | 3 | 2 | 2 | 2 | 3 | - | - | - | 2 | - | - | - |
| | CO7 | 3 | 3 | 2 | 2 | - | - | - | - | 2 | - | - | - |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CSS52** | **DATA STRUCTURES AND ALGORITHMS LABORATORY** | PCR | 0 | 0 | 3 | 3 | 2 |
| Pre-requisites | | Course Assessment methods (Continuous (CT) and end assessment (EA)) | | | | | |
| NIL | | CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | CO1: Understanding the suitability and compatibility of array and linked list implementations for different application problems.<br>CO2: Understanding the concept of abstract data types from real-life scenarios and their implementation in computing system.<br>CO3: Identify, design and implementation of stack, queue, binary tree, and graph as applicable for given problem.<br>CO4: Implementation of different searching and sorting techniques using appropriate data structures and perform efficiency analysis.<br>CO5: Create efficient algorithms for real-life applications. |
| Topics Covered | **List of Experiments:**<br>1. Application of arrays using dynamic memory allocation.<br>2. Implementation and Applications of linked lists.<br>3. Implementation of stack, and applications of stack.<br>4. Implementation of queue, applications of queue: Priority queue.<br>5. Implementation of Binary tree, Binary tree traversal: Preorder, Inorder and Postorder traversal.<br>6. Implementation of binary search tree and operations on it.<br>7. Implementation of linear search, binary search (recursive, non-recursive).<br>8. Implementation of different sorting algorithms.<br>9. Implementation of graph algorithms: Breadth first search, Depth first search.<br>10. Case Studies. |
| Text Books, and/or reference material | **Text Books:**<br>1. S. Lipschutz, “Data Structures (Schaum’s Outline Series)”, McGraw Hill Education; First edition (2017).<br>2. E. Horowitz, S. Sahni, S. Anderson-Freed, “Fundamentals of Data Structures in C”, Universities Press; Second edition (2008).<br>3. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India Private Limited, Seventh edition (2017).<br>**Reference Books:**<br>1. B. S. Gottfried, "Programming with C", McGraw Hill Education, 4th Ed. (2018). |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSS52 | CO1 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - |
| | CO2 | - | 1 | 1 | 3 | - | - | - | - | - | - | - | - |
| | CO3 | 2 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | - |
| | CO4 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - |
| | CO5 | 3 | 3 | 3 | 3 | 3 | - | 1 | 1 | - | - | 1 | 2 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **XXS51** | **Extra Academic Activities** | PCR | **0** | **0** | **2** | **2** | **1** |

| **Pre-requisites** | Course Assessment methods (Continuous (CT) and end assessment (EA)) |
|---|---|
| NIL | CT+EA |

| | |
|---|---|
| **Course Outcomes** | • CO1: Social Interaction through the medium of sports<br>• CO2: Team building and self defence |
| **Topics Covered** | **YOGA**<br>• Introduction of Yoga- Suryanamaskar. 1L<br>• Sitting Posture / Asanas – Padmasana, Vajrasana, Ardha Kurmasana, Ustrasana, Janusirshasana, Gomukhasana, Bhadrasana. 7L<br>• Mudra- Gyana Mudra, Chin Mudra. 1L<br>• Laying Posture/ Asana-Pavana Mukhtasana, Uttana Padasana, Sarpasana, Bhujangasana (Cobra Pose), Eka Pada Salabhasana, Dhanurasana, Chakrasana, Viparitkarani, Ardha Halasana (Half Plough Pose), Naukasana (Boat Posture), Shavasana (Relaxing Pose) , Makarasana. 7L<br>• Meditation-Om Chant. 1L<br>• Standing Posture / Asana-Tadasana (Mountain Pose), Vrikshana (Tree Pose), Ardha Chandrasana, Padahastasana, Ardha Chakrasana (Half Wheel Posture). 5L<br>• Pranayama-Deep Breathing, Anulom Vilom, Shitali, Bhramari. 5L<br>• Kriya- Kapalbhati 1L<br>**TAEKWONDO**<br>• Introduction About Taekwondo- Meaning Of Taekwondo, Korean Language Of Dress, Fighting Area, Punch, Block, Kicks Etc. 1L<br>• Stance- Ready Stance, Walking Stance, Front Stance, Back Stance. 2L<br>• Punch Technique- Front Fist Punch, Double Fist Punch, With Stance Etc. Blocks- Upper Blocks, Middle Block, Side Block, Suto Etc. 4L<br>• Foot Technique- Standing Kick, Front Kick, Doliyo, Back Kick Etc. 6L<br>• Poomsae (Forms)- Jang, Yi Jang. 6L<br>• Self Defense Technique- Self Defense from Arms, Fist and Punch. 4L<br>• Sparring (Kyorugi)- One Step Sparring 2L<br>• Combination Technique- Combined Kick And Punch. 2L<br>• Project Work 1L |

**Mapping of CO (Course outcome) and PO (Programme Outcome)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XXS51 | CO1 | - | - | - | - | - | 2 | - | - | 2 | - | - | 1 |
| | CO2 | - | - | - | - | - | - | - | 2 | 3 | - | - | 1 |

**Correlation levels 1, 2 or 3 as defined below**:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)