GLOBAL INSTITUTE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)
COURSE CATALOGUE
REGULATIONS B.TECH – GR - 25
MECHANICAL ENGINEERING
I YEAR II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods Per Week			Credits	Scheme of Examination Max Marks		
				L	T	P		CIA	SEE	Total
THEORY										
MA201BS	Ordinary Differential Equations and Vector Calculus	BSC	Foundation	3	0	0	3	40	60	100
ME202ES	Engineering Mechanics	ESC	Foundation	3	0	0	3	40	60	100
EC203ES	Elements of Electrical and Electronics Engineering	ESC	Foundation	3	0	0	3	40	60	100
ME204ES	Thermodynamics	ESC	Foundation	3	0	0	3	40	60	100
CS205ES	Python Programming	ESC	Foundation	3	0	0	3	40	60	100
CH206BS	Engineering Chemistry	BSC	Foundation	3	0	0	3	40	60	100
PRACTICAL										
EC207ES	Elements of Electrical and Electronics Engineering Lab	ESC	Foundation	0	0	2	1	40	60	100
CH208BS	Engineering Chemistry Lab	BSC	Foundation	0	0	2	1	40	60	100
CS209ES	Python Programming Lab	ESC	Foundation	0	0	2	1	40	60	100
			Total Credits	**18**	**0**	**6**	**21**			

COURSE CONTENT

ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS								
I Year - II Semester: ECE, CSE, CSE (AI & ML), CSE (Data Science), CE & ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MA201BS	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite: Mathematical Knowledge at the pre-university level								

1. COURSE OVERVIEW

This course serves as a foundation course on differential equations and vector calculus. It includes techniques for solving ordinary differential equations, partial differential equations, vector differentiation and vector integration. It is designed to extract the mathematical developments, and skills, from basic concepts to advanced level of engineering problems to meet technological challenges.

2. COURSE OBJECTIVE

The students will try to Learn:

1) Methods of solving the differential equations of first and higher order.
2) Concept, properties of Laplace transforms
3) Solving ordinary differential equations using Laplace transform techniques
4) The physical quantities involved in the engineering field related to vector-valued functions
5) The basic properties of vector-valued functions and their applications to line, surface and volume integrals

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Identify whether the given differential equation of first order is exact or not.
CO 2	Solve higher differential equations and apply the concept of differential equations to real-world problems.
CO 3	Use the Laplace transforms techniques to solve ODEs.
CO 4	To find Gradient, Divergence, Curl and Vector identities
CO 5	Evaluate the line, surface and volume integrals and convert them from one to another

4. COURSE CONTENT

UNIT - I: First Order Ordinary Differential Equations **8 L**

Exact differential equations – Equations reducible to exact differential equations – linear and Bernoulli's equations – Orthogonal Trajectories (only in Cartesian Coordinates).

Applications: Newton's law of cooling – Law of natural growth and decay.

UNIT - II: Ordinary Differential Equations of Higher Order **10 L**

Second-order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax}, sinax , cosax, polynomials in $x, e^{ax}V(x), and\ xV(x)$, Method of variation of parameters.

UNIT - III: Laplace Transforms **10 L**

Laplace Transforms: Laplace Transform of standard functions – First shifting theorem – Laplace transforms of functions multiplied by 't' and divided by 't' – Laplace transforms of derivatives and integrals of function – Evaluation of integrals by Laplace transforms – Laplace transform of periodic functions – Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

UNIT - IV: Vector Differentiation **10 L**

Vector point functions and scalar point functions – Gradient – Divergence and Curl – Directional derivatives – Vector Identities – Scalar potential functions – Solenoidal and Irrotational vectors**.**

UNIT-V: Vector Integration **10 L**

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

5. TEXT BOOKS

1) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2) R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition, 2016.

6. REFERENCE BOOKS

1) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3) N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications,
4) Reprint, 2008.
5) H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**2**										**2**	**3**	**2**
CO 2	**2**	**3**										**2**	**2**	**3**
CO 3	**2**	**3**											**2**	**3**
CO 4	**3**	**-**	**1**		**2**							**2**	**3**	**-**
CO 5	**3**	**3**			**1**							**2**	**3**	**3**

COURSE CONTENT

ENGINEERING MECHANICS								
I Year - II Semester: ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME202ES	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite:								

1. COURSE OVERVIEW

This course offers a comprehensive foundation in Engineering Mechanics, covering force systems, rigid body equilibrium, and the principles of moments and couples. It delves into frictional behaviour, centroids, and centres of gravity, essential for structural analysis and design. Students explore moment of inertia concepts for both area and mass, including key theorems and composite bodies. The dynamics of particles and rigid bodies are examined through motion analysis, Newtonian mechanics, and energy principles. By integrating theory with practical applications, the course equips learners with analytical tools to solve real-world mechanical problems.

