



Four-Year Undergraduate Programme

Bachelor of Technology

Mathematics and Computing

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

1. Vision of the Department

“To offer quality applied education to the youngsters for excellence in their branch and catalysing their better career prospects and opportunities ahead by increasing their mathematical and physical science knowledge and grooming them for campus drive.”

2. Mission of the Department

M1: The mission of Aeronautical Engineering Department is to assure quality students getting salutary position in society.

M2: Empower graduates to excel in research across all facets of Mathematics and computing, equipping them with the skills and knowledge needed for impactful contributions to the field.

M3: Foster a teaching environment that emphasizes depth, originality, and critical thinking, ensuring our students develop a strong foundation between theoretical subjects and industrial application.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Mathematics and computing curriculum enables graduates to attain.

PEO 1	Pursue successful career in engineering involving professional knowledge and skills for analysis, design and solution of real time engineering problems.
PEO 2	Excel in professional career with sound fundamental knowledge and pursue life-long learning including higher education and research.
PEO 3	Demonstrate interpersonal skills, leadership ability and team building to achieve organization goals and serve society with professional ethics and integrity.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Engineering knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	Problem analysis:	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	Design/development of solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PLO 4	Conduct investigations of complex problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PLO 5	Modern tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	The engineer and society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	Environment and sustainability:	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	Individual and team work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	Project management and finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	Life-long learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO-1	Understanding between Mathematics and computing systems	Exhibit a strong theoretical foundation in mathematics and design interfaces between computing subsystems.
PSO-2	Demand as per recent development	Integrate mathematical principles with computing techniques to address interdisciplinary challenges in areas such as data science, cryptography, and scientific computing
PSO-3	Software Skill	Develop efficient algorithms for computational problem-solving, emphasizing optimization and scalability.

6. Credit Framework

Semester wise Credit distribution of the Programme	
Semester-1	21
Semester-2	18
Semester-3	23
Semester-4	21
Semester-5	22
Semester-6	22
Semester-7	26
Semester-8	14
Total Credits:	167

Category wise Credit distribution of the Programme	
Category	Credit
Major Core	103
Minor Stream	00
Multidisciplinary	13
Ability Enhancement Course	9
Skill Enhancement Courses	17
Value added Courses	0
Summer Internship	2
Research Project/Dissertation	23
Total Credits:	167

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303107152	ICT Workshop	1	0	2	-
2	03161101	Calculus	4	4	0	0
3	03161102	Foundations of Statistical Analysis	4	4	0	0
4	303105103	Open-Source Software	2	1	2	0
5	303106103	Electrical and Electronic Engineering	4	3	2	-
6	303192102	Engineering Physics-II	4	3	2	-
7	303193103	Communication Skills	2	-	-	2

Total			21	15	8	2
Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
8	303104105	Environmental Science	AUDIT	1	0	0
9	03161151	Linear Algebra	4	4	0	0
10	03161152	Probability and Inferential Statistics	4	4	0	0
11	303105102	Art of Programming	4	3	1	0
12	03161153 ^T	Physics for Engineering	4	3	2	-
13	303193152	Advanced Communication & Technical Writing	2	-	-	2
Total			18	15	3	2
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
14	03161201	Discrete Mathematics	4	4	0	0
15	03161203	Graph Theory	4	4	0	0
16	303105201	Design of Data Structure	3	3	0	0
17	303105202	Design of Data Structure Laboratory	2	0	4	0
18	303105203	Database Management System	3	3	0	0
19	303105204	Database Management System Laboratory	1	0	2	0
20	303105229	Python Programming	3	3	0	0
21	303105230	Python Programming Laboratory	1	0	2	0
22	303193203	Professional Communication Skills	2	0	0	2
Total			23	17	8	2
Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
23	03161253	Differential Equations	4	4	0	0
24	03161251	Numerical Methods	4	3	2	0
25	03107401	Data Communication and Networking	4	3	2	0
26	303105251	Operating System	4	3	2	0
27		Data Analytics with R	4	3	2	0
28	303193252	Professional Grooming and Personality Development	1	0	0	2
Total			21	16	8	2

1.1 Detailed Syllabus

Semester 1

- a. **Course Name:** Calculus
- b. **Course Code:** 03161101
- c. **Prerequisite:** Basic concepts of Calculus
- d. **Rationale:** Calculus is the branch of mathematics that deals with continuous change. This course provides foundational understanding of rates of change and computational techniques essential for advanced courses, data analysis, and problem-solving in fields essential to model real-world phenomena, analyse data, and develop efficient algorithms critical for addressing complex challenges.
- e. **Course Learning Objective:**

CLOBJ 1	To define and compute limits, understand the concept of continuity, and apply these concepts to various types of functions.
CLOBJ 2	Comprehend the derivative of a function, understand the geometric interpretation of the derivative as a slope, and apply differentiation to solve problems involving rates of change, motion, and optimization.
CLOBJ 3	Apply integration to solve problems involving areas, volumes, work, and other physical applications.

f. Course Learning Outcomes:

CLO 1	Exhibit an understanding of the consequences of various mean value theorems for differentiable functions.
CLO 2	Apply the concepts limit, continuity and partial derivatives of functions of multiple variables in optimization problems.
CLO 3	Apply the concept of multiple integration in problem solving.
CLO 4	Analyze Inter-relationship amongst the line integral, double and triple integral formulations.
CLO 5	Use the Green, Gauss and Stokes' theorems in complex problem solving.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	0	0	4	20	20	0	60	0	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Topics	Weightage %	Teaching hours
1	Unit-1: Application of Derivative of Functions of One Variable Review of the function of one variable, limit, continuity, and differentiability, mean value theorems and applications, Riemann integration, fundamental theorem of calculus, application to length, area, volume, and surface area of revolution.	25%	15
2	Unit-2: Multivariate Calculus Functions of several variables, limit and continuity, partial derivatives and differentiability, composite functions, chain rule, implicit functions, Euler's theorem, Taylor's expansion, Jacobian, maxima and minima, method of Lagrange multipliers.	25%	15
3	Unit-3: Multiple Integration Double integration, change of order, change into polar form, application to area and volume.	20%	12
4	Unit-4: Vector Calculus Vector-valued function, velocity and acceleration, the gradient of a scalar function, directional derivatives, divergence and curl of a vector-valued function. Parameterization of curves and surfaces, vector fields, line integrals, Green's theorem, surface integrals, Gauss divergence theorem and Stokes' theorems with applications.	30%	18

i. Text Book and Reference Book:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, Pearson India.
2. Ron Larson, Bruce Edwards, Calculus, Cengage Learning.
3. James Stewart, Calculus: Early Transcendentals, Brooks/Cole.
4. Tom M Apostol, Calculus, Wiley Publication.

- a. **Course Name:** Foundations of Statistical Analysis
- b. **Course Code:** 03161102
- c. **Prerequisite:** None
- d. **Rationale:** Basic Understanding statistical methods enables students to effectively analyse data, make informed decisions, and contribute to advancements in the field of mathematics, computing, and related industries. This course equips students with basic statistical tools of data analysis.

e. **Course Learning Objective:**

CLOBJ 1	Grasp the fundamental idea of making inferences about a population based on sample data, distinguishing between descriptive and inferential statistics.
CLOBJ 2	Solidify their understanding of probability theory, including the role of probability distributions in inferential statistics, and be able to work with common distributions (e.g., normal, t, chi-square, F-distributions).
CLOBJ 3	Develop a deep understanding of hypothesis testing, including setting up null and alternative hypotheses, selecting appropriate tests (e.g., z-test, t-test, chi-square test), calculating test statistics, and making decisions based on p-values and significance levels.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate an ability to explain the basic knowledge on data collection and data analysis using various statistical elementary tools such as mean, median, mode, standard deviation and variance, skewness and kurtosis.
CLO 2	Fit a curve such as straight-line, second-degree parabola, logarithmic curve, exponential curve to the given set of values of the variables.
CLO 3	Analyse correlation and regression between two variables based on the given set of values.
CLO 4	Analyse multiple regression coefficients to assess their significance in multivariate analysis.

g. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					
Hours per Week				Credit	Internal Evaluation			ESE		Total
Lecture	Tutorial	Lab	Total		MSE	CE	P	T	P	
4	-	-	4	4	20	20	0	60	0	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; CE- Continuous Evaluation, MSE-Mid Semester Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr.	Topic	Weightage	Teaching Hrs.
1.	Unit-1: Introduction Statistics: definition, organization, collection, and interpretation of data Measures of location (or central tendency) and dispersion: mean,	25%	15

	median and mode, standard deviation and variance, coefficient of variance.		
2.	Unit-2: Skewness, Moments, and Kurtosis Introduction, difference between dispersion and skewness, test of skewness, measures of skewness, moments, kurtosis, measures of kurtosis.	25%	15
3.	Unit-3: Correlation, Regression and Curve Fitting Correlation, Karl's Pearsons coefficient of correlation, Spearman's Rank correlation coefficient, Regression analysis, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and exponential curves.	25%	15
4.	Unit-4: Partial Correlation, Multiple regression Analysis Introduction, partial correlation, partial correlation coefficient, multiple correlation, multiple regression analysis, reliability of estimates	25%	15

i. Text Book and Reference Book:

1. S. P Gupta, Statistical Methods, Sultan Chand & Sons, Educational Publication.
2. Ken Black, Business Statistics for contemporary decision mapping, John Wiley & Sons, Inc.
3. Anderson, Sweeney, Williams, Essential of Modern Business Statistics, Cengage Learning
4. Dr. D.C Agarwal, Dr. Pradeep K Joshi, Probability and Statistics for Data Science, Shree Sai Publication.

a. Course Name: Communication Skill

b. Course Code: 303193103

c. Prerequisite: Knowledge of English Language studied till 12th standard

d. Rationale: Basic Communication Skills are essential for all Engineers.

e. Course Learning Objective:

CLOBJ 1	Students will demonstrate the ability to communicate ideas clearly and effectively
CLOBJ 2	Students will develop strategies for building positive interpersonal relationships, fostering effective collaboration and teamwork.
CLOBJ 3	Students will develop active listening skills, including the ability to comprehend, interpret, and respond appropriately to spoken messages.
CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (emails, reports, memos, etc.).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will understand and utilize various digital communication tools and platforms, demonstrating proficiency in virtual communication.

f. Course Learning Outcomes:

CLO 1	Understand the importance of creative and critical thinking.
CLO 2	Expand vocabulary with proper pronunciation.
CLO 3	Comprehend the basics of English grammar.
CLO 4	Read & write effectively for a variety of contexts.
CLO 5	Develop confidence in speaking skills.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	2	0	2	50	50	-	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Crazy Scientist: The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	5%	2
2	Phonetics: - IPA Introduction (listening tracks) - Phonic Sounds - Pronunciation Practice including transcription	10%	4
3	Vocabulary Building & Word Formation Process: - Compounding, clipping, blending, derivation, creative respelling, coining and borrowing - Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided)	10%	2
4	Speaking Activity: Role plays on Critical Thinking (Life boat) - This activity topic gears towards making students do role play based on various scenarios. - It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it. - It aims to improve students' convincing skills.	10%	4

5	Picture Description & Picture Connector • Enable students to use vocabulary and useful expression to describe the picture. • In this class the students will be trained to form logical connections between a set of pictures which will be shared with them. • This geared towards building creativity and presentation skills.	15%	2
6	Mine Activity: Usage of Preposition: • Students will learn to use proper propositions by active participation in the activity.	8%	2
7	Worksheets on Identifying Common Errors in Writing: • Sentence structure • Punctuations • Subject-Verb Agreement • Noun-Pronoun Agreement	12%	2
8	Reading Skills: • The art of effective reading and its various strategies to be taught to the learners and practice exercises be given on reading comprehension.	10%	2
9	Speech and spoken Exchanges; Extempore: • Students will learn the correct usage of spoken language as different from the written form. It will help the students in extempore speech. • This will be done by making the students give variety of impromptu speeches in front of the class: 1 minute talk on simple topics. • To change the average speakers in the class to some of the best Orator.	10%	4
10	Book Review: • The learners will identify the central idea of the book, author's style and approach towards the book. • This will enable the learners to express their point of view and hone their creativity and writing skills.	10%	4
11	Activity Session • This will enhance the creative thinking among students. • To develop their interpersonal communication skills.	0%	2

i. Text Book and Reference Book:

