JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in MECHANICAL ENGINEERING
COURSE STRUCTURE and SYLLABUS (R25 Regulations)
Applicable from AY 2025-26 Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	MA101BS	Matrices and Calculus	3	1	0	4
2.	PH102BS	Advanced Engineering Physics	3	0	0	3
3.	ME103ES	C Programming and Data Structures	3	0	0	3
4.	ME104ES	Engineering Mechanics	3	0	0	3
5.	EN105HS	English for Skill Enhancement	3	0	0	3
6.	PH106BS	Advanced Engineering Physics Lab	0	0	2	1
7.	CS107ES	C Programming and Data Structures Lab	0	0	2	1
8.	ME108ES	Engineering Workshop	0	0	2	1
9.	EN109HS	English Language and Communication Skills Lab	0	0	2	1
		Induction Program	-	-	-	-
		Total Credits	**15**	**01**	**08**	**20**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	MA201BS	Ordinary Differential Equations and Vector Calculus	3	0	0	3
2.	CH202BS	Applied Chemistry	3	0	0	3
3.	CS203ES	Python Programming	3	0	0	3
4.	EE204ES	Elements of Electrical and Electronics Engineering	3	0	0	3
5.	ME205ES	Thermodynamics	3	0	0	3
6.	ME206ES	Engineering Drawing and Computer Aided Drafting	2	0	2	3
7.	CH207BS	Chemistry Lab for Engineers	0	0	2	1
8.	CS208ES	Python Programming Lab	0	0	2	1
9.	EE209ES	Elements of Electrical and Electronics Engineering Lab	0	0	2	1
		Total Credits	**17**	**00**	**08**	**21**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	MA301BS	Probability, Statistics and Complex Variables	3	0	0	3
2.	ME302PC	Mechanics of Solids	3	0	0	3
3.	ME303PC	Material Science and Metallurgy	3	0	0	3
4.	ME304PC	Production Technology	3	0	0	3
5.	ME305PC	Fluid Mechanics and Hydraulic Machines	3	0	0	3
6.	MA306PC	Computational Mathematics Lab	0	0	2	1
7.	ME307PC	Production Technology Lab	0	0	2	1
8.	ME308PC	Material Science and Mechanics of Solids Lab	0	0	2	1
9.	ME309PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
10.	ME310SD	Design Thinking and Ideation	0	0	2	1
		Total Credits	**15**	**0**	**10**	**20**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	ME401PC	Kinematics of Machinery	3	0	0	3
2.	ME402PC	Thermal Engineering - I	3	0	0	3
3.	ME403PC	Design of Machine Elements	3	0	0	3
4.	ME404PC	Instrumentation and Control Systems	3	0	0	3
5.	ME405PC	Operations Research	2	0	0	2
6.	MS406HS	Innovation and Entrepreneurship	2	0	0	2
7.	ME407PC	Conventional and Computer Aided Machine Drawing	0	0	2	1
8.	ME408PC	Instrumentation and Control Systems Lab	0	0	2	1
9.	ME409PC	Thermal Engineering-I Lab	0	0	2	1
10.	ME410SD	Data Analytics and Python for Engineers	0	0	2	1
11.	VA400HS	Indian Knowledge System	1	0	0	1
		Total Credits	**17**	**0**	**8**	**21**

III YEAR I SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1.	ME501PC	Design of Transmission Elements	3	0	0	3
2.	ME502PC	Thermal Engineering - II	3	0	0	3
3.	ME503PC	Metrology and Machine Tools	3	0	0	3
4.		Professional Elective-I	3	0	0	3
5.		Open Elective-I	2	0	0	2
6.	ME504PC	Thermal Engineering - II Lab	0	0	2	1
7.	ME505PC	Metrology and Machine Tools Lab	0	0	2	1
8.	ME506PC	Modelling and Drafting Lab	0	0	2	1
9.	ME507PC	Field Based Research Project	0	0	4	2
10.	ME508SD	Modelling and Simulation Tools	0	0	2	1
11.	VA500HS/ VA501HS	Gender Sensitization*/ Human Values and Professional Ethics*	1	0	0	0.5+0.5
		Total Credits	**15**	**0**	**12**	**21**

***Note: For the courses Gender Sensitization and Human Values and Professional Ethics -** one hour of instruction will be conducted on alternate weeks. For example, if a one-hour class for Gender Sensitization is conducted this week, then a one-hour class for Human Values and Professional Ethics will be conducted in the following week.