2. COURSE OBJECTIVE

1) To introduce the fundamental principles of force systems and equip students with analytical tools to solve problems involving rigid body equilibrium in two and three dimensions.
2) To develop an understanding of frictional forces and teach methods for locating centroids and centres of gravity in various engineering structures.
3) To enable students to compute area and mass moments of inertia using core theorems and apply these concepts to structural and mechanical design.
4) To provide a foundation in particle dynamics through the study of motion, forces, energy, and momentum using multiple coordinate systems.
5) To apply principles of kinetics and energy methods to analyse the motion of rigid bodies and mechanical systems in planar motion.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Analyse and solve problems involving force systems and rigid body equilibrium using vector mechanics and free body diagrams.
CO 2	Understand the principles of friction and be able to determine centroids and centres of gravity for various geometries and composite bodies.
CO 3	Calculate area and mass moments of inertia for standard and composite sections using fundamental theorems and principles.
CO 4	Apply Newton's laws and energy-momentum principles to analyse the motion of particles in rectilinear and curvilinear paths.
CO 5	Evaluate the motion of rigid bodies using D'Alembert's principle and work-energy methods in planar mechanical systems.

4. COURSE CONTENT

UNIT - I: Introduction to Engineering Mechanics

Force Systems: Basic concepts, Rigid Body equilibrium, System of Forces, Parallelogram law, Coplanar Concurrent Forces, Components of forces in Space, Resultant, Moment of Forces and its Application. Couples and Resultant of Force System: Equilibrium of Force Systems, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

UNIT - II: Friction and Centre of Gravity

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction. Motion of Bodies, Wedge friction, Screw jack and Differential Screw jack. Centroid and Centre of Gravity: Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections, Centre of Gravity and its implications, Theorem of Pappus.

UNIT - III: Moment of Inertia

Definition, Area Moment of Inertia, Moment of inertia of Plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections. Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem. Mass Moment of Inertia: Moment of Inertia of Masses, Radius of Gyration, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of composite bodies.

UNIT - IV: Dynamics of a Particle

Rectilinear motion, Plane curvilinear motion: Rectangular and Polar coordinates. Relative and constrained motion, Newton's law of motion for a particle (rectangular, path, and polar coordinates). Work -kinetic energy, power, potential energy. Impulse and momentum: Linear, Angular, Elastic Impact (Direct and oblique).

UNIT - V: Kinetics of Rigid Bodies

Introduction, 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 Method: Work-Energy principle and its application in plane motion of connected bodies or Systems, Work energy Applied to particle motion, Kinetics of rigid body rotation.

5. TEXT BOOKS

1) Singer's Engineering Mechanics – Statics and Dynamics, Reddy Vijay Kumar K. and J. Suresh Kumar. B.S Publications, 3rd Edition, Rpt. 2024.
2) Engineering Mechanics, Shames and Rao, Pearson Education, 1st Edition, 2005.

6. REFERENCE BOOKS

1) Vector Mechanics for Engineers – Statics and Dynamics, Beer F.P and Johnston E.R Jr., Mc Graw Hill, 12th Edition, 2019.
2) Engineering Mechanics, Dumir P.C, Sengupta and Srinivas, Universities Press, 1st Edition, 2020.
3) Engineering Mechanics, Hibbeler R.C, Pearson, 14th Edition, 2017.
4) Engineering Mechanics, Arshad Noor, Zahid and Goel, Cambridge University Press,1st Edition, 2018.
5) Engineering Mechanics, Basudeb Bhattacharyya, Oxford University Press, 2nd Edition, 2014.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**2**	**2**	**1**	**1**					**1**			**2**	**2**	**2**
CO 2	**2**	**2**	**1**	**1**					**1**			**2**	**2**	**2**
CO 3	**2**	**2**	**1**	**2**					**1**			**2**	**2**	**2**
CO 4	**2**	**2**	**1**	**2**					**1**			**2**	**2**	**2**
CO 5	**2**	**2**	**1**	**1**					**1**			**2**	**2**	**2**

COURSE CONTENT

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING								
I Year - II Semester: CE / ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
EC203ES	**FOUNDATION**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite: Nil								

1. COURSE OVERVIEW

Course is about to design and analyze Analog circuits and systems using fundamental principles of Electronic Devices.