1. "Understanding and Using English Grammar", Betty Azar & Stacy Hagen; Pearson Education
2. "Business Correspondence and Report Writing ", SHARMA, R. AND MOHAN, K.
3. "Communication Skills", Kumar S and Lata P; New Delhi Oxford University Press
4. "Technical Communication: Principles and Practice" Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. "Practical English Usage MICHAEL SWAN
6. "A Remedial English Grammar for Foreign Student", F.T. WOOD
7. "On Writing Well", William Zinsser; Harper Paperbacks, 2006; 30th anniversary edition
8. "Oxford Practice Grammar", John Eastwood; Oxford University Press

- a. **Course Name:** Open-Source Software
- b. **Course Code:** 303105103
- c. **Prerequisite:** Basic knowledge of software applications.
- d. **Rationale:** Open Source has acquired a prominent place in the software industry. Having knowledge of Open Source and its related technologies is essential for Computer Science students. This course introduces Open-Source methodologies and ecosystem to students
- e. **Course Learning Objective:**

CLOBJ1	Gain familiarity with Principles of OSS, Open-Source Standards, Requirements for Software, OSS success, Free Software, Examples, Licensing, Free Vs. Proprietary Software, Free Software Vs. Open-Source Software, Public Domain.
CLOBJ2	Acquire Knowledge regarding Open-Source History, Open-Source Initiatives, Open Standards Principles, Methodologies, Philosophy, Software freedom, Open-Source Software Development, Licenses, Copyright vs. Copy left, Patents, Zero marginal cost, Income- generation Opportunities, Internationalization
CLOBJ3	Acquire knowledge of Community and Communication, Contributing to Open-Source Projects Introduction to GitHub, interacting with the community on GitHub, Communication and etiquette, testing open-source code, reporting issues, contributing code. Introduction to Wikipedia, contributing to Wikipedia or contributing to any prominent open-source project of student's choice. Open-Source Ethics and Social Impact: Open source vs. closed source, Open-source Government, Ethics of Open Source,
CLOBJ4	Understand GNU/Linux, Android, Free BSD, Open Solaris. Open-Source Hardware, Virtualization Technologies, Containerization Technologies: Docker, Development tools, IDEs, Debuggers, Programming languages, LAMP, Open-Source Database technologies
CLOBJ 5	Demonstrate apache Web server, BSD, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, WordPress, Git, GCC, GDB, GitHub, Open Office, Libre Office Study

f. **Course Learning Outcomes:**

CLO 1	Differentiate between Open Source and Proprietary software and Licensing.
CLO 2	Recognize the applications, benefits, and features of Open-Source Technologies
CLO 3	Gain knowledge to start, manage open-source projects.
CLO 4	Worked with Open-Source ecosystem, its use, impact, and importance.
CLO 5	Learn Open-Source methodologies, case studies with real life examples.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme
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L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	1	2	20	20	20	60	30	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to Open-Source: Open Source, Need and Principles of OSS, Open-Source Standards, Requirements for Software, OSS success, Free Software, Examples, Licensing, Free Vs. Proprietary Software, Free Software Vs. Open- Source Software, Public Domain. History of free software, Proprietary Vs Open-Source Licensing Model, use of Open- Source Software, FOSS does not mean no cost. History: BSD, The Free Software Foundation and the GNU Project	15%	1
2	Open-Source Principles and Methodology: Open-Source History, Open Source Initiatives, Open Standards Principles, Methodologies, Philosophy, Software freedom, Open-Source Software Development, Licenses, Copyright vs. Copy left, Patents, Zero marginal cost, Income-generation Opportunities, Internationalization. Licensing: What Is A License, How to create your own Licenses, Important FOSS Licenses (Apache, BSD, PL, LGPL), copyrights and copy lefts, Patent	20%	3
3	Open-Source projects: Starting and maintaining own Open-Source Project, Open-Source Hardware, Open-Source Design, Open-source Teaching, and Open source media. Collaboration: Community and Communication, Contributing to Open source Projects Introduction to GitHub, interacting with the community on GitHub, Communication and etiquette, testing open-source code, reporting issues, contributing code. Introduction to Wikipedia, contributing to Wikipedia or contributing to any prominent open-source project of student's choice. Open-Source Ethics and Social Impact: Open source vs. closed source, Open-source Government, Ethics of Open source, Social and Financial impacts of open-source technology, Shared software, Shedsources, Open Source as a Business Strategy	20%	3
4	Understanding Open-Source Ecosystem: Open-Source Operating Systems: GNU/Linux, Android, Free BSD, Open Solaris. Open-Source Hardware, Virtualization Technologies, Containerization Technologies: Docker, Development tools, IDEs, Debuggers, Programming languages, LAMP, Open- Source Database technologies	20%	4
5	Case Studies: Example Projects Apache Web server, BSD, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, WordPress, Git, GCC, GDB, GitHub, Open Office, Libre Office Study: Understanding the developmental models, licensing, mode of funding, commercial/non-commercial use.	25%	4

i. Textbook and Reference Book:

1. Open-Source Technology”, Kailash Vadera & Bhavyesh Gandhi, University Science Press, Laxmi Publications, 2009, Software Engineering, Sommerville (Text Book)
2. Open-Source Technology and Policy”, Fadi P. Deek and James A. M. McHugh, Cambridge University Press, 2008Software Engineering Pankaj Jalote; Wiley India
3. Perspectives on Free and Open-Source Software”, Clay Shirky and Michael Cusumano, MIT press

j. List of Practical's

1.	Demonstration of Basic Linux commands.
2.	Execute C Program using gcc compiler.
3.	Demonstration of gprof command using Linux.
4.	Create and Edit documents using Google Docs.
5.	Create Presentation using Google Slides.
6.	Demonstration of different Arithmetic and Logical Formulas using OpenOffice Calc.
7.	Use of HTML to create simple web page.
8.	Demonstration of MathML – a markup language for describing mathematical notation.
9.	Demonstration of virtualization using Docker Container.
10.	Demonstration GitHub Facility.

a. Course Name: ENGINEERING PHYSICS II

b. Course Code: 303192102

c. Prerequisite: Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation, vector calculus up to 12thscience level.

d. Rationale: Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.

e. Course Learning Objective:

CLOBJ 1	Familiarize with quantum mechanics and its application for atomic and molecular domain
CLOBJ 2	Get knowledge about different types of optoelectronic devices and its working
CLOBJ 3	Get familiar with lasers, optical fibers, semiconductors and their application

f. Course Learning Outcomes:

CLO 1	Understand the band structure and origin of band gap in semiconductors
CLO 2	Formulate and conceptualize various theoretical aspects and the physical phenomena at atomic level.
CLO 3	Analyse the optical transition processes in semiconductors and identify the materials

	useful in optoelectronic devices.
CLO 4	Use different techniques of measurement of bandgap, resistivity and other parameters of interest of semiconductors
CLO 5	Understand the fabrication and applications of low dimensional semiconductor devices.

g. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					
Hours per Week				Credit	Internal Evaluation			ESE		Total
Lecture	Tutorial	Lab	Total		MSE	CE	P	T	P	
3	-	2	5	4	0	40	20	60	30	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **CE-** Continuous Evaluation, **MSE-**Mid Semester Exam

h. Course Content:

Sr.	Topic	Weightage	Teaching Hrs.
1.	UNIT-I: Modern Physics Introduction about quantum Mechanics, Schrodinger's equations, Time dependent and Time Independent Wave Equation, Physical Significance of the wave Function, Application of Schrodinger equation in particle in One Dimensional Potential Box and Tunneling effects.	20%	9
2.	UNIT-II: Band theory& Semiconductors Energy bands in solids, Classification of Materials into Conductors, Semiconductors & Insulators, Density of state, E-k diagram, Kronig-Penny model (to introduce origin of band gap), Effective mass. Direct and indirect band gap.	20%	9
3.	UNIT-III: Materials Classification of materials Magnetic materials, Nanomaterials based on semiconductors and metal oxides, Basic characteristic properties of nanomaterials, Novel Materials. Physical, Thermal, Electrical, Optical and Magnetic properties of materials.	20%	9
4.	UNIT-IV: Laser and Fiber Optics Lasers Interaction of radiation with Matter, Absorption, Spontaneous and Stimulated emission, Characteristics of Lasers, Types of Lasers: Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers. Fiber Optics: Principle and Structure of Optical Fiber, Numerical Aperture of fiber, Types of Optical Fibers, Attenuation in Optical Fibers, Applications of Optical Fibers.	20%	9
5.	UNIT-V: Devices Optoelectronic Devices: Photoconductive cell, photovoltaic cell, Photodiode, Phototransistor, LED, IR emitters, Opto coupler, X-ray diffractometer, Quantum devices and their applications.	20%	9

i. Text Book and Reference Book:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995)
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007)

- 3 S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. Engineering Physics — HK Malek and A. K. Singh- Mc Graw Hill Publication
- 5 Semiconductor Optoelectronic Devices- P. Bhattacharya-Prentice Hall of India
6. Fundamentals of Physics- Halliday, Resnick and Walker

j. List of Experiments:

Sr. No.	Names of Experiments
1.	Determination of Velocity of ultrasonic waves in water
2.	Determination of Dielectric constants of Dielectric samples.
3.	Measurement of Band gap of semiconductor material.
4.	Measurement of Hall coefficient R_H and carrier concentration in a semiconductor.
5.	Measurement of Planck's constant using LED.
6.	Measurement of wavelength of laser light using diffraction grating.
7.	Measurement of Numerical aperture of an optical Fiber.
8.	Moment of Inertia of a flywheel.
9.	Measurement of power loss in an optical fibre.
10.	Determination of particle size by diffraction of light

- a. **Course Name:** Electrical and Electronics Engineering
- b. **Course Code:** 303106103
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
- d. **Rationale:** The course provides introductory treatment of the field of Electrical Engineering to the students of various branches of engineering
- e. **Course Learning Objective:**

CLOBJ 1	Master analysis techniques including Kirchhoff's laws, simplification methods, superposition, Thevenin's, and Norton's theorems for effective DC circuit analysis."
CLOBJ 2	Solve problems related to Alternating current, alternating voltage, etc, Demonstrate a clear understanding of Pure R, L C circuit and combination of RLC, Series and Parallel combination of R, L and C, etc
CLOBJ 3	Understand different single phase and three phase circuits.
CLOBJ 4	Learn diode behaviours, rectification techniques, and transistor functions as switches and amplifiers in electronic circuits."
CLOBJ 5	Develop DC-regulated power supplies.
CLOBJ 6	Understand sensors and transducers, their applications, and differentiate between their types and functionalities in electronic systems."

f. Course Learning Outcomes:

CLO 1	Solve basic electrical circuit problems using various laws and theorems.
CLO 2	Discuss the role of resistor, capacitor and inductor and their performance characteristics for AC circuit
CLO 3	Compare the working of Delta and Star, 3 phase circuits based on voltage and current relationship
CLO 4	Evaluate the operating regions of BJTs through DC analysis and determine Q-points using load line analysis
CLO 5	Design and construct DC-regulated power supplies using linear voltage regulators, ensuring stable output voltages.
CLO 6	Analyze and compare various types of sensors and transducers based on operating principles, characteristics, and applications in diverse fields.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	DC Circuits Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Mesh and Node analysis, Simplifications of networks using series and parallel combinations and star-delta conversions. Superposition, Thevenin and Norton Theorems.	10%	05
2	AC Circuits Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors, examples based on theory. Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of the concept of reactance, the study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and R-L-C circuit, concept of	30%	15

	impedance, admittance, conductance and susceptance in case of above combinations and relevant voltage-current phasor diagrams, the concept of active, reactive and apparent power and power factor, examples based on theory. Concept of three-phase supply and phase sequence. Voltages, currents and power relations three-phase have balanced star-connected loads and delta-connected loads along with phasor diagrams.		
3	Diode and Transistors Introduction to Ideal Diode, Effect of temperature Ideal diodes, unbiased diode and Forward and reverse bias of Diode. PIV, surge current, Diode as Uncontrolled switch. Rectifiers: Half wave, Full wave, and bridge wave. Ripple factor, PIV rating. Choke and Capacitor input filter rectifiers, Clipper and Clamper circuits, Voltage multiplier: Construction and working of BJT, Characteristics & specifications of BJT (PNP & NPN transistors), Biased and unbiased BJT, Configuration of the transistor, the concept of gain & BW, Operation of BJT in the cut-off, saturation & active regions (DC analysis), BJT as a switch, Transistor as an amplifier, Voltage divider bias and analysis, VDB load line and Q point	30%	15
4	Voltage Regulator Basic series and shunt regulator, Types of voltage regulator IC: Fixed and adjustable positive and negative linear voltage regulator, IC linear fixed voltage regulator (78XX, 79XX, LM340 Series), Linear Adjustable Regulator (IC LM317, LM337, and IC 723 IC regulator), DC Regulated Power supply, Switched-mode power supply (SMPS).	15%	05
5	Sensors and Transducers Introduction to sensors and Transducers, Comparison between sensors and Transducers, Applications of Sensors and Transducers, Types of Electronic sensors, Types of Transducers.	15%	05

i. Text Book and Reference Book:

1. A text book of Electrical technology Vol2, By B. L. Theraja | S. Chand Publication
2. Electrical Engineering Fundamentals (Text Book), By V. D. Toro | Prentice Hall India | 2, Pub. Year 1989
3. Electrical and Electronics Technology, By E. Hughes | Pearson | 10, Pub. Year 2010
4. Basic Electrical Engineering, By D. P. Kothari and I. J. Nagrath, | Tata McGraw Hill | 3, Pub. Year 2010
5. Basic Electrical Engineering, By D. C. Kulshreshtha | McGraw Hill | 1, Pub. Year 2009
6. Fundamentals of Electrical Engineering, By Leonard S. Bobrow | Oxford University Press | 2, Pub. Year 1996

j. List of Experiments:

1.	To Study about Various Electrical and Electronics Symbols and demonstrate various measuring instruments used in Basic electrical Engineering laboratory.
2.	To Perform and Solve Electrical Networks with Series and Parallel Combinations of Resistors Using Kirchhoff's Laws.

3.	To Obtain Inductance, Power and Power Factor of the Series RL Circuit With AC Supply Using Phasor Diagram.
4.	To Obtain Capacitance, Power and Power Factor of the Series RC Circuit With AC Supply Using Phasor Diagram.
5.	To Obtain Inductance, Capacitance, Power and Power Factor of the Series R-L-C Circuit With AC Supply Using Phasor Diagram.
6.	Verification of superposition theorem with dc source.
7.	Verification of Thevenin's theorem with dc source.
8.	Verification of Norton's theorems in dc circuits.
9.	Verification of Current and Voltage Relations in Three Phase Balanced Star and Delta Connected Loads.
10.	To study the cut-section of a dc machine, single phase induction machine and three phase induction machine.
11.	Find out the Efficiency and Voltage Regulation of Single Phase Transformer by Direct Load Test.
12.	To Plot V-I characteristics Diodes. (a) PN junction diode Characteristics, (b) Zener Diode characteristics.
13.	To Observe Rectifier Circuit (a) Half wave Rectifier without filter, (b) Full wave rectifier without filter, (c) Half wave
14.	To Observe Response of Clipping and Clamping circuits using diodes (a) Diode Positive Clipper without and with Biased clipper, (b) Diode Negative Clipper without and with Biased clipper, (c) Biased Positive Negative Clipper (Combinational Clipper), and (d) Positive Clamper, and Negative Clamper.
15.	Designing of power supply using IC regulator circuit. (a) Designing of +5 Volt DC Power Supply using 7805, (b) Designing of -5 Volt DC Power Supply using 7905, (c) Designing of +12 Volt DC Power Supply using 7812, and (d) Designing of -12 Volt DC Power Supply using 7912.
16.	(a)To Plot and Study input-output characteristics of Common Base (B) configuration of the Transistor and (b) To Plot and Study input-output characteristics of common Emitter (CE) configuration of Transistor.
17.	To study the Voltage divider bias circuit: (a) To observe the effect of change in base current on the Q-operating point, and (b) To set Q point for operation of a transistor amplifier in the linear region
18.	To plot characteristics of Schottky and Varactor diode.
19.	Designing of Linear Adjustable Regulator using IC LM317.
20.	Introduction to Sensors and Transducers.

- a. **Course Name:** ICT workshop
- b. **Course Code:** 303107152
- c. **Prerequisite:** Basic Computer Knowledge and Physics
- d. **Rationale:** This course is design to provide basic knowledge of Electronics components and computer components. This course helps in learning problem solving process of Electronics circuits and Computer.

e. **Course Learning Objective:**

CLOBJ 1	Identification and Symbolic Representation of Basic Electronics Components
CLOBJ 2	Circuit Analysis Using Digital Multimeter and understanding of working of CRO and Function Generator.
CLOBJ 3	Learn and practice proper soldering and de-soldering techniques to ensure reliable and clean electrical connections.
CLOBJ 4	Demonstrate and understand the operation of a different sensors in electronic systems.
CLOBJ 5	Collaborate in a group to design, implement, and present a project utilizing various electronic components and sensors.

f. **Course Learning Outcomes:**

CLO 1	Students will accurately identify and interpret the symbolic representations of essential electronic components
CLO 2	Students will be proficient in using a digital multimeter to measure and analyze circuit parameters such as voltage and current, and will demonstrate the ability to apply these measurements for circuit verification and troubleshooting..
CLO 3	Students will have a comprehensive understanding of the operation and specifications of Cathode Ray Oscilloscopes (CROs) and function generators.
CLO 4	Students will be able to demonstrate the operation and application of a Different Electronics Sensors.
CLO 5	Students will collaboratively design, implement, and present a project that integrates various electronic components and sensors, showcasing their ability to apply course knowledge in a practical, team-based context.

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lectur e Hrs/We ek	Tutori al Hrs/We ek	Lab Hrs/We ek	Hrs/We ek	Credi t	Internal Evaluation			ECE		
					MSE	C E	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

List of Practical	
1.	Identification and symbolic representation of electronics basic components. (Diode,Zener diode, LED, transistor)
2.	Verify the circuit analysis (voltage and current) using Digital Multimeter
3.	Understanding of working and specifications of CRO and Function generator.
4.	Design 5V power supply using 7805.
5.	Understanding soldering techniques and practicing proper soldering and de-soldering.
6.	Demonstrate the working of Temperature Sensor
7.	Verify the functionality of water flow sensor
8.	Verify the functionality of distance measurement sensor
9.	Demonstrate the working of Rain detector Sensor
10.	Group Project based on electronics components and sensors

Semester 2

- a. **Course Name:** Environmental Science
- b. **Course Code:** 303104105
- c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and Biology up to 10th science level
- d. **Rationale:** Basic knowledge of the environment is essential for all human beings for a good life and sustainable existence
- e. **Course Learning Objective:**

CLOBJ 1	Apply systems thinking to analyse the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyse the causes, effects, and control measures of population explosion

- f. **Course Learning Outcomes:**

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with the environment
CLO 2	Identify eco-friendly measures in engineering projects
CLO 3	Understand preventive steps for environmental protection.
CLO 4	Act as a responsible individual who is aware of efficient usage of resources and securing sustainable development

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	0	0	-	50	-	-	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

- h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	ENVIRONMENTAL HEALTH, ECOLOGY AND QUALITY OF LIFE	25%	7

	Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies, Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass.		
2	POLLUTION PREVENTION Air & Noise pollution - Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste	20%	6
3	POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST DEVELOPMENTS Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System (ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modelling (BIM) and City Finance Approach to Climate-Stabilizing Targets (C-FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for sustainable development.	27%	7
4	SMART CITIES Introduction to smart cities - about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart. City as a system of systems – Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of smart city approach – core elements, open data, sustainability, privacy and ethics, development processes. Smart Citizens – their role, engaging citizens, IES Cities, Energy systems, Approaches for Citizen Engagement, co-creating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens,	30%	10

all age-friendly cities, mobility on demand, motion maps. Infrastructure, Technology and Data – urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Sensored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data Innovation – smart innovations, smart city ecosystem, data-driven innovations for smart cities Standards and Capacity Building – the role of Standard, BSI smart city Standards, HyperCat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam Smart Measurements - metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and education, urban data school.		
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i. Text Book and Reference Book:

1. “Environmental Studies For Undergraduate Courses”,(Text Book),By Dr Erach Bharucha | Orient Black Swan | Second Edition, Pub. Year 2013.
2. “Basics of Environmental Studies”, By U K Khare, Tata McGraw Hill
3. “Environmental Studies” By Anindita Basak, Drling Kindersley (India)Pvt. Ltd Pearson
4. “Environmental Sciences”, By Daniel B Botkin & Edward A Keller, John Wiley & Sons
5. “Air Pollution”, By M N Rao, H. V N Rao, McGraw Hill Publishing Company Limited, New Delhi
6. “Environmental Engineering” By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous | McGraw-Hill

a. Course Name: Advanced Communication & Technical Writing

b. Course Code: 303193152

c. Prerequisite: Knowledge of English Language studied till 12th standard

d. Rationale: Communication confidence laced with knowledge of English grammar is essential for all engineers.

e. Course Learning Objective:

CLOBJ 1	Demonstrate the ability to adapt writing style to different audiences and purposes.
CLOBJ 2	Create comprehensive technical documents such as reports, manuals, and proposals.
CLOBJ 3	Refine editing and proofreading skills for complex technical documents.
CLOBJ 4	Explore and apply technical communication through various mediums (video, web

	content, multimedia)
CLOBJ 5	Incorporate advanced document design principles for clarity and readability.

f. Course Learning Outcomes:

CLO 1	Develop four basic skills
CLO 2	Construct grammatically correct sentences.
CLO 3	Develop and deliver professional presentation skills
CLO 4	Develop the skills of critical thinking.
CLO 5	Compare different types of written communication.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	2	0	2	50	50	-	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Developing Effective Listening Skills: To help students understand the meaning and importance of good listening skills, learning the traits of being a good listener through activity and listening audio tracks.	10%	2
2	Error analysis: To provide insights into the complicated processes of language development as well as a systematic way for identifying, describing and explaining errors. (Tenses, Voices, Reported speech)	10%	4

3	Delivering different types of speeches: Students will understand and use the different patterns for structuring speeches: Welcome / Introductory speech, Vote of Thanks speeches, Farwell speeches	10%	2
4	Professional Presentations: Students will learn Combating stage fright, preparing power point presentation, Delivering PPT	10%	4
5	Essay writing: Students will overcome the common pitfalls in the task of essay writing by understanding - Basics of Paragraph development and paragraph jumble - Types of essays - Characteristic features of essays - Guiding Principles	10%	2
6	Reading Comprehension: - Employing Different Reading Skills - Activity - Practice	10%	2
7	Project Proposal: To equip students with the various elements required to prepare a winning proposal.	5%	2
8	Misplaced Modifiers: Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	5%	2
9	Movie Review: - A movie show followed by writing a review. - To provide an exposure to students how to express their opinions about some film or documentary with unbiased and objective approach.	10%	4
10	Narrative Writing: - Narrative writing helps them explore different characters and settings. - To help students clarify their thinking, and teach them to express that in writing in an organized way.	5%	4
11	Writing Reports: - Process of writing - Order of writing - Final draft & checklist for reports - Sample reports: - Memorandum - Letter report	10%	2
12	Critical Thinking: - Need, relevance and Significance of Critical Thinking - Logic in problem solving and decision making(activities) Moral Reasoning (Case Studies)	5%	1

13	Activity Session (Presentation) An activity where the scene of a press conference is created in the class. Students are encouraged to ask sharp questions and in turn are invited to assume roles of famous personalities, thus answering the questions posed.	0%	1
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i. Text Book and Reference Book:

1. "Understanding and Using English Grammar", Betty Azar & Stacy Hagen; Pearson Education
2. "Business Correspondence and Report Writing ", SHARMA, R. AND MOHAN, K.
3. "Communication Skills", Kumar S and Lata P; New Delhi Oxford University Press
4. "Technical Communication: Principles and Practice" Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. "Practical English Usage MICHAEL SWAN
6. "A Remedial English Grammar for Foreign Student", F.T. WOOD
7. "On Writing Well", William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
8. "Oxford Practice Grammar", John Eastwood; Oxford University Press

a. Course Name: Linear Algebra

b. Course Code: 03161151

c. Prerequisite: Basic Knowledge of Matrix and Determinants

d. Rationale: Studying this course is crucial as it forms the foundational pillars of various advanced mathematical theories, computational methods, and applications in fields such as physics, engineering, computer science, and data analysis, providing tools to model and solve complex systems, understand geometric relationships, and develop algorithms for data processing and optimization.

e. Course Learning Objective:

CLOBJ 1	Learn how to perform matrix operations (addition, multiplication, transposition, inversion) and understand key properties of matrices, including rank, determinant, and trace.
CLOBJ 2	Understand the concept of a linear transformation, including its representation by a matrix, and be able to find the image and kernel of a transformation.
CLOBJ 3	Understand the concept of orthogonality in vector spaces, including orthogonal projections, the Gram-Schmidt process, and the properties of inner product spaces.

f. Course Learning Outcomes:

CLO 1	Solve a system of linear algebraic equation using Row Echelon and LU Decomposition of a matrix.
CLO 2	Analyse various forms and properties of a matrix based on its Eigen values and Eigen vectors
CLO 3	Solve various problems in coding-decoding, Principal Component Analysis using the Eigen values and Eigen vectors of a matrix.
CLO 4	Analyse various properties of linear transformations using the matrix forms.
CLO 5	Create orthogonal and orthonormal bases using Gram-Schmidt process
CLO 6	Use bases and orthonormal bases to solve application problem.

g. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					
Hours per Week				Credit	Internal Evaluation			ESE		Total
Lecture	Tutorial	Lab	Total		MSE	CE	P	T	P	
4	-	-	4	4	20	20	0	60	0	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **CE-** Continuous Evaluation, **MSE-**Mid Semester Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topic	Weightage	TeachingHrs.
1.	Unit-1: Matrices Introduction, System of linear equations (Homogeneous and Nonhomogeneous systems) by Gauss Elimination, and LU Decomposition Method, Rank, Eigenvalues and Eigenvectors, Algebraic and Geometric Multiplicity, Diagonalization, Cayley-Hamilton theorem and Applications-coding-decoding, Principal Component Analysis (PCA).	35%	21
2.	Unit-2: Vector Space Vector spaces over the field of real numbers, Elementary Properties of Vector Spaces, Subspaces, Spanning set, Linear independence and dependence, Basis and Dimension.	20%	12
3.	Unit-3: Linear Transformation Definition of Linear Transformation from R^n to R^m , Some Standard Linear Transformation, The Null Space & Column Space, The Rank-Nullity Theorem, Matrix of Linear Transformation.	25%	15
4.	Unit-4: Inner Product Spaces Inner-product spaces, norm and its properties, angle between two vectors, orthogonal vectors, orthonormal vector, Gram-Schmidt	20%	12

	process, orthonormal basis.		
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i. Textbook and Reference Books:

1. H. Anton, Elementary Linear Algebra with Applications, John Wiley.
2. G. Strang, Linear Algebra and Its Applications, Brooks/Cole India.
3. Kreyszig, Advanced Engineering Mathematics, Wiley.
4. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall.
5. T. M. Apostol, Calculus, Volume II, 2nd Edition, Wiley.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.

a. Course Name: Probability and Statistical Inference

b. Course Code: 03161152

c. Prerequisite: Basics concepts of Statistics such as frequency distribution, measures of central tendency etc. and Probability.

d. Rationale: Statistics is a bridge between Mathematics and computing, it is used in data analysis, business, research, political science, social science, physical education etc.

e. Course Learning Objective:

CLOBJ 1	Learn how to perform matrix operations (addition, multiplication, transposition, inversion) and understand key properties of matrices, including rank, determinant, and trace.
CLOBJ 2	Understand the concept of a linear transformation, including its representation by a matrix, and be able to find the image and kernel of a transformation.
CLOBJ 3	Understand the concept of orthogonality in vector spaces, including orthogonal projections, the Gram-Schmidt process, and the properties of inner product spaces.

f. Course Learning Outcomes:

CLO 1	Estimate the chances of occurrence of an event using concepts of probability theory.
CLO 2	Use various probability functions and cumulative distribution functions such as Binomial, Uniform, Exponential, Poisson and Normal Distributions.
CLO 3	Demonstrate proficiency in selecting appropriate sampling techniques.
CLO 4	Analyze sampling distributions of sample means ($\bar{x}$) and proportions using the central limit theorem.
CLO 5	Apply the concepts of point and interval estimators using the interpretation of their properties in practical scenarios

CLO 6	Apply the different testing tools like t-test, F-test, chi-square test to analyze the relevant real-life problems.
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g. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					
Hours per Week				Credit	Internal Evaluation			ESE		Total
Lecture	Tutorial	Lab	Total		MSE	CE	P	T	P	
4	-	-	4	4	20	20	0	60	0	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **CE-** Continuous Evaluation, **MSE-**Mid Semester Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topic	Weightage	Teaching Hrs.
1.	Unit-1: Probability Theory Basics of probability, Conditional probability, Bayes' rule.	20%	12
2.	Unit-2: Probability Distribution Random variable, probability mass function and probability density function, mathematical expectation and variance, discrete distribution: binomial distribution, Poisson distribution, continuous distributions: uniform distribution, exponential distribution, normal distribution	25%	15
3.	Unit-3: Sampling and Sampling Distribution Sampling, sampling techniques, central limit theorem, sampling distribution of $\bar{x}$ and proportion, estimator, point and interval estimator, properties of the estimator.	15%	9
4.	Unit-4: Hypothesis Testing Introduction to hypothesis, testing of hypothesis about a population mean, population proportion, and variance using z-test, t-test, the difference in two mean using z-test, difference between two means (Independent samples and dependent samples) using t-test, two population variance, F- distribution, introduction to design of experiment, analysis of Variance – one way and two-way classification, chi-square test, characteristics of chi-square distribution, chi-square test of goodness of fit, chi-square test as a test of independence.	40%	24

i. Textbooks and Reference Books

1. S. P. Gupta, Statistical Method, Sultan Chand & sons Educational Publication
2. Ken Black, Business Statistics for Contemporary Decision Making, John Wiley & Sons, Inc.,
3. Andreson, Sweeney, Williams, Essential of Modern Business Statistics, Cengage Learning.
4. Dr. D. C. Agarwal, Dr. Pradeep K Joshi, Probability & Statistics for Data Science, Shree Sai Prakashan

Art of programming

- a. **Course Name:** Programming for Problem Solving
- b. **Course Code:** 303105102
- c. **Prerequisite:** Requires Basic Knowledge of Computer
- d. **Rationale:** This course is design to provide basic ideas of computer programming. This course also makes help to understand programming language. It will help to develop their logical abilities.
- e. **Course Learning Objective:**

CLOBJ 1	Recognize and recall fundamental principles and organizations of computers, demonstrating a foundational understanding of computer architecture and design.
CLOBJ 2	Comprehend the concepts of computer programming languages, illustrating a grasp of syntax, semantics, and the essential components of programming languages.
CLOBJ 3	Develop algorithms for solving basic engineering problems, demonstrating the ability to apply theoretical knowledge to practical problem-solving scenarios.
CLOBJ 4	Demonstrate proficiency in the practical application of C programming by writing, compiling, and debugging programs, showcasing the ability to implement and troubleshoot code effectively.
CLOBJ 5	Evaluate and analyse complex computational programs written in C, demonstrating the capacity to assess and understand intricate solutions to computational challenges.
CLOBJ 6	Develop simple projects using the C programming language, showcasing creativity and application of learned principles to produce functional and practical software solutions.

f. Course Learning Outcomes:

CLO 1	Recognize the computer's basic principles and organizations.
CLO 2	Understand Concepts of Computer Programming Language.
CLO 3	Develop the algorithm for solving basic Engineering Problems.
CLO 4	Write, Compile and debug program with C Programming.
CLO 5	Analyse the Solved, Complex Computational Program written in C.
CLO 6	Develop simple projects using C Language.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage	Teaching Hours
1	Number System: Introduction and type of Number system, Conversion between number system, Arithmetic operations on number system, Signed and unsigned number system Software, Computer Languages and Computer Program	2%	3
2	Introduction to 'C' Programming: Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory.	3%	3
3	Constants, Variables and data Types: Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, assigning values to variables, typedef, and defining symbolic constants.	5%	2
4	Operators and Expression: Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively.	10%	3
5	Management Input and Output Operators: Introduction, reading a character, writing a character, formatted input, formatted output.	5%	2
6	Control structure in C: Decision Making & branching: Decision making with If & If .. Else statements, If.. Else statements (Nested Ladder), The Switch & goto statements, The ternary (?:) Operator Looping: The while statement, The break statement & The Do.. While loop, The FOR loop, Jump within loops – Programs	15%	4
7	Array: Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.	10%	4
8	String: string, string storage, Built-in-string functions	10%	3
9	User-Defined Functions: Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing.	10%	5
10	Structure and Unions: Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions	10%	5
11	Pointers: Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers, functions returning a pointer	10%	5
12	Dynamic memory allocation: Introduction to Dynamic memory allocation, malloc (), calloc (), free (), realloc ()	5%	2
13	File Management in C: Introduction to file management and its functions	5%	1

i. Text Book and Reference Book:

1. "Programming in ANSI C", (Textbook), By E. Balaguruswamy, Tata McGraw-Hill
2. "C Programming: Test Your Skills", By Ashok Kamthane
3. "Computer Fundamentals", By P.K. Sinha and Priti Sinha, BPB Publications, 4th Edition
4. "Star C Programming", STAR Certification, C Certification Exam
5. "Programming with C", By Byron Gottfried, Tata McGraw Hill Education.
6. "C The Complete Reference", By Herbert Schildt
7. "Let Us C", By Yeshavant Kanetkar | BPB Publications

j. Experiment List

Sr. NO.	Experiment List
1	Write a program to print HELLO FRIENDS!
2	Write a program that reads two nos. from key board and gives their addition, subtraction, multiplication, division and modulo.
3	Write a program to calculate area of circle, use Ω as symbolic constants.
4	Write a program to convert days into months and days.
5	Write a program which calculates the summation of three digits from the given 3-digit number.
6	Write a program to demonstrate enumerates data type.
7	Write a program to compute Fahrenheit from centigrade.
8	Write a program to calculate simple interest. Read the price of item in decimal form e.g. 12.50 and separate Rs and Paise from the given value e.g. 12 rupees and 50 paise.
9	Write a program to find the largest of the three nos. using Nested-If-Else statement.
10	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
11	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
12	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
13	Write a program to read marks from keyboard and your program should display equivalent grade according to following table. Marks Grade 100-80 Dist 60-79 First Class 35-59 Second Class
14	Write a program to read marks of a student from keyboard whether the student id pass (if).
15	Write a program to find the sum of first N odd numbers.
16	Write a program using while loop construct which finds the factorial of a given integer number.
17	Write a C program using do«while and for loop constructs to reverse the digits of the number.
18	Write a program to demonstrate use of Switch- Break Statement.
19	Write a program to find out all the numbers divisible by 5 and 7 between 1 to 100.
20	Check for Armstrong number. A number is Armstrong if sum of cube of every digit is same as the original number. E.g. $153=1^3+5^3+3^3=153$
21	Write a program to print the output of bellow series. $1!+2!+3!+4!+..... n!$
22	Write a program to print the following outputs using for Loop. 1 * 12 ** 123 ***