III YEAR II SEMESTER

S.No	Course Code	Course Title	L	T	P	Credits
1.	ME601PC	Dynamics of Machinery	3	0	0	3
2.	ME602PC	Heat Transfer	3	0	0	3
3.	MS603HS	Business Economics and Financial Analysis	3	0	0	3
4.		Professional Elective-II	3	0	0	3
5.		Open Elective – II	2	0	0	2
6.	ME604PC	Heat Transfer Lab	0	0	2	1
7.	ME605PC	Applied Manufacturing Lab	0	0	2	1
8.	ME606PC	Kinematics and Dynamics Lab	0	0	2	1

9.	EN607HS	English for Employability Skills Lab	0	0	2	1
10.	ME608SD	Troubleshooting of Mechanical Systems	0	0	2	1
11.	VA600ES	Environmental Science	1	0	0	1
		Total Credits	**15**	**0**	**10**	**20**

IV YEAR, I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	ME701PC	Finite Element Methods	3	0	0	3
2.	ME702PC	Robotics and Automation	3	0	0	3
3.	ME703PC	Industrial Engineering and Management	3	0	0	3
4.		Professional Elective - III	3	0	0	3
5.		Professional Elective – IV	3	0	0	3
6.		Open Elective – III	2	0	0	2
7.	ME704PC	Computer Aided Analysis Lab	0	0	2	1
8.	ME705PC	Robotics and Automation Lab	0	0	2	1
9.	ME706PC	Industry Oriented Mini Project/ Internship	0	0	4	2
		Total Credits	**17**	**0**	**08**	**21**

IV YEAR, II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Professional Elective – V	3	0	0	3
2.		Professional Elective – VI	3	0	0	3
3.	ME801PC	Project Work	0	0	42	14
		Total Credits	**6**	**0**	**42**	**20**

Professional Elective-I

1	ME511PE	Power Plant Engineering
2	ME512PE	Automobile Engineering
3	ME513PE	Refrigeration and Air-Conditioning
4	ME514PE	Renewable Energy Sources

Professional Elective – II

1	ME621PE	Additive Manufacturing
2	ME622PE	Micro Manufacturing
3	ME623PE	Artificial Intelligence in Mechanical Engineering
4	ME624PE	Advanced Machining Processes

Professional Elective-III

1	ME731PE	Mechanical Vibrations
2	ME732PE	Mechanics of Composite Materials and Structures
3	ME733PE	Design for Manufacturing and Assembly
4	ME734PE	Mechatronic Systems

Professional Elective-IV

1	ME741PE	Plant Maintenance and Reliability Engineering
2	ME742PE	Total Quality Management
3	ME743PE	Database Management Systems

1	ME741PE	Plant Maintenance and Reliability Engineering
2	ME742PE	Total Quality Management
4	ME744PE	Production Planning and Control

Professional Elective-V

1	ME851PE	Product Design and Manufacturing
2	ME852PE	Computational Fluid Dynamics
3	ME853PE	Electric and Hybrid Vehicles
4	ME854PE	Artificial Neural Networks

Professional Elective-VI

1	ME861PE	Hydraulics and Pneumatics
2	ME862PE	Sustainable Engineering
3	ME863PE	AI/ML for Design Analysis
4	ME864PE	Project Management

OPEN ELECTIVES

Open Elective-I:

1	ME511OE	Optimization Methods
2	ME512OE	Industrial Robotics

Open Elective-II:

1	ME621OE	Artificial Intelligence in Mechanical Engineering
2	ME622OE	Non-Conventional Sources of Energy

Open Elective-III:

1	ME731OE	Engineering Materials
2	ME732OE	Digital Manufacturing

MA101BS: MATRICES AND CALCULUS

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Objectives: To learn

1. Applying basic operations on matrices and their properties.
2. Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
3. Concept of eigen values and eigen vectors and to reduce the quadratic form to canonical form
4. Geometrical approach to the mean value theorems and their application to the mathematical problems
5. Finding maxima and minima of functions of two and three variables.
6. Evaluation of multiple integrals and their applications.