2. COURSE OBJECTIVE

The students will try to Learn:

1) To understand magnetic circuits, DC circuits and AC single phase and three phase circuits.
2) To study and understand the different types of DC, AC machines and Transformers.
3) To import the knowledge of various electrical installations.
4) To introduce the concept of power, power factor and its improvement.
5) To introduce the concepts of diodes and transistors, and
6) To impart the knowledge of various configurations, characteristics and applications.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	To analyze and solve electrical circuits using network laws and theorems.
CO 2	To understand and analyze basic Electric and Magnetic circuits
CO 3	To study the working principles of Electrical Machines
CO 4	To introduce components of Low Voltage Electrical Installations
CO 5	To identify and characterize diodes and various types of transistors.

4. COURSE CONTENT

UNIT – I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL and KCL, analysis of simple circuits with dc excitation. A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits, Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT – II:

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT - III:

Electrical Machines: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three phase Induction motor, Torques equations and Speed control of Three phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:

P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt, Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications. Rectifiers and Filters: P-N junction as a rectifier, Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V:

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations. Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

5. TEXT BOOKS

1) Basic Electrical and electronics Engineering, M S Sukija and TK Nagasarkar, Oxford University, 1st Edition, 2012.
2) Basic Electrical and electronics Engineering, D P Kothari and I J Nagarath, McGraw Hill Education, 2nd Edition, 2020.

6. REFERENCE BOOKS

1) Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI,9th Edition, 2006
2) Millman's Electronic Devices and Circuits,J. Millman, C. C. Halkias and Satyabrata Jit, TMH, 2nd Edition, 1998.
3) Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971.
4) Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press, 2nd edition, 2004.
5) Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005.
6) Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011.
7) Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th edition, 2003.
8) Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010.
9) Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989.

7. ELECTRONIC RESOURCES

1) **https://onlinecourses.nptel.ac.in/noc21_ee80/preview**

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**2**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
CO 2	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO 3	**2**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**
CO 4	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO 5	**3**	**2**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

COURSE CONTENT

THERMODYNAMICS								
I Year - II Semester: Mechanical Engineering								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME204ES	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite:								

1. COURSE OVERVIEW

This course introduces the fundamental principles of thermodynamics, including the study of systems, properties, and processes. It covers the First and Second Laws of Thermodynamics and their application to closed and open systems. Students learn about entropy, thermodynamic property relations, and the behaviour of ideal and real gases. The course explores psychometrics, gas mixtures, and various power and refrigeration cycles. Emphasis is placed on applying theoretical knowledge to analyse energy systems and evaluate cycle performance.

2. COURSE OBJECTIVE

The students will try to Learn:

1) To introduce the basic concepts and laws of thermodynamics.
2) To apply the first and second laws to closed and open systems.
3) To understand the properties of pure substances and their use in thermodynamic processes.
4) To study the working principles and performance of thermodynamic cycles.
5) To prepare students for applications in engines, power plants and refrigeration.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Understand the basics of Thermodynamics
CO 2	Apply first and second laws of thermodynamics to different systems
CO 3	Determine the feasibility of a process w.r.to entropy changes
CO 4	Apply concepts of thermodynamic property relations to ideal gas and real gases
CO 5	Evaluate performance of power cycles and refrigeration cycles

4. COURSE CONTENT

UNIT-I: Basic Concepts and First Law of Thermodynamics

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale, PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

UNIT-II: Second Law of Thermodynamics and Availability

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

UNIT-III: Pure Substance and Perfect Gas

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

UNIT-IV: Real Gas models and Perfect Gas Mixtures

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT-V: Psychrometry and Thermodynamic Cycles

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

Thermodynamic Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton and Rankine cycles – Performance Evaluation. Refrigeration Cycles: Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

5. TEXT BOOKS

1) Engineering Thermodynamics, P.K. Nag, Mc Graw Hill, 7th Edition, 2020.
2) Fundamentals of Thermodynamics, Richard E. Sonntag and Claus Borgnakke, Wiley, 8th Edition, 2014.