23	Write a program to print the following outputs using for Loop. (a) 1 (b) 321 21 21 321 1
24	Write a program which sorts 10 numbers into ascending order.
25	Write a program to find maximum element from 1-D array.
26	Write a program to find number of odd and even elements from the 1-D array.
27	Write a program add two 2x2 matrices.
28	Write a program to count number of positive, negative and zero elements from 3x3 matrix.
29	Write a function for the following operations on string: Copy one string to another Comparing two strings Adding a string to the end of another.
30	Write a program to count vowels from a entered String.
31	Write a program which finds whether a string is a palindrome or not.
32	Write a program to find factorial of a number using recursion.
33	Write a program that used user defined function Swap () and interchange the value of two variable.
34	Write a function to return 1 if the number is prime otherwise return 0.
35	Define a structure type, personal that would contain person name, date of joining and salary.
36	Define a structure called cricket that will describe the following information: Player name Team name Batting average
37	Write a program to add two numbers using pointers.
38	Write a program to swap two numbers using pointer
39	Write a program to illustrate reading files contents.
40	Write a program to illustrate the use of fgets()

a. **Course Name:** PHYSICS FOR ENGINEERING

b. **Course Code:** 03161153^T

c. **Prerequisite:** Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation, vector calculus up to 12th science level.

d. **Rationale:** Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.

e. **Course Learning Objective:**

CLOBJ 1	Familiarize with waves and oscillations
CLOBJ 2	Understand physical phenomena at atomic and micro level
CLOBJ 3	Get familiar with Python programming to solve physical problems

f. Course Learning Outcomes:

CLO 1	Understand the basic concept of classical mechanics to solve static and dynamic problems
CLO 2	Understand the basic concept of wave and oscillation
CLO 3	Formulate and conceptualize various theoretical aspects and the physical phenomena at macro and atomic level.
CLO 4	Understand the theoretical analysis using Python programming.

g. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					
Hours per Week				Credit	Internal Evaluation			ESE		Total
Lecture	Tutorial	Lab	Total		T	CE	P	T	P	
3	-	2	5	4	-	40	20	60	30	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **CE-** Continuous Evaluation, **ESE-** External End Evaluation

h. Course Content:

Sr.	Topic	Weightage	Teaching Hrs.
1.	Unit1. Oscillations and waves: Damped and forced oscillations, Resonance, Q factor, Sharpness of resonance, transverse waves on a string, Equations of longitudinal and transverse waves and solutions, Reflection and transmission of waves at a boundary, Impedance matching between two medium.	25%	10
2.	Unit 2. Electrodynamics: Concept of Field, Gradient, Divergence, Curl, Scalar and Vector Potential, Maxwell's equations, concept of displacement current, Derivation of wave equation for plane electromagnetic wave, Poynting theorem, Energy density.	25%	10
3.	Unit 3. Materials: Magnetic Materials Theory, properties and classification of magnetic materials, soft and hard magnetic materials, ferrites, Applications Superconducting Materials: Meissner effect, penetration depth, type-1 and type-2 superconductors, High temperature superconductors, Applications.	25%	10
4.	Unit4. Scientific computing Basic concepts in Python, Loops, conditions and functions, Basics of Numpy, Basics of Scipy, Basics of Matplotlib, Applications in special problems like Laplace, Poisson diffusion and Schrodinger equation.	25%	15

i. Text Book and Reference Book:

1. A Text Book of Engineering Physics, M.N. Avadhanulu, P.G. Khirsagar, 2011, Ninth edition.
2. Physics for Computer Science Students, Narciso Garcia, Arthur Damask and Steven Schwarz, Springer, 2012, Second Edition
3. Scientific Computing Using Python, Abhijeet Kar Gupta, Techno World Publications.

j. List of Experiments:

Sr. No.	Names of Experiments
1	Basic programming using functions.
2	Using different python packages like numpy, scipy, etc.
3	Creating Plots using Python.
4	Solving Laplace equation in python.
5	Solving Poisson equation in python.
6	Study of Diffusion equation using Spectral method.
7	Study of Wave equation in python.
8	Study of Schrodinger equation using python.
9	Boundary value problem using shooting method
10	Eigen function and Eigen values for differential equation.

Semester - 3

- a. **Course Name:** Discrete Mathematics
- b. **Course Code:** 03161201
- c. **Prerequisite:** Basic Concepts of Set Theory, Function
- d. **Course Learning Objective:**

CLOBJ 1	The course provides a mathematical background related to computer engineering.
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e. Course Learning Outcomes:

CLO 1	Understand various properties of sets and relations like POSet, Equivalence relation.
CLO 2	Analyse propositional logic statements and proof techniques for arguments.
CLO 3	Identify logical equivalences.
CLO 4	Apply divisibility, modular arithmetic, integer representation and conversion algorithms, and implement key operations and cryptographic techniques.
CLO 5	Analyse Boolean expressions and design logic circuits using gates.
CLO 6	Apply Karnaugh maps for circuit minimization

f. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
4	-	-	-	4	40	-	-	60	-	100

SEE - Semester End Examination, T - Theory, P – Practical

g. Course Content:

W - Weightage (%) , T - Teaching hours

Sr.	Topics	W	T
1	Functions and Relations Functions, Recursive Functions, Relations, and their properties, n -ary Relations and their applications, Representing relations, Closures of Relations, Equivalence Relations, Partial Orderings. Lattices: Definitions and properties, Hasse diagrams and examples.	25	15
2	Propositional Logic and Proofs: Propositions, Conditional Statements, Converse, Contrapositive, and inverse, Truth tables of Compound Propositions, Logic and Bit operations, Propositional Equivalences, Satisfiability, Predicates and Quantifiers. Proof Techniques: Introduction to Proofs, Proof methods and Strategies, Forward Proof, Proof by contradiction, Proof by contraposition, Exhaustive Proof and Proof by cases.	25	15
3	Number Theory and Cryptography Divisibility and Modular Arithmetic- The Division Algorithm Modular arithmetic, Arithmetic modulo m , Integer Representations and Algorithms- Binary Expansion, Octal and Hexadecimal Expansions, Base Conversions, Conversion between Binary, Octal and Hexadecimal expansions, Algorithms for Integer Operations- Addition Algorithm, Multiplication Algorithm, Algorithm for	25	15

	division and mod, Cryptography.		
4	Boolean Algebra and Logic Circuits Boolean Algebra, Boolean Expressions and Boolean Function, Identities of Boolean Algebra, Duality, Representing Boolean Functions, Sum of Products Expansions, and Product of Sums Expansion, Logic Gates, Combinations of Gates, Examples of circuits, Adders, Minimization of Circuits, Karnaugh Maps.	25	15

h. Text Book and Reference Book:

1. Discrete Mathematics and its Applications (TextBook) By Kenneth H. Rosen | Tata McGraw – Hill
2. Discrete Mathematical Structure and It's Application to Computer Science (TextBook) By J.P. Tremblay and R. Manohar | TataMcgraw-Hill | TMG
3. Discrete Mathematics By Norman L. Biggs | Oxford University Press | 2nd Edition
4. Discrete Mathematics with Applications By Susanna S. Epp | Wadsworth Publishing Co. Inc. | 4
5. Elements of Discrete Mathematics A Computer Oriented Approach By C. L. Liu and D P Mohapatra | Tata McGraw – Hill | 3

a. Course Name: Graph Theory

b. Course Code: 03161203

c. Prerequisite: Basic knowledge of discrete mathematics and linear algebra

d. Course Learning Objective:

CLOBJ 1	The objective for studying graph theory stems from its ability to model, analyze, and solve problems in a wide range of fields. Below are the key reasons why graph theory is significant.
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e. Course Learning Outcomes:

CLO 1	Define fundamental concepts of graph theory, including graphs, subgraphs, degrees of vertices, and graph types.
CLO 2	Represent graphs using various methods such as adjacency matrices, incidence matrices, and adjacency lists, and analyze their properties.
CLO 3	Analyze the properties of trees, including rooted and binary trees,
CLO 4	Apply algorithms like Kruskal's and Prim's to find minimum spanning trees in networks.
CLO 5	Examine the concepts of connected graphs, cut-vertices, bridges, and k-connected graphs.
CLO 6	Apply graph colouring in practical scenarios.

f. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
4	-	-	-	4	40	-	-	60	-	100

SEE - Semester End Examination, T - Theory, P - Practical

g. Course Content:

W - Weightage (%), T - Teaching hours

Sr.	Topics	W	T
1	An Introduction to Graphs Introduction, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements.	20	12
2	Connected graphs and shortest paths Connected graphs and shortest paths – Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm.	20	12
3	Tree Trees, basic properties of trees, Binary trees Spanning and Minimal spanning trees, Algorithms: Kruskal's and Prim's Algorithms. Cut Vertices and Connectivity: Cut vertices, cut sets and their properties, the max-flow min-cut theorem, max-flow algorithm, connectivity and edge connectivity, Menger's theorem (without proof), max flow algorithm	30	18
4	Graph Colouring Chromatic Number, Chromatic Polynomial, and Applications. Applications in Scheduling, Map Colouring, and Register Allocation. Four -Colour Theorem Matching and Covering Maximum Matching, Perfect Matching, and Hall's Marriage Theorem. Applications Shortest Path Algorithms (Dijkstra and Floyd-Warshall). Applications in Social Networks, Circuit Design, and Data Structures	30	18

h. Text Book and Reference Book:

1. Graphs – An Introductory Approach By Wilson and Watkins
2. Introduction to Graph theory (TextBook) By Robin Wilson, | Pearson Publication
3. Graph Theory with Applications to Engineering and Computer Science (TextBook) By Narsingh Deo | PHI
4. Schaums Outlines Graph Theory, (TextBook) By TMH Balakrishnan

- a. **Course Name:** Design of Data Structures
b. **Course Code:** 303105201
c. **Prerequisite:** Computer Programming and Basic Syntaxes
d. **Course Learning Objective:**

CLOBJ 1	Data structure is a subject of primary importance in Information and Communication Technology.
CLOBJ 2	Organizing or structuring data is important for implementation of efficient algorithms and program development.
CLOBJ 3	Efficient problem solving needs the application of appropriate data structure during program development.

e. **Course Learning Outcomes:**

CLO 1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation
CLO 2	Understand basic data structures such as arrays, linked lists, stacks and queues
CLO 3	Describe the hash function and concepts of collision and its resolution methods
CLO 4	Solve problem involving graphs, trees and heaps
CLO 5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	4	0	5	20	20	20	60	30	150

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

g. **Course Content:**

W - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays. Performance analysis of an algorithm and space and time complexities	10	6
2	Stacks, Recursion and Queue: Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. Recursion -Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Queues: Definition, Array Representation, Queue Operations, Circular Queues,	15	8

	Circular queues using Dynamic arrays, Deque, Priority Queues and its problems		
3	Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists	10	5
4	Searching and Sorting: Interpolation Search Sorts: Selection Sort Insertion Sort Bubble Sort Quick Sort Merge Sort, Radix Sort	10	5
5	Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - In Order, Post Order, Pre Order; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression	10	4
6	Red Black Trees and AVL Trees: Introduction-Operations on Red Black Trees AVL tree Construction Operations on AVL Trees	15	8
7	Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing	15	3
8	Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search.	15	5

h. Text Book and Reference Book:

1. Fundamentals of Data Structures in C, 2ND eDITION, E.Horowitz, S.,Sahni and Susan Anderson- Freed, Universities Press (TextBook)
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

i. List of Experiments:

1.	Implement Stack and its operations like (creation push pop traverse peek search) using linear data structure
2.	Implement Infix to Postfix Expression Conversion using Stack
3.	Implement Postfix evaluation using Stack.
4.	Implement Towers of Hanoi using Stack.
5.	Implement queue and its operations like enqueue, dequeue, traverse, search.
6.	Implement Single Linked lists and its operations(creation insertion deletion traversal search reverse)
7.	Implement Double Linked lists and its operations(creation insertion deletion traversal search reverse)
8.	Implement binary search and interpolation search.
9.	Implement Bubble sort, selection sort, Insertion sort, quick sort ,merge sort.
10.	Implement Binary search Tree and its operations (creation, insertion, deletion).
11.	Implement Traversals Preorder Inorder Postorder on BST.
12.	Implement Graphs and represent using adjacency list and adjacency matrix and implement basic operations with traversals (BFS and DFS).