Course outcomes: After learning the contents of this paper, the student must be able to

1. Write the matrix representation of a set of linear equations and to analyze the solution of the system of equations
2. Find the Eigen values and Eigen vectors
3. Reduce the quadratic form to canonical form using orthogonal transformations.
4. Solve the applications of the mean value theorems.
5. Find the extreme values of functions of two variables with/ without constraints.
6. Evaluate the multiple integrals and apply the concept to find areas, volumes.

UNIT-I: Matrices **8 L**

Rank of a matrix by Echelon form and Normal form – Inverse of Non-singular matrices by Gauss-Jordan method. System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations. Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors **10 L**

Linear Transformation and Orthogonal Transformation: Eigen values – Eigen vectors and their properties – Diagonalization of a matrix – Cayley-Hamilton Theorem (without proof) – Fnding inverse and power of a matrix by Cayley-Hamilton Theorem. Quadratic forms and Nature of the Quadratic Forms – Reduction of Quadratic form to canonical form by Orthogonal Transformation.

UNIT-III: Single Variable Calculus **10 L**

Limit and Continuous of functions and its properties. Mean value theorems: Rolle's theorem – Lagrange's Mean value theorem with their Geometrical Interpretation and applications – Cauchy's Mean value Theorem – Taylor's Series (All the theorems without proof).

Curve Tracing: Curve tracing in cartesian coordinates.

UNIT-IV: Multivariable Calculus (Partial Differentiation and applications) **10 L**

Definitions of Limit and continuity – Partial Differentiation: Euler's Theorem – Total derivative – Jacobian – Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V: Multivariable Calculus (Integration) **10 L**

Evaluation of Double Integrals (Cartesian and polar coordinates) – change of order of integration (only Cartesian form) – Change of variables for double integrals (Cartesian to polar). Evaluation of Triple Integrals – Change of variables for triple integrals (Cartesian to Spherical and Cylindrical polar coordinates). Applications: Areas by double integrals and volumes by triple integrals.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Editon, 2016.

REFERENCE BOOKS:

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

PH102BS: ADVANCED ENGINEERING PHYSICS

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: 10+2 Physics

Course Objectives:

1. To study crystal structures, defects, and material characterization techniques like XRD and SEM.
2. To understand fundamental concepts of quantum mechanics and their applications in solids and nanomaterials.
3. To introduce quantum computing principles, quantum gates, and basic quantum algorithms.
4. To learn the properties and applications of magnetic and dielectric materials.
5. To explore the working and applications of lasers and fibre optics in modern technology.

Course Outcomes:

1. **CO1**: Analyze crystal structures, identify defects, and apply XRD and SEM techniques for material characterization.
2. **CO2**: Apply quantum mechanical principles to explain particle behaviour and energy band formation in solids.
3. **CO3**: Understand quantum computing concepts, use quantum gates, and explain basic quantum algorithms.
4. **CO4**: Classify magnetic and dielectric materials and explain their properties, synthesis, and applications.
5. **CO5**: Explain the principles of lasers and fibre optics and their applications in communication and sensing.

UNIT - I: Crystallography & Materials Characterization

Introduction: Unit cell, space lattice, basis, lattice parameters; crystal structures, Bravais lattices, packing factor: SC, BCC, FCC; Miller indices, inter-planar distance; defects in crystals (Qualitative): point defects, line defects, surface defects and volume defects. concept of nanomaterials: surface to volume ratio, X -ray diffraction: Bragg's law, powder method, calculation of average crystallite size using Debye Scherrer's formula, scanning electron microscopy (SEM): block diagram, working principle.

UNIT - II: Quantum Mechanics

Introduction, de-Broglie hypothesis, Heisenberg uncertainty principle, physical significance of wave function, postulates of quantum mechanics: operators in quantum mechanics, eigen values and eigen functions, expectation value; Schrödinger's time independent wave equation, particle in a 1D box, Bloch's theorem (qualitative), Kronig-Penney model (qualitative): E-k diagram, effective mass of electron, formation of energy bands, origin of bandgap, classification of solids, concept of discrete energy levels and quantum confinement in nanomaterials.