6. REFERENCE BOOKS

1) Thermodynamics, Yunus A Cengel, Michael A Boles, Mehmet Kanoglu, McGraw-Hill, 9th Edition, 2019.
2) Thermodynamics, J.P. Holman, McGraw Hill Education, 10th Edition, 2010.
3) Engineering Thermodynamics, Chattopadhyay, Oxford, 2nd Edition, 2015.
4) Engineering Thermodynamics, Rogers, Pearson, 4th Edition, 1996.
5) Engineering Thermodynamics, M Achuthan, PHI, 2nd Edition, 2009.
6) Thermodynamics for Engineers, Kenneth A. Kroos, Merle C. Potter, Cengage, 1st Edition, 2014.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**2**	**2**		**1**								**2**	**2**
CO 2	**3**	**3**	**2**	**2**	**1**		**2**						**3**	**2**
CO 3	**3**	**3**	**3**	**2**	**2**								**3**	**2**
CO 4	**3**	**2**	**2**	**2**	**3**								**2**	**3**
CO 5	**3**	**2**	**2**	**2**	**3**		**2**						**2**	**3**

COURSE CONTENT

PYTHON PROGRAMMING								
I Year - II Semester: CE / ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
CS205ES	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite: Basic knowledge of computer fundamentals, C programming.								

1. COURSE OVERVIEW

This course provides a comprehensive introduction to Python programming, designed for beginners and those looking to strengthen their coding skills. You will learn fundamental programming concepts, syntax, and practical applications of Python in various fields such as web development, data analysis, automation, and more.

2. COURSE OBJECTIVE

The students will try to Learn:

Introduce the fundamentals of Python programming for problem-solving.

1) Develop skills to write structured, modular, and efficient Python code.
2) Enable students to use Python's built-in data structures and libraries effectively.
3) Provide knowledge on file handling, exception handling, and object-oriented programming in Python.
4) Equip students with the ability to apply Python for real-world applications including data processing and automation.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Write Python programs using variables, operators, expressions, and control structures.
CO 2	Implement Python programs using built-in data structures like lists, tuples, sets, and dictionaries.
CO 3	Apply modular and object-oriented programming principles in Python.
CO 4	Handle files, exceptions, and apply Python libraries for problem-solving.
CO 5	Develop small-scale applications in Python for automation and data manipulation.

4. COURSE CONTENT

UNIT - I: **(10L)**

Introduction to Python and Basics of Programming Introduction to Python: Features, Applications, Installation, IDEs, Python Syntax, Indentation, Comments, Variables, Data Types, Type Casting, Operators: Arithmetic, Relational, Logical, Assignment, Membership, Identity, Bitwise, Input/Output functions (input(), print()), Control Structures: if, if-else, if-elif-else, Nested Conditions, Looping: for, while, Nested Loops, break, continue, pass.

UNIT - II: **(10L)**

Data Structures in Python Strings: Creation, Indexing, Slicing, Methods, String Formatting, Lists: Creation, Indexing, Slicing, List Comprehension, Methods, Tuples: Properties, Indexing, Methods, Sets: Creation, Operations, Methods, Dictionaries: Creation, Access, Methods, Dictionary Comprehension, Iterating over data structures.

UNIT – III **(10L)**

Functions and Modules Functions: Defining, Calling, Parameters, Return Values, Types of Arguments: Positional, Keyword, Default, Variable Length, Scope of Variables: Local and Global, Lambda Functions, Map, Filter, Reduce, Recursion in Python, Modules: Importing, Creating User-defined Modules, Standard Modules (math, random, datetime), Packages in Python.

UNIT - IV: **(9L)**

File Handling and Exception Handling File Handling: Opening, Reading, Writing, Appending, File Modes, File Methods, Working with CSV and JSON Files, Exception Handling: try, except, else, finally, Built-in Exceptions, Raising Exceptions, Introduction to Regular Expressions (re module).

UNIT - V: **(9L)**

Object-Oriented Programming and Applications OOP Basics: Classes, Objects, Attributes, Methods, Constructor (__init__), self keyword, Inheritance: Single, Multiple, Multilevel, Hierarchical, Method Overriding, Method Overloading (conceptual), Encapsulation and Polymorphism, Application Development: Data Processing Script, Basic Calculator, File Organizer, Simple Data Analysis with pandas.

5. TEXT BOOKS

1) Python Programming: Using Problem Solving Approach by Reema Thareja.
2) Python Crash Course by Eric Matthes, Learning Python by Mark Lutz.