- a. **Course Name:** Database Management System
b. **Course Code:** 303105203
c. **Prerequisite:** Basic Computer Knowledge
d. **Course Learning Objective:**

CLOBJ 1	The course will enable students to understand the different issues involved in the design and implementation of a database system as well execute various database queries using SQL.
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e. **Course Learning Outcomes:**

CLO 1	Understand basic concepts of Database.
CLO 2	Understand Relational Models and its importance.
CLO 3	Build proper structured database for a given problem or application.
CLO 4	Learn how various transactions are managed in real-time scenarios.
CLO 5	Understand the evaluation parameters of a query as well as security parameters of database.
CLO 6	Implement SQL concepts to build dynamic database applications.

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	2	0	4	20	20	20	60	30	150

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

g. **Course Content:**

W - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	Introduction: Introduction and applications of DBMS, File Processing System and its limitations, ANSI/SPARC Model, Data Independence, Client-Server Architecture, Users & DBA, Database Architecture.	10	3
2	SQL: Data Definition Language (DDL) commands, Data Manipulation Language (DML) commands, Data Control Language (DCL) commands, Transaction Control Language (TCL) commands. Predicates & Clauses: Logical Operators (AND / OR), Relational Operators, BETWEEN Predicate, IN & NOT IN Predicate, LIKE Predicate. Functions in SQL: Aggregate Functions, Character Functions, Arithmetic Functions, Date Functions, Conversion Functions.	10	4
3	Data Models: Hierarchical Model, Network Model, Relational Model, Object Oriented Model. E-R Diagram: Introduction to E-R Diagram, Entities, Attributes & its types, Relationships, Mapping Cardinalities, Participation Constraints, Weak Entity Sets, Specialization, Generalization, Aggregation.	10	5

4	Relational Data Model: Relational Data Model: Introduction, Degree, Cardinality. Constraints & Keys: Primary Key, Foreign Key, Super Key, Candidate Key, Not Null Constraint, Check Constraint. Relational Algebra Operations: Selection, Projection, Cross-Product, Rename, Joins (Natural & Outer Join), Set Operators (Union, Intersection, Set Difference), Aggregate Functions.	10	4
5	Relational Database Design: Functional Dependency – definition, trivial and non-trivial FD, Armstrong's Axioms/Inference Rules, Closure of FD, Closure of Attributes, Candidate Key, Finding a Candidate Key, Decomposition (Lossy & Lossless), Database Anomalies, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF, 5NF	20	6
6	Transaction: Transaction: Introduction, ACID Properties, Transaction Life Cycle, Scheduling, Serial Schedule, Interleaved Schedule, Transaction Operations, Serializability (View & Conflict), Two-Phase Commit Protocol. Database Recovery: Introduction, Log Based Recovery, Shadow Paging, Checkpoints. Concurrency Control: Introduction, Lock Based Protocol, Two Phase Lock Protocol, Intention Locking, Multiple Granularity, Time-based Protocol. Deadlock: Introduction, Deadlock Detection, Deadlock Recovery, Deadlock Prevention (Wait-Die, Wound-Wait & Timeout-Based Approach).	20	12
7	Query Processing: Query Processing: Introduction, Layers of Query Processing, Measures of Query Cost, File Scans (Linear & Binary Search), Materialized View, Pipelining. Query Optimization: Introduction, Equivalence Rules, Cost-Based Query Optimization.	10	3
8	Security: Data Security, Data Integrity, Authentication, Authorization, Encryption, Decryption, Access Control (DAC, RBAC, MAC), Intrusion Detection, SQL Injection	5	2
9	PL/SQL Concepts: Views, PL/SQL Block, Cursors, Triggers, Stored Procedures, Store Functions	5	3

h. Text Book and Reference Book:

1. Database System Concepts (TextBook) By Abraham Silberschatz, Henry Korth, S. Sudarshan | McGraw Hill International | 6th Edition
2. An Introduction to Database Systems By C. J. Date, A. Kannan, S. Swamynathan | Pearson Education | 8th Edition
3. SQL, PL/SQL – The Programming Language By Ivan Bayross | BPB Publications

i. List of Experiments:

1.	1. What is DBMS? Explain advantages of DBMS over FPS. 2. List 15 applications of Database. Explain any 2 how Database can be helpful in managing that application? 3. Create the Database for the following: 1. Student Details using Excel. 2. Employees Details using MS Access 3. Facebook using Excel
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2.	Create following Tables: Important Instructions: • Use varchar2(30) datatype for Alphanumeric Characters and Special Symbols, number datatype for Numbers, date datatype for Date. • Use same table and column name (Capital and Small Case) as mentioned in this file. • Insert proper data (Capital and Small Case) as mentioned in this file. • Employee Emp_name Street City Adam Spring Pittsfield Brooks Senator Brooklyn Curry North Rye Demalo SunShine San Deago
3.	Simple Queries: 1. Describe deposit, branch. 2. Describe borrow, customers. 3. List all data from table DEPOSIT. 4. List all data from table BORROW. 5. List all data from table CUSTOMERS. 6. List all data from table BRANCH. 7. Give account no and amount of depositors. 8. List all data from SAILORS. 9. List Boat Name and its color. 10. List Employee name and its city. 11. List all the details of Clients. 12. Describe various products and its price. 13. Describe sailor's name, age and its rating. 14. Describe the managers of various employees 15. Describe the details of Loan for customers. 16. Describe the date of travel of various sailors.
4.	Simple Queries: (1) Give name of depositors having amount greater than 4000. (2) List the employees having salary less than 22000. (3) List the sailors having age more than 25. (4) List the boats travelling on 10-oct-98 (5) List the details of boat "Interlake". (6) List the details of the red colored boat. (7) List the details of clients whose city is Mumbai (8) List Client Name, due balance and city of the clients having balance greater than 1500. (9) Describe the details of products having selling price less than 500. (10) List the products for which quantity ordered is less than 120 and cost price is greater than 250. (11) Display account details having amount greater 2200. (12) Display all the customers staying in Nagpur (13) Display the names of sailors having rating greater than 7 (14) Display the orders made in the month of June (15) List all the accounts created in the month of March

5.	“Like” Queries: 1. Display all customers whose name start with ‘M’. 2. Display all the customers whose name ends with ‘L’. 3. Display all loan details whose branch starts with ‘A’. 4. Display the details of sailors whose name is minimum 6 characters long. 5. Display the details of Employees whose address starts with ‘S’. 6. List the details of the boat ending with ‘e’. 7. List the details of clients having ‘h’ as a 3rd character in his/her name. 8. List Client Name, due balance and city whose pin code starts with 4. 9. List all customers whose city contains ‘a’ as second character. 10. List client names and city whose state has ‘a’ as fourth or fifth character.
6.	“Aggregate Functions & DML” Queries: 1. List total deposit from deposit.. 2. Give Maximum loan given to a customer. 3. Describe the average age of all the sailors. 4. Count total number of customers 5. Count total number of customer’s cities. 6. Display total target for the salesman. 7. Update the salary of the employee having 10000 to 11500 8. Update the city of client from Bangalore to Bengaluru. 9. Give the 15% hike in the salary of all the Employees. Rename that column to “New Salary”. 10. Increase the sell price of all products by 20% and label new column as “New Sell Price”. (Do not update the table) 11. Provide the count of customers staying in “Bombay”
7.	“Join” Queries: 1. Find the salary of Adam. 2. Find the city where Brooks work. 3. Display the sailor’s details whose boat is booked for 9th May, 98. 4. Display the day of ride and sailor name for boat 103. 5. Display the sailor name and its age for Red colored and 101 boat. 6. Display the sailor details whose boat is never booked. 7. Display the sailor name that has Red or Green Boat. 8. Display all sailor details and boat details and who has Interlake boat. 9. Display sailor’s rating with boat details or the trip on 10th October, 98. 10. Display the sailor id and name whose age is more than 42 or who has Blue colored boat. 11. Display name and rating of sailor whose boat name is Clipper. 12. List products whose selling price is more than 500 and less than equal to 750. 13. Describe the second highest salary of an employee. 14. Display the date of travel and sailor’s name whose age is between 35 and 65. 15. List all the employees working for “FBC”.

8.	“Join” Queries: 1. Display all the employee name and the city where they work. 2. Display the employee name and company’s name having salary more than 15000. 3. Find the average rating and age of all sailors. 4. List various products available. 5. Display the names of salesman who have salary more than 2850. 6. Change the cost price of Trousers to 950 7. List all the clients having “a” as a second character in their names. 8. List all the products whose QtyonHand is less than Reorderlvl. 9. Print the description and total qty sold for each product. 10. Find out all the products which have been sold to “Ivan Bayross”. 11. Find the names of all clients who have purchased Trousers. 12. Find the products and their quantities for the orders placed by client C00001 and C00002. 13. List the client details who place order no. O19001. 14. List the name of clients who have placed orders worth Rs. 10000 or more. 15. Find the total of Qty ordered for each Order.
9.	“Miscellaneous” Queries: 1. Find the average rate for each Order. 2. Give the loan details of all the customers. 3. List the customer name having loan account in the same branch city they live in. 4. Provide the loan details of all the customers who have opened their accounts after August’95. 5. List the order information for client C00001 and C00002. 6. List all the information for the order placed in the month of june. 7. List the details of clients who do not stay in Maharashtra. 8. Determine the maximum and minimum product price. Rename the output as “Max_Price” and “Min_Price”. 9. Count the number of products having price less than or equal to 500. 10. List the order number and the day on which client placed an order. 11. List the month and the date on which an order is to be delivered. 12. List the date, 25 days after today’s date. 13. Find the total of all the billed orders in the month of June. 14. List the products and orders from customers who have ordered less than 5 units of “Pull Overs”. 15. Find the list of products and orders placed by “Ivan Bayrosss” and “Mamta Muzumdar”. 16. List the clients who placed order before June’04. 17. List all the clients who stays in “Bengaluru” or “Mangalore”.
10.	PL/SQL Block: 1. Write a PL/SQL Block to Add 2 Numbers 2. Write a PL/SQL Block to find Area of Rectangle, Triangle and Square. 3. Write a PL/SQL Block to find Maximum of 3 numbers 4. Write a PL/SQL Block to print sum of N Numbers using For Loop. 5. Write a PL/SQL Block to generate Fibonacci series of N numbers

- a. **Course Name:** Python Programming
- b. **Course Code:** 303105229
- c. **Prerequisite:** Basic knowledge of Computer and programming.
- d. **Course Learning Objective:**

CLOBJ 1	Understand Python syntax, data types, and control structures.
CLOBJ 2	Develop modular programs using functions and modules.
CLOBJ 3	Apply object-oriented programming concepts.
CLOBJ 4	Handle files and exceptions in Python.
CLOBJ 5	Use standard libraries for problem solving.

e. **Course Learning Outcomes:**

CLO 1	Understand the basic concepts of Python programming, including data types, operators, control structures, and syntax rules.
CLO 2	Develop modular and efficient programs using functions, recursion, and built-in data structures like lists, tuples, sets, and dictionaries.
CLO 3	Apply object-oriented programming concepts such as classes, objects, inheritance, and polymorphism to design structured applications.
CLO 4	Implement file handling mechanisms and apply exception handling techniques to build robust and error-free programs.
CLO 5	Analyze and solve data processing problems using Python libraries such as NumPy, Pandas, and Matplotlib for scientific computing and data visualization.