UNIT - III: Quantum Computing

Introduction, linear algebra for quantum computation, Dirac's Bra and Ket notation and their properties, Hilbert space, Bloch's sphere, concept of quantum computer, classical bits, Qubits, multiple Qubit system, quantum computing system for information processing, evolution of quantum systems, quantum measurements, entanglement, quantum gates, challenges and advantages of quantum computing over classical computation, quantum algorithms: Deutsch-Jozsa, Shor, Grover.

UNIT - IV: Magnetic and Dielectric Materials

Introduction to magnetic materials, origin of magnetic moment-classification of magnetic materials, hysteresis, Weiss domain theory of ferromagnetism, soft and hard magnetic materials, synthesis of ferrimagnetic materials using sol-gel method, applications: magnetic hyperthermia for cancer treatment,

magnets for EV, Giant Magneto Resistance (GMR) device.
Introduction to dielectric materials, types of polarization (qualitative): electronics, ionic & orientation; ferroelectric, piezoelectric, pyroelectric materials and their applications: Ferroelectric Random-Access Memory (Fe-RAM), load cell and fire sensor.

UNIT - V: Laser and Fibre Optics

Introduction to laser, characteristics of laser, Einstein coefficients and their relations, metastable state, population inversion, pumping, lasing action, Ruby laser, He-Ne laser, CO_2 laser, semiconductor diode laser, applications: Bar code scanner, LIDAR for autonomous vehicle.
Introduction to fibre optics, total internal reflection, construction of optical fibre, acceptance angle, numerical aperture, classification of optical fibres, losses in optical fibre, applications: optical fibre for communication system, sensor for structural health monitoring.

TEXT BOOKS:

1. Walter Borchardt-Ott, *Crystallography: An Introduction*, Springer.
2. Charles Kittel, *Introduction to Solid State Physics*, John Wiley & Sons, Inc.
3. Thomas G. Wong, *Introduction to Classical and Quantum Computing*, Rooted Grove

REFERENCE BOOKS:

1. Jozef Gruska, *Quantum Computing*, McGraw Hill
2. Michael A. Nielsen & Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press.
3. John M. Senior, *Optical Fiber Communications Principles and Practice*, Pearson Education Limited.

Useful Links

- https://shijuinpallotti.wordpress.com/wp-content/uploads/2019/07/optical-fiber-communications-principles-and-pr.pdf
- https://www.geokniga.org/bookfiles/geokniga-crystallography_0.pdf
- https://dpbck.ac.in/wp-content/uploads/2022/10/Introduction-to-Solid-State-PhysicsCharles-Kittel.pdf
- https://www.thomaswong.net/introduction-to-classical-and-quantum-computing-1e4p.pdf
- https://www.fi.muni.cz/usr/gruska/qbook1.pdf
- https://profmcruz.wordpress.com/wp-content/uploads/2017/08/quantum-computation-and-quantum-information-nielsen-chuang.pdf

CS103ES: C PROGRAMMING AND DATA STRUCTURES

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

Course Outcomes:

1. Understand the various steps in Program development.
2. Explore the basic concepts in C Programming Language.
3. Develop modular and readable C Programs
4. Understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
5. Apply data structures such as stacks, queues in problem solving
6. To understand and analyze various searching and sorting algorithms.

UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development

Introduction to C Language – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output

Structure of a C Program – Operators, Bit-wise operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Statements.

UNIT - II

Statements – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Recursion.

Designing Structured Programs- Functions, basics, user defined functions, inter function communication, standard functions.

Arrays – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays.

UNIT - III

Pointers – Introduction, Pointers for inter function communication, pointers to pointers, compatibility,

Pointer Applications – Passing an array to a function, Memory allocation functions, array of pointers

Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion.

UNIT - IV

Derived types – The Typedef, enumerated types, Structures – Declaration, definition and initialization of structures, accessing structures, operations on structures, complex structures. Unions – Referencing unions, initializers, unions and structures.

Input and Output – Text vs Binary streams, standard library functions for files, converting file types, File programs – copy, merge files.

UNIT – V

Sorting- selection sort, bubble sort, insertion sort,

Searching-linear and binary search methods.