6. REFERENCE BOOKS

1) Introduction to Python Programming by Gowrishankar S., Veena A.
2) Python Cookbook by David Beazley and Brian K. Jones.
3) Fluent Python by Luciano Ramalho, Automate the Boring Stuff with Python by Al Sweigart.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**3**	**2**	**1**	**3**	**1**	**0**	**0**	**2**	**2**	**1**	**3**	**3**	**3**
CO 2	**3**	**3**	**3**	**2**	**3**	**1**	**0**	**0**	**2**	**2**	**1**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**2**	**3**	**1**	**0**	**1**	**2**	**2**	**1**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**2**	**3**	**1**	**0**	**1**	**2**	**2**	**1**	**3**	**3**	**3**
CO 5	**3**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**3**	**2**	**3**	**3**	**3**

COURSE CONTENT

ENGINEERING CHEMISTRY								
I Year - I Semester: CSE **I Year - II Semester: CE, ME, ECE, CSE(AIML), CSE(DS)**								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
CH206BS	**FOUNDATION**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**-**	**-**	**3**	**40**	**60**	**100**
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				**Total Classes: 48**		
Prerequisite: Basic principles of Chemistry								

1. COURSE OVERVIEW

Engineering Chemistry Course, focuses on the chemical principles and technologies relevant to engineering and industry. It covers water chemistry and treatment methods, electrochemical processes, batteries, corrosion mechanisms and control techniques, and the application of smart materials and biosensors. The course also explores challenges and future opportunities in sustainable energy solutions, particularly green hydrogen.

2. COURSE OBJECTIVE

The students will try to Learn:

1) The new advances in Engineering Chemistry and acquire the essential skills to become a competent engineering professional.
2) The industrial significance of water treatment, fundamental principles of battery chemistry, and the impact of corrosion along with its control methods for structural protection.
3) The foundational knowledge of various energy sources and their practical applications in engineering and classification, properties, and engineering applications of polymers for material selection and industrial advancements.
4) The working of smart materials, biosensors, and analytical techniques applicable in engineering, industrial, environmental, and biomedical fields.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Understand the fundamental properties of water and its applications in both domestic and industrial purposes.
CO 2	Gain basic knowledge of electrochemical processes and their relevance to corrosion and its control methods.
CO 3	Comprehend the significance and practical applications of batteries and various energy sources, enhancing their potential as future engineers and entrepreneurs.
CO 4	The basic concepts and properties of polymers, lubricants and other engineering materials.
CO 5	Apply the principles of UV-Visible, IR spectroscopy and Raman spectroscopy in analyzing pollutants in dye industries and biomedical applications.

4. COURSE CONTENT

UNIT – I: Water and its treatment: [8]

Introduction, types of hardness and units– Estimation of hardness of water by complexometric method - Numerical problems. Potable water and its specifications (WHO) - Steps involved in the treatment of potable water – Disinfection of potable water by chlorination and break-point chlorination. Defluoridation - Nalgonda technique.

Boiler troubles: Scales, Sludges and Caustic embrittlement. Internal treatment of boiler feed water - Calgon conditioning, Phosphate conditioning, Colloidal conditioning. External treatment methods - Softening of water by ion- exchange processes. Desalination of brackish water - Reverse osmosis.

UNIT – II: Electrochemistry and Corrosion [8]

Introduction - Electrode potential, standard electrode potential, types of electrodes, Nernst equation (no derivation), Galvanic cell, cell representation, EMF of cell- Numerical problems. Reference electrodes - Primary reference electrode – Standard Hydrogen Electrode (SHE), Secondary reference electrode - Calomel electrode. Determination of pH of an unknown solution using SHE and Calomel electrode.

Corrosion: Introduction - Definition, causes and effects of corrosion - Theories of corrosion, chemical and electrochemical corrosion - Mechanism of electrochemical corrosion, Types of corrosion: galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion - Nature of the metal, Nature of the corroding environment. Corrosion control methods - Cathodic protection Methods - Sacrificial anode and impressed current methods.

UNIT - III: Energy Sources: [8]

Batteries: Introduction – Classification of batteries - Primary, secondary and reserve batteries with examples. Construction, working and applications of Zn-air and Lithium ion battery. Fuel Cells – Differences between a battery and a fuel cell, construction and applications of Direct Methanol Fuel Cell (DMFC).