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	2	-	4	40	-	20	60	30	150

SEE - Semester End Examination, T - Theory, P - Practical

g. **Course Content:**

W - Weightage (%) , T - Teaching hours

Sr.	Topics	W	T
1	Unit 1 Introduction to Python: Python environment setup, IDEs (IDLE, PyCharm, Jupyter), Keywords, Identifiers, Variables, Data types, Type conversions ,Operators and Expressions ,Conditional Statements (if, if-else, nested if),Looping (for, while, nested loops), Break, continue, pass statements	15	9
2	Unit 2 Functions, Strings, Lists, Tuples, Sets, and Dictionaries: Defining Functions, Function Arguments, Recursion, Anonymous Functions (Lambda), String operations and built-in string methods ,List operations and list comprehensions , Tuple, Set, Dictionary operations	15	9

3	Unit 3 Object-Oriented Programming in Python : Object-Oriented Programming in Python Introduction to classes and objects, Constructors and destructors ,Data hiding, encapsulation ,Inheritance and polymorphism, Operator overloading	20	9
4	Unit 4 File Handling and Exception Handling: Reading from and writing to text files, Working with file methods, Pickling objects, Error handling: try-except, else-finally, raising exceptions ,User-defined exceptions	25	9
5	Unit 5 Advanced Python and Libraries: Modules and Packages, Working with NumPy arrays and operations, Introduction to Pandas: Data Frame creation and manipulation, Basic Data Visualization using Matplotlib ,Handling JSON data	25	9

h. Text Book and Reference Book:

1. Python Programming By by Reema Thareja | Oxford University Press
2. Introducing Python By Lubanovic Bill, O' Reilly
3. PYTHON: The Complete Reference By Martin C. Brown | McGraw-Hill, 2001
4. Python Programming: An Introduction to Computer Science By John Zelle | Course Technology Cengage Learning Publications | 2nd, Pub. Year 2013

i. List of Experiments:

1.	Practical 1 Install Python and set up different IDEs. Write a program for basic arithmetic operations.
2.	Practical 2 Write programs using conditional and loop constructs.
3.	Practical 3 Develop programs using functions, including recursion and lambda functions.
4.	Practical 4 String manipulations and regular expressions.
5.	Practical 5 Programs on lists, tuples, sets, and dictionaries.
6.	Practical 6 Create classes and implement OOP concepts (inheritance, polymorphism).
7.	Practical 7 Read from and write to text files, perform file operations
8.	Practical 8 Implement exception handling in a program.
9.	Practical 9 Perform array manipulations using NumPy.
10.	Practical 10 Create simple graphs using Matplotlib and handle CSV files using Pandas.

- a. **Course Name:** Professional Communication Skills
b. **Course Code:** 303193203
c. **Prerequisite:** Knowledge of English language in practical life

d. **Course Learning Objective:**

CLOBJ 1	Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism
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e. **Course Learning Outcomes:**

CLO 1	Write, read and understand workplace English
CLO 2	Speak and participate in oral organizational communication
CLO 3	Use verbal & non-verbal communication for delivering a business presentation
CLO 4	Enhance Management skills.
CLO 5	Learn the process of negotiation.

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
-	2	-	-	2	100	100	-	-	-	100

SEE - Semester End Examination, T - Theory, P - Practical

g. **Course Content:**

W - Weightage (%), T - Teaching hours

Sr.	Topics	W	T
1	Technical Writing: Email etiquette & Email writing Letter Writing(Types of Letters & Layout): Trains students on detailed email and letter writing Students will be able to write formal letters following certain stipulated formats. They will learn different types of letters for different official purposes.	10	4
2	Interpersonal Communication at Workplace: Dynamics of communication To develop the confidence to handle a wide range of demanding situation more effectively at the workplace To enable the students to analyse their own interpersonal communication style.	10	2
3	Debate: The three minute debate planner To enable the students to generate effective critical thinking into primary issues in the given topic. Students will be able to resolve controversies and recognize strengths and weaknesses of arguments.	10	4
4	Goal setting & Tracking To enable the students to define strategies or implementation steps to attain the identified goals and make progress every day.	10	2
5	Time Management & Task Planning (Case –study) To enable the students to identify their own time wasters and adopt strategies to reduce them.	5	2

	To enable students to clarify and priorities their objective and goals by creating more planning time		
6	Reading Comprehension: Intermediate level To enable the students develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	5	2
7	Listening Skills: Small everyday conversation & comprehension Provides practice on understanding accents and day to day Listening to English conversations in different context.	10	2
8	Information design and writing for print and online media: Blog Writing To enable students to design information that is targeted to specific audiences in specific situation to meet defined objectives. To create blogs and share their own knowledge and experience to the world.	5	2
9	Advanced vocabulary Building The students will expand their vocabulary so as to enhance their proficiency in reading and listening to academic texts, writing, and The students will attain vocabulary to comprehend academic and social reading and listening The students will develop adequate speaking skills to communicate effectively.	10	4
10	Picture Perception To prepare the students for a test for basic intelligence and IQ, generally done on the first day of SSB (Sashastra Seema Bal is one of India's Central Armed Police Forces)	5	1
11	Appreciation, Apology and Acknowledgement letters To enable the students to maintain productive business relationship through different types of letters. To enable the students to express their feelings without speaking out loud.	10	2
12	The Art of Negotiation To enable the students to reach an agreement for mutual benefits through negotiation. To enable the students to learn a process by which compromise or agreement is reached while avoiding argument and dispute	5	2
13	Activity Session (Game of Truth) To make the students think of significance of certain things in their life. To make them share their thoughts and perception of matters in life, with others.	0	1

h. Text Book and Reference Book:

1. Business Correspondence and Report Writing By SHARMA, R. AND MOHAN, K.
2. Communication Skills 2011 By Kumar S and Lata P | Oxford University Press
3. Practical English Usage By MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student By F.T. WOOD
5. On Writing Well By William Zinsser | Harper Paperbacks,2006 | 30th anniversary edition
6. Oxford Practice Grammar, By John Eastwood | Oxford University Press
7. Quantitative Aptitude for Competitive Examinations By Dr. R.S. Aggarwal

Semester -4

- a. **Course Name:** Differential Equations
- b. **Course Code:** 03161253
- c. **Prerequisite:** Basic Algebra, Functions and Calculus
- d. **Course Learning Objective:**

CLOBJ 1	The objective of the syllabus explores how quantities change over time or space, essential for modeling realworld phenomena. It provides a mathematical framework to predict and analyze dynamic systems, driving advancements in science and technology.
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- e. **Course Learning Outcomes:**

CLO 1	Understand the concept of differential equations.
CLO 2	Develop skills to solve differential equations using analytical methods.
CLO 3	Apply methods to solve real world applications.
CLO 4	Apply properties of special functions in discussion the solution of ODE.
CLO 5	Find Laplace transform of a given function and its inverse Laplace transform.

- f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
4	-	-	-	4	40	-	-	60	-	100

SEE - Semester End Examination, T - Theory, P - Practical

- g. **Course Content:**

W - Weightage (%) , T - Teaching hours

Sr.	Topics	W	T
1	First order ordinary differential equation: Definition, Order, Degree, Formation, Exact and Non-Exact Differential equation, Linear and Bernoulli's equations Applications: Growth model, LR circuit. RC- circuit.	20	12
2	Higher order ordinary differential equation Ordinary differential equation of higher orders, Homogeneous Linear ODEs with constant coefficients, Euler-Cauchy equations, Non-Homogeneous ODEs, Method of Undetermined coefficient, Method of Variation of Parameter Applications: LCR-Circuit, Spring-Mass System	30	18
3	Power Series Power series solution at ordinary point, Legendre polynomials, Bessel function of first kind and their properties.	20	12
4	Laplace Transform: Laplace Transform of elementary functions and its properties- Linearity property, first shifting theorem, multiplication by t, and division by t, Laplace transformation of derivatives and integrals, Inverse Laplace transform, using partial fraction, Convolution theorem and Applications to solve the ordinary differential equation.	30	18

- h. **Text Book and Reference Book:**

- Advanced Engineering Mathematics (TextBook) By E. Kreyszig | Willey India Edition
- Higher Engineering Mathematics By B. S. Grewal | Khanna Publications

3. A text book of Engineering Mathematics By N.P. Bali and Manish Goyal | Laxmi Publications
4. A.R.Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London
5. D.A. Murray, Introductory Course in Differential Equations. Orient Longman (India).

a. **Course Name:** Numerical Methods

b. **Course Code:** 03161251

c. **Prerequisite:** Basic Knowledge of Functions, calculus and algebra.

d. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental concepts of numerical analysis
CLOBJ 2	Apply appropriate numerical techniques
CLOBJ 3	Use numerical methods for interpolation, differentiation, and integration,

e. **Course Learning Outcomes:**

CLO 1	Evaluate numerical solutions of algebraic and transcendental equations.
CLO 2	Apply Interpolation methods for prediction to real world problems.
CLO 3	Compute numerical differentiation and Integration.
CLO 4	Solve Ordinary Differential Equations numerically.
CLO 5	Program various numerical methods using python.

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/W eek	Hrs/Wee k	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	2	-	4	40	-	20	60	30	150

SEE - Semester End Examination, T - Theory, P - Practical

g. **Course Content:**

Sr.	Topic	Weightage	Teaching Hrs.
1	Numerical solution of Linear Systems and Roots of Algebraic and Transcendental Equations Solution of System of Linear Equations: Gauss Jacobi, Gauss Seidel Methods. Roots of Algebraic and Transcendental Equations: Bisection Method, Regula-Falsi method and Newton Raphson Method.	25	15
2	Finite Differences and Interpolation Introduction to Finite Differences: Forward and Backward Differences, Relation Between Operators, Differences of a polynomial & minus; Factorial Polynomial. Interpolation: Newton's forward and Backward Interpolation for Equal Intervals; Divided Differences and Properties, Interpolation with Unequal Intervals & minus; Newton's Divided Difference Interpolation, Lagrange's Interpolation, Inverse Lagrange's Interpolation.	25	15

3	Numerical Differentiation and Integration Numerical Differentiation: Newton's Forward and Backward Difference Formulae to Compute First and Higher Order Derivatives. Numerical Integration: Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three Eight Rule. Applications of Trapezoidal Rule, Applications of Simpson's One-Third Rule.	25	15
4	Numerical Solution of Ordinary Differential Equations Taylor Series Method, Euler's Method, Modified Euler's method, Runge-Kutta Second-Order Method, Runge-Kutta Fourth Order Method and their order of convergence. Lab work: Numerical programs for Euler's Method and Runge-Kutta Fourth Order Method using Python.	25	15

h. Text Book and Reference Book:

1. "Numerical Methods for Engineers, (TextBook)By Gupta, S. K., | New Academic Science, 2012.
2. Numerical Methods in Engineering & Science with Programs (TextBook)By Dr. B. S. Grewal | Khanna Publishers
3. Numerical Methods for Scientific and Engineering Computation By M. K. Jain, S. R. K. Iyengar, R. K. Jain | New Age International Limited Publisher
4. Introductory Methods of Numerical Analysis (TextBook) By S. S. Sastry | Prentice Hall India Learning Private Limited
5. Introduction to Numerical Analysis By C.E. Froberg | Addison-Wesley

i. List of Experiments:

Sr. No.	Names of Experiments
1	LAB-1 Solving system of linear equation using Guass Jacobi and Guass Seidel in Python programming.
2	LAB-2 Find the roots of equation using Regula Falsi in Python Programming.
3	LAB-3 Find roots of equation using Newton Raphson Method in Python Programming.
4	LAB-4 Using interpolation methods for equal and unequal intervals in python programming.
5	LAB-5 Using Trapezoidal rule and Simpson's rule in Python Programming.
6	LAB-6 Using Euler's Method to solve differential equations in Python Programming.
7	LAB-7 Using R-K 4th order to solve differential equation in Python Programming.

- a. **Course Name:** Data Communication and Networking
- b. **Course Code:** 03107401
- c. **Prerequisite:** Basic knowledge of Computer languages.
- d. **Course Learning Objective:**

CLOBJ 1	Introduction to analysis and design of computer and communication networks through understanding the network layered architecture and the protocol stack and by conducting hands-on programming and lab activities
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- e. **Course Learning Outcomes:**

CLO 1	Explain the concept of TCP/IP and OSI layers.
CLO 2	Analyse the Design issues and problems of all layers.
CLO 3	Analyse various algorithms.
CLO 4	Design small projects based on security issues, the control algorithm.