Data Structures – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

TEXT BOOKS:

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

REFERENCE BOOKS:

1. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3 Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
4. C for Engineers and Scientists, H. Cheng, McGraw-Hill International Edition
5. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education / PHI
6. C Programming & Data Structures, E. Balagurusamy, TMH.
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
8. C & Data structures – E V Prasad and N B Venkateswarlu, S. Chand & Co.

ME104ES: ENGINEERING MECHANICS

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: The objectives of this course are to

1. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
2. Perform analysis of bodies lying on rough surfaces.
3. Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
4. Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
5. Explain the concepts of work energy method and its applications to translation, rotation and plane motion and the concept of vibrations

Course Outcomes: At the end of the course, students will be able to

1. Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

UNIT - I: Introduction to Engineering Mechanics

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

UNIT - II: Friction and Centre of Gravity

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction. Motion of Bodies, Wedge friction, Screw jack and Differential Screw jack.

Centroid and Centre of Gravity: Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections, Centre of Gravity and its implications, Theorem of Pappus.

UNIT - III: Moment of Inertia

Definition, Area Moment of Inertia, Moment of inertia of Plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections. Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem.

Mass Moment of Inertia: Moment of Inertia of Masses, Radius of Gyration, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of composite bodies.

UNIT - IV: Dynamics of a Particle

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

UNIT - V: Kinetics of Rigid Bodies

Introduction, Types of motion, Instantaneous centre of rotation in plane motion and simple problems, D' Alembert's principle and its applications in plane motion and connected bodies. Work-Energy Method: Work-Energy principle and its application in plane motion of connected bodies or Systems, Work energy Applied to particle motion, Kinetics of rigid body rotation.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EN105HS: ENGLISH FOR SKILL ENHANCEMENT

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

INTRODUCTION

National Education Policy-2020 aims at preparing students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. It also emphasizes language study and promotion of languages through understanding and proper interpretation. English language is central to the educational eco system. The importance of language as medium of communication for personal, social, official and professional needs to be emphasized for clear and concise expression. Teaching and learning of receptive and productive skills viz., Listening, Speaking, Reading and Writing (LSRW) are to be taught and learnt effectively in the undergraduate Engineering programs. Learners should be encouraged to engage in a rigorous process of learning to become proficient users of English language by adopting a deeply focused and yet flexible approach as opposed to rote learning.

In this connection, suitable syllabus, effective pedagogy, continuous assessments and students' involvement result in productive learning. This course supports the latest knowledge and skill requirements and shall meet specified learning outcomes. The main objectives of English language teaching and learning as medium of communication and for promotion of cultural values are embedded in this syllabus. Efforts are being made in providing a holistic approach towards value-based language learning which equips the learner with receptive as well as productive skills.

The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed textbook for detailed study. The students should be encouraged to read the texts leading to reading comprehension. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material.

LEARNING OBJECTIVES: This course will enable the students to:

a. Improve their vocabulary.
b. Use appropriate sentence structures in their oral and written communication.
c. Develop their reading and study skills.
d. Equip students to write paragraphs, essays, précis and draft letters.
e. Acquire skills for Technical report writing.

COURSE OUTCOMES: Students will be able to:

a. Choose appropriate vocabulary in their oral and written communication.
b. Demonstrate their understanding of the rules of functional grammar and sentence structures.
c. Develop comprehension skills from known and unknown passages.
d. Write paragraphs, essays, précis and draft letters.
e. Write abstracts and reports in various contexts.

SYLLABUS: The course content / study material is divided into **Five Units.**

UNIT –I

Theme: **Perspectives**
Lesson on 'The Generation Gap' by Benjamin M. Spock from the prescribed textbook titled *English for the Young in the Digital World* published by Orient Black Swan Pvt. Ltd.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Words Often Misspelt - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing with Reference to Parts of Speech particularly

Articles and Prepositions – Degrees of Comparison

Reading: Reading and Its Importance- Sub Skills of Reading – Skimming and Scanning.

Writing: Sentence Structures and Types -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing Precisely –Nature and Style of Formal Writing.

UNIT –II

Theme: **Digital Transformation**

Lesson on '*Emerging Technologies*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Reading Strategies-Guessing Meaning from Context – Identifying Main Ideas – Exercises for Practice

Writing: Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence – Linkers and Connectives - Organizing Principles in a Paragraph – Defining- Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence - Essay Writing - Writing Introduction and Conclusion.