Fuels: Introduction and characteristics, Calorific value of fuel - HCV, LCV- Dulong's formula –Numerical problems.

Fossil **fuels:** Introduction, classification, Petroleum - Refining of Crude oil, Cracking - Moving bed catalytic cracking. LPG and CNG - composition and uses.

Synthetic Fuels: Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen.

UNIT - IV: Polymers: [8]

Definition, classification of polymers: Based on origin and tacticity with examples - Types of polymerization - Addition (free radical addition mechanism) and condensation polymerization.

Plastics, Elastomers and Fibers: Definition and applications (PVC, Buna-S, Nylon-6,6).

Thermoplastics and thermosetting plastics, Fiber reinforced plastics (FRP).

Conducting polymers: Definition and classification with examples - Mechanism of conduction in trans-Polyacetylene and applications of conducting polymers.

Biodegradable polymers: Polylactic acid (PLA) and its applications.

UNIT - V: Applications of Materials: [8]

Cement: Portland cement, its composition, setting and hardening.

Phase rule: Definition – Phase, component, degrees of freedom. Phase rule equation. Phase diagrams - One component system - water. Two component system - Lead silver system.

Lubricants: Definition and characteristics of a good lubricant – thin film mechanism of lubrication, properties of lubricants - viscosity, cloud and pour point, flash and fire point.

Interpretative spectroscopic applications of UV-Visible spectroscopy for Analysis of pollutants in dye industry, IR spectroscopy in night vision-security, Pollution Under Control- CO sensor (Passive Infrared detection).

5. TEXT BOOKS

1) Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010.
2) Engineering Chemistry by Rama Devi, Dr.P.Aparna and Rath, Cengage learning, 2025.
3) Engineering Chemistry: by Thirumala Chary Laxminarayana & Shashikala, Pearson Publications (2020).
4) Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011.
5) Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007.
6) Raman Spectroscopy in Human Health and Biomedicine.

6. REFERENCE BOOKS

1) Engineering Chemistry: by Thirumala Chary Laxminarayana & Shashikala, Pearson Publications (2020)
2) Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011.
3) Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007.
4) Raman Spectroscopy in Human Health and Biomedicine.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**2**													**2**
CO 2	**1**		**3**				**2**							
CO 3	**1**				**3**									**2**
CO 4	**3**				**2**									
CO 5	**3**	**2**												

COURSE CONTENT

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING LAB								
I Year - II Semester: CE / ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
EC207ES	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	**-**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 32				**Total Classes: 32**		
Prerequisite: Nil								

1. COURSE OVERVIEW

Course is about to design and analyze Analog circuits and systems using fundamental principles of Electronic Devices.

2. COURSE OBJECTIVE

The students will try to Learn:

1) To understand magnetic circuits, DC circuits and AC single phase and three phase circuits.
2) To study and understand the different types of DC, AC machines and Transformers.
3) To import the knowledge of various electrical installations.
4) To introduce the concept of power, power factor and its improvement.
5) To introduce the concepts of diodes and transistors, and
6) To impart the knowledge of various configurations, characteristics and applications.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	To analyze and solve electrical circuits using network laws and theorems.
CO 2	To understand and analyze basic Electric and Magnetic circuits
CO 3	To study the working principles of Electrical Machines
CO 4	To introduce components of Low Voltage Electrical Installations
CO 5	To identify and characterize diodes and various types of transistors.

4. COURSE CONTENT

1) **PART A:** ELECTRICAL
   1) Verification of KVL and KCL
   2) (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer (ii) Verification of Relationship between Voltages and Currents (StarDelta, DeltaDelta, Delta Star, StarStar) in a Three Phase Transformer
   3) Measurement of Active and Reactive Power in a balanced Three phase circuit.
   4) Performance Characteristics of a Separately Excited DC Shunt Motor
   5) Performance Characteristics of a Three phase Induction Motor
   6) No Load Characteristics of a Three phase Alternator

2) **PART B:** ELECTRONICS
   1) Study and operation of (i) Multimeters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
   2) P-N Junction diode characteristics
   3) Zener diode characteristics and Zener as voltage Regulator
   4) Input and Output characteristics of Transistor in CB, CE configuration
   5) Full Wave Rectifier with and without filters
   6) Input and Output characteristics of FET in CS configuration

5. REFERENCE BOOKS

1) Lab manual for Analog Circuits.