- f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Wee k	Tutorial Hrs/Wee k	Lab Hrs/Wee k	Hrs/	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	2	-	4	20	20	20	60	30	150

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

- g. **Course Content:**

W - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W	T
1	Computer Networks and the Internet The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and their Service Models, Problem: Connecting to a Network , Framing, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks (802.3), Wireless, What's Next: "The Internet of Things"	10	4
2	Link layer :links, Access networks and LAN Introduction to Link layers, Error detection and correction techniques, MAC protocols, Switched LAN, link virtualization, Data center networking	15	7
3	Network layer Virtual Circuit and Datagram Network, Router, The Routing Algorithms, Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing in the Internet, Broadcast and Multicast Routing.	15	7
4	Transport Layer Introduction and transport layer service, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Congestion Control of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of congestion control, TCP Congestion Control.	15	7

5	Application Layer Principles of network applications, Hyper Text Transfer Protocol (HTTP), Domain Name Service (DNS). FTP, Email, DNS—The Internet's Directory Service.	15	7
6	Wireless and Mobile networks wireless links and networks characteristics, 802.11, cellular internet access, mobility management, mobile IP	10	4
7	NETWORK SECURITY Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms, Digital Signatures, Management Of Public Keys, IPsec, Firewalls.	10	4
8	Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding	10	5

h. Text Book and Reference Book:

1. Computer Networking: A Top-Down Approach Featuring the Internet By James F. Kurose, Keith W. Ross. | Addison-Wesley | 7th Edition
2. Computer Networks By Andrew S Tannebaum | Pearson, 2012
3. Data Communication and Networking By Behrouz Forouzan | TMH

i. List of Experiments:

Sr. No.	Names of Experiments
1	Introduction to WIRESHARK
2	Generate DNS traffic and trace packets using wireshark.
3	Generate HTTP traffic, trace packets using wireshark.
4	Create a network using CISCO packet tracer
5	Packet capture and analysis of application that uses UDP .Investigate the header fields in the UDP segment as well as the checksum calculation
6	Introduction to NS2
7	To study and perform simple node connection using TCL (Tool Command language) script
8	To Perform Unequal packet drop using UDP protocol in NS2.
9	Introduction to NS3.
10	Creating point to point module using NS3.
11	Implementing CSMA protocol using NS3.
12	To study and execute Network Commands.
13	Implementation of Character stuffing and DE stuffing.
14	Implementation of Parity checker. Write a CRC code and verify it using C.

- a. **Course Name:** Operating System
- b. **Course Code:** 303105251
- c. **Prerequisite:** Fundamentals of Computer Systems Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.
- d. **Course Learning Objective:**

CLOBJ 1	This course is an introduction to the theory and practice behind modern computer operating systems.
CLOBJ 2	Topics will include what an operating system does (and doesn't) do, system calls and interfaces, processes, concurrent programming, resource scheduling and management, virtual memory, deadlocks, algorithms, programming, and security.
CLOBJ 3	The approach of the subject is from both a theoretical perspective as well as a practical one.

e. **Course Learning Outcomes:**

CLO 1	Distinguish different styles of operating system design.
CLO 2	Understand device and I/O management functions in operating systems as part of a uniform device abstraction.
CLO 3	Understand disk organization and file system structure
CLO 4	Give the rationale for virtual memory abstractions in operating systems.
CLO 5	Understand the main principles and techniques used to implement processes and threads as well as the different algorithms for process scheduling.
CLO 6	Understand the main mechanisms used for inter-process communication

f. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	2	0	4	20	20	20	60	30	150

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

g. **Course Content:**

W - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	INTRODUCTION: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	5	3
2	PROCESSES, THREAD & PROCESS SCHEDULING: Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.	20	9

	Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR.		
3	INTER-PROCESS COMMUNICATION: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem etc	15	6
4	DEADLOCKS: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	10	5
5	MEMORY MANAGEMENT & VIRTUAL MEMORY: Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation 'Fixed and variable partition' Internal and External fragmentation and Compaction; Paging: Principle of operation 'Page allocation' Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory 'Hardware and control structures' Locality of reference, Page fault, Working Set, Dirty page/Dirty bit 'Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	30	13
6	I/O SYSTEMS, FILE & DISK MANAGEMENT: I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software. File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling algorithms - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	20	9

h. Text Book and Reference Book:

1. Operating System Concepts Essentials (TextBook) By AviSilberschatz, Peter Galvin, Greg Gagne | 9th Edition Wiley Asia Student Edition.
2. Operating Systems Internals and Design Principles By William Stallings | PHI | 5th Edition
3. Operating System: A Design-oriented Approach By Charles Crowley, | 1st Edition - Irwin Publishing
4. Operating Systems: A Modern Perspective By Gary J. Nutt | Addison-Wesley; 2nd Edition | 2nd Edition
5. Design of the Unix Operating Systems By Maurice Bach, | Prentice-Hall of India | 8th Edition
6. Understanding the Linux Kernel By Daniel P. Bovet, Marco Cesati, | O'Reilly and Associates | 3rd Edition

i. List of Experiments:

Sr. No.	Names of Experiments
1	Study of Basic commands of Linux.
2	Study the basics of shell programming.
3	Write a Shell script to print given numbers sum of all digits.
4	Write a shell script to validate the entered date. (eg. Date format is: dd-mm-yyyy).
5	Write a shell script to check entered string is palindrome or not.
6	Write a Shell script to say Good morning/Afternoon/Evening as you log in to system.
7	Write a C program to create a child process.
8	Finding out biggest number from given three numbers supplied as command line arguments.
9	Printing the patterns using for loop.
10	Shell script to determine whether given file exist or not.
11	Write a program for process creation using C. (Use of gcc compiler.
12	Implementation of FCFS & Round Robin Algorithm.
13	Implementation of Banker's Algorithm.

a. Course Name: Data Analytics with R

b. Course Code:

c. Prerequisite: Basic knowledge of programming and data handling.

d. Course Learning Objective:

CLOBJ 1	Gain insights into Data Analytics and its significance across industries.
CLOBJ 2	Learn R programming fundamentals and its role in data analytics.
CLOBJ 3	Understand decision-making, control statements, and functions in R.
CLOBJ 4	Explore data visualization techniques using R's powerful libraries.
CLOBJ 5	Apply statistical models and machine learning techniques for data analytics.

e. Course Learning Outcomes:

CLO 1	Understand the key concepts and applications of Data Analytics.
CLO 2	Install and use R Studio efficiently for data processing.
CLO 3	Implement control structures and manage data using R programming.
CLO 4	Perform exploratory data analysis and visualize data effectively.
CLO 5	Apply statistical models and predictive analytics in real-world scenarios.

f. Teaching & Examination Scheme:

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/	Tutoria l Hrs/	Lab Hrs/	Hrs/	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	2	-	4	20	20	20	60	30	150

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

g. Course Content:

W - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	UNIT-1 Foundations of Data Analytics: Introduction to Data Analytics; Importance & Real-world Applications ; Data Types: Structured, Semi-Structured, Unstructured ;Data Preprocessing and Cleaning ;Role of Data Science in Decision Making	15	6
2	UNIT-2 Fundamentals of R Programming: Introduction to R and its Applications; Installing & Setting Up R Studio; Writing and Executing R Scripts; Understanding Console and Environment Settings; Variables, Data Types, Operators, and Expressions; Introduction to R Packages & Libraries	15	6
3	UNIT-3 Control Structures & Data Handling in R: User Input and Output Operations; Conditional Statements (If-Else, Switch) ; Looping Constructs (For, While, Repeat);Break and Next Statements; Data Structures in R: Vectors, Lists, Data Frames, Matrices, Arrays; Handling Missing Data and Data Manipulation Techniques	20	8
4	UNIT-4 Data Visualization & Exploratory Analysis: Importing Data from Multiple Sources: CSV, JSON, XML, Databases, APIs ;Exploratory Data Analysis (EDA) Techniques; Data Visualization using ggplot2 and Base R; Creating & Customizing Charts and Graphs; Bar Plots, Line Charts, and Histograms; Scatter Plots, Boxplots, and Heatmaps; Interactive Data Visualization	25	10
5	UNIT-5 Statistical Analysis and Predictive Modeling: Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation; Probability Distributions: Normal & Binomial; Hypothesis Testing and ANOVA; Regression Analysis: Simple & Multiple Linear Regression, Logistic Regression; Introduction to Time Series Forecasting; Clustering and Classification Techniques in R	25	10

h. Text Book and Reference Book:

1. R for everyone: advanced analytics and graphics By W. N. Venables, D.M. Smith and the R Development Core Team | Version 3.0.1 (2013-05-16)
2. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics By Tanenbaum | Prentice-Hall International.
3. Beginning R: An Introduction to Statistical Programming By Larry Pace | Latest Edition

4. Statistics and data analysis: from elementary to intermediate By Dunlop, Dorothy D., and Ajit C. Tamhane| Prentice Hall|2000
5. Introductory Statistics with R By P Dalgaard | 2nd Edition.

i. List of Experiments:

Sr. No.	Names of Experiments
1	Introduction to R Programming (a) Install and set up R and RStudio. (b) Write and execute basic R scripts. (c) Perform simple arithmetic operations in R.
2	Working with Data Types and Operators (a) Understand different data types in R (numeric, character, logical, factor). (b) Perform operations using arithmetic, relational, and logical operators. Convert between different data types.
3	Control Structures and Functions in R (a) Implement decision-making structures (if, if-else, switch). (b) Use loops (for, while, repeat) for iterative tasks. (c) Create and use user-defined functions in R.
4	Data Structures in R (a) Work with vectors, lists, matrices, and data frames. (b) Perform indexing, subsetting, and manipulation of data structures. (c) Merge, sort, and reshape data frames.
5	Handling and Cleaning Data (a) Read data from CSV, JSON, and Excel files into R. (b) Identify and handle missing values (NA). (c) Remove duplicate and inconsistent data entries.
6	Data Manipulation using dplyr and tidyr (a) Use dplyr for filtering, selecting, grouping, and summarizing data. (b) Apply tidyr functions like gather(), spread(), separate(), and unite().
7	Working with Date and Time in R (a) Understand date and time formats in R. (b) Perform date arithmetic and time-based calculations. (c) Extract specific components like day, month, and year.
8	Reading and Writing Files in R (a) Read data from text files, CSV, and Excel files. (b) Write data into different file formats. (c) Perform basic file handling operations.
9	Sorting and Filtering Data (a) Sort data in ascending and descending order.

	(b) Filter data based on conditions. (c) Use logical operators to refine data selection.
10	Basic String Operations in R (a) Perform string manipulation using functions like paste(), substr(), tolower(), toupper(). (b) Work with regular expressions for pattern matching. (c) Clean and process text data.

- a. **Course Name:** Professional Grooming and Personality Development
- b. **Course Code:** 303193252
- c. **Prerequisite:** Knowledge of communication theories and basic management skills are essential.
- d. **Rationale:** Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.
- e. **Course Learning Objective:**

CLOBJ 1	Acquiring soft skills, life skills & aptitude skills are crucial for organizational communication as well as for employability respectively.
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f. **Course Learning Outcomes:**

CLO 1	Identity and develop soft skills required for personal and professional growth.
CLO 2	Develop professional etiquette & desired behaviour at the workplace
CLO 3	Speak and participate effectively in oral organizational communication
CLO 4	Improve comprehensive skills for reading
CLO 5	Know how to be assertive in professional environment

g. **Teaching & Examination Scheme:**

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
-	1	-	-	1	100	100	-	-	-	100

SEE - Semester End Examination, T - Theory, P – Practical

h. Course Content:

W - Weightage (%) , T - Teaching hours

Sr.	Topics	W	T
1	Self Development and Assessment Various self-assessments for personal and professional development skills that are relevant to career development: - Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Guess, Think, Communicate, Relate, and Dream	25	4
2	Corporate Etiquette Tips and guide to develop personality and gain various etiquettes manners, case studies and activities. Telephone etiquette Etiquette for foreign business trips Etiquette for small talks Respecting privacy Learning to say 'No'	25	4
3	Public Speaking It's process of communicating information to an audience and is helpful in career advancement. Effective Public speaking skills includes: Choosing appropriate pattern Selecting appropriate method Art of persuasion Making speeches effective Delivering different types of speeches	20	4
4	Reading Skills Activity & Reading Comprehension Aims to improve students' Comprehensive Skills in English Language by getting them involved in reading activity and providing practice for reading comprehension.	15	2
5	Listening Skills- Inquiry Based Listening Questions Aims to improve students' listening skills in English Language providing them practice of various types of inquiry based listening tracks. Students will listen and will be able to find out details from the conversations.	15	1