6. MATERIALS ONLINE

Course template
Lab manual

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**2**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
CO 2	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO 3	**2**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**
CO 4	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO 5	**3**	**2**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

COURSE CONTENT

ENGINEERING CHEMISTRY LABORATORY								
I Year - I Semester: CSE **I Year - II Semester: ECE, CE, ME, CSE(AI&ML), CSE(DS)**								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
CH208BS	**FOUNDATION**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	**-**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 32				**Total Classes: 32**		
Prerequisite: Basic principles of chemistry								

1. COURSE OVERVIEW

This laboratory course equips B. Tech students with practical skills in key chemical analysis techniques such as volumetric analysis, conductometry, potentiometry, and pH measurement, enabling precise quantification of chemical substances. It also includes experiments on polymer preparation, corrosion rate determination, and lubricant property evaluation. Additionally, virtual lab sessions introduce students to advanced topics like fuel cells, smart biomedical materials, electric vehicle batteries, and solar cell applications, bridging theoretical knowledge with modern technological advancements and fostering a comprehensive understanding of chemistry's role in engineering.

2. COURSE OBJECTIVE

The students will try to Learn:

1) The core chemical principles relevant to engineering applications.
2) The water hardness estimation method to assess its suitability for drinking purposes.
3) The ability to perform acid-base titrations using instrumental methods such as conductometry, potentiometry, and pH metry.
4) The hands-on synthesis of polymers, specifically Bakelite and Nylon – 6, 6, gaining practical experience in polymer preparation techniques in the laboratory.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Perform volumetric analysis by estimating water hardness using complexometry
CO 2	Develop skills in conductometric techniques to determine the concentration of acids.
CO 3	Gain practical experience in potentiometric analysis in to estimate acid concentration and also Iron(II) from the given samples
CO 4	Understand and apply pH metry techniques to determine acid concentrations
CO 5	Acquire hands-on experience in polymer synthesis by preparing Bakelite and Nylon-6,6 in the laboratory.
CO 6	Explore corrosion measurement methods, lubricant property evaluation, and virtual labs on renewable energy technologies, smart materials, and battery applications to bridge theoretical concepts with modern engineering applications.

4. LIST OF EXPERIMENTS / DEMONSTRATIONS:

1) Volumetric Analysis: Estimation of Hardness of water by EDTA Complexometry method.
2) Conductometry:
    a) Estimation of the concentration of strong acid by Conductometry.
    b) Estimation of the concentration of strong and weak acid in an acid mixture by Conductometry.

3) Potentiometry:
    a) Estimation of concentration of Fe+2ion by Potentiometry using KMnO4.
    b) Estimation of concentration of strong acid with strong base by Potentiometry using quinhydrone.
4) pH Metry: Determination of an acid concentration using pH meter.
5) Preparations:
    a) Preparation of Bakelite.
    b) Preparation Nylon – 6, 6.
6) Corrosion: Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.
7) Lubricants:
    a) Estimation of acid value of given lubricant oil.
    b) Estimation of viscosity of lubricant oil using Ostwald's Viscometer.
8) Virtual lab experiments:
    a) Construction of Fuel cell and it's working.
    b) Smart materials for Biomedical applications.
    c) Batteries for electrical vehicles.
    d) Functioning of solar cell and its applications.

5. REFERENCE BOOK

1) Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022).
2) Vogel's text book of practical organic chemistry 5th edition.
3) Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
4) College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007).

6. MATERIALS ONLINE

a) Course template
b) Lab manual

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**2**													**2**
CO 2	**1**		**3**				**2**							
CO 3	**1**				**3**									**2**
CO 4	**3**				**2**									
CO 5	**3**	**2**												

COURSE CONTENT

PYTHON PROGRAMMING LAB								
I Year - II Semester: ME								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
CS209ES	**FOUNDATION**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	**-**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 32				**Total Classes: 32**		
Prerequisite: Nil								

1. COURSE OVERVIEW

The course focuses on practical Python programming skills through a series of progressively challenging tasks. In the initial weeks, students get familiar with Python basics, including using the interpreter, writing simple programs, and understanding basic functions. As the course advances, students work on more complex problems like matrix operations, file handling, and implementing algorithms. They also explore object-oriented programming concepts, exception handling, and basic GUI development. The course culminates with applications in numerical computing and digital logic, preparing students for real-world problem-solving scenarios.

2. COURSE OBJECTIVE

The students will try to Learn:

1) To install and run the Python interpreter.
2) To learn control structures.
3) To Understand Lists, Dictionaries in python.
4) To Handle Strings and Files in Python.

3. COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	Develop the application specific codes using python.
CO 2	Understand Strings, Lists, Tuples and Dictionaries in Python
CO 3	Verify programs using modular approach
CO 4	Verify programs using file I/O, Python standard library
CO 5	Implement Digital Systems using Python

4. LIST OF EXPERIMENTS:

1)
   a) Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.
   b) Start the Python interpreter and type help () to start the online help utility.
2) Start a Python interpreter and use it as a Calculator.
3) Write a program to calculate compound interest when principal, rate and number of periods are given.

4) Read the name, address, email and phone number of a person through the keyboard and print the details.

5) Print the below triangle using for loop.

```
 5
4 4
3 3 3
2 2 2 2
1 1 1 1 1
```

6) Write a program to check whether the given input is digit or lowercase character or uppercase character or a special character (use 'if-else-if' ladder)

7) Python program to print all prime numbers in a given interval (use break)

8) Write a program to convert a list and tuple into arrays.

9) Write a program to find common values between two arrays.

10) Write a function called palindrome that takes a string argument and returns True if it is a palindrome and False otherwise. Remember that you can use the built-in function len to check the length of a string.

11) Write a function called is sorted that takes a list as a parameter and returns True if the list is sorted in ascending order and False otherwise.

12) Write a function called has duplicates that takes a list and returns True if there is any element that appears more than once. It should not modify the original list.

13) Write a function called remove duplicates that takes a list and returns a new list with only the unique elements from the original. Hint: they don't have to be in the same order.

14) The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add "I", "a", and the empty string.

15) Write a python code to read dictionary values from the user. Construct a function to invert its content. i.e., keys should be values and values should be keys.

16) Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'

17) Remove the given word in all the places in a string?

18) Write a function that takes a sentence as an input parameter and replaces the first letter of every word with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?

19) Writes a recursive function that generates all binary strings of n-bit length

20) Write a python program that defines a matrix and prints

21) Write a python program to perform multiplication of two square matrices

22) How do you make a module? Give an example of construction of a module using different geometrical shapes and operations on them as its functions.

23) Use the structure of exception handling all general-purpose exceptions.

24) Write a function called draw_rectangle that takes a Canvas and a Rectangle as arguments and draws a representation of the Rectangle on the Canvas.

25) Add an attribute named color to your Rectangle objects and modify draw_rectangle so that it uses the color attribute as the fill color.

26) Write a function called draw_point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas.

27) Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw_circle that draws circles on the canvas.

28) Write a python code to read a phone number and email-id from the user and validate it for correctness.

29) Write a Python code to merge two given file contents into a third file.

30) Write a Python code to open a given file and construct a function to check for given words present in it and display on found.

31) Write a Python code to Read text from a text file, find the word with most number of occurrences

32) Write a function that reads a file *file1* and displays the number of words, number of vowels, blank spaces, lower case letters and uppercase letters.

33) Import numpy, Plotpy and Scipy and explore their functionalities.

34) Install NumPy package with pip and explore it.

35) Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR

36) Write a GUI program to create a window wizard having two text labels, two text fields and two buttons as Submit and Reset.

5. TEXT BOOKS

1) Supercharged Python: Take your code to the next level, Overland.
2) Learning Python, Mark Lutz, O'reilly.

6. REFERENCE BOOKS

1) Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
2) Python Programming A Modular Approach with Graphics, Database, Mobile, and Web Applications, Sheetal Taneja, Naveen Kumar, Pearson.
3) Introduction to Python Programming, Gowrishakar S, Veena A, CRC Press.
4) Programming with Python, A User's Book, Michael Dawson, Cengage Learning, India Edition.
5) Python for Data Science, Dr. Mohd Abdul Hameed, Wiley publications.
6) Core Python Programming, Dr. R. Nageswara Rao, Dreamtech press.
7) Introduction to Python, Gowrishankar S, Veena A., CRC Press.

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	**3**	**2**	**2**	**1**	**2**							**1**		
CO 2	**3**	**3**	**2**	**2**	**2**							**1**		
CO 3	**3**	**3**	**2**	**2**	**3**							**2**		
CO 4	**3**	**3**	**2**	**2**	**3**							**2**		
CO 5	**3**	**2**	**2**	**1**	**3**							**2**		