UNIT –III

Theme: **Attitude and Gratitude**

Poems on '*Leisure'* by William Henry Davies and '*Be Thankful'* - Unknown Author from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-Skills of Reading – Identifying Topic Sentence and Providing Supporting Ideas - Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with CV/Resume –Difference between Writing a Letter and an Email - Email Etiquette.

UNIT –IV

Theme: **Entrepreneurship**

Lesson on '*Why a Start-Up Needs to Find its Customers First*' by Pranav Jain from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Standard Abbreviations in English – Inferring Meanings of Words through Context – Phrasal Verbs – Idioms.

Grammar: Redundancies and Clichés in Written Communication – Converting Passive to Active Voice and Vice-Versa.

Reading: Prompt Engineering Techniques– Comprehending and Generating Appropriate Prompts - Exercises for Practice

Writing: Writing Practices- Note Making-Précis Writing.

UNIT –V

Theme: **Integrity and Professionalism**

Lesson on '*Professional Ethics*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Technical Vocabulary and their Usage– One Word Substitutes – Collocations.

Grammar: Direct and Indirect Speech **-** Common Errors in English (Covering all the other aspects of grammar which were not covered in the previous units)

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) – Inferring the Meaning and Evaluating a Text- Exercises for Practice

Writing: ***Report Writing - Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Technical Report.***

Note: *Listening and Speaking skills which are given under Unit-6 in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.*

- (**Note**: As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech. First Year is* ***Open-ended****,* besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.)

TEXT BOOK:

1. Board of Editors*. 2025. English for the Young in the Digital World.* Orient Black Swan Pvt. Ltd*.*

REFERENCE BOOKS:

1. Swan, Michael. (2016). *Practical English Usage.* Oxford University Press. New Edition.
2. *Karal, Rajeevan. 2023. English Grammar Just for You.* Oxford University Press. New Delhi
3. 2024*. Empowering with Language: Communicative English for Undergraduates.* Cengage Learning India Pvt. Ltd. New Delhi
4. Sanjay Kumar & Pushp Lata. 2022. *Communication Skills – A Workbook.* Oxford University Press. New Delhi
5. Wood,F.T. (2007). *Remedial English Grammar.* Macmillan.
6. Vishwamohan, Aysha. (2013). *English for Technical Communication for Engineering Students.* Mc Graw-Hill Education India Pvt. Ltd.

PH106BS: ADVANCED ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To provide practical exposure to advanced concepts in solid-state and modern physics.
2. To synthesize and study the physical properties of materials like semiconductors, ferromagnetic, and ferroelectric substances.
3. To perform semiconductor characterization using Hall effect and band gap experiments.
4. To explore the working principles of lasers and optical fibers through hands-on experiments.
5. To develop skills in data analysis, interpretation, and scientific reporting.

Course Outcomes:

1. **CO1:** Synthesize and analyze nanomaterials such as magnetite (Fe_3O_4) using chemical methods.
2. **CO2:** Determine key electrical, magnetic, and optical properties of semiconductors and other functional materials.
3. **CO3:** Characterize semiconductors using Hall effect and energy gap measurement techniques.
4. **CO4:** Demonstrate working knowledge of laser systems and optical fiber parameters through experimental study.
5. **CO5:** Apply scientific methods for accurate data collection, analysis, and technical report writing.

List of Experiments:

1. Synthesis of magnetite (Fe_3O_4) powder using sol-gel method.
2. Determination of energy gap of a semiconductor.
3. Determination of Hall coefficient and carrier concertation of a given semiconductor.
4. Determination of magnetic moment of a bar magnet and horizontal earth magnetic field.
5. Study of B-H curve of a ferro magnetic material.
6. Study of P-E loop of a given ferroelectric crystal.
7. Determination of dielectric constant of a given material.
8. Determination of Curie's temperature of a given ferroelectric material.
9. A) Determination of wavelength of a laser using diffraction grating.
   B) Study of V-I & L-I characteristics of a given laser diode.
10. A) Determination of numerical aperture of a given optical fibre.
    B) Determination of bending losses of a given optical fibre.

Note: Any 8 experiments are to be performed.

CS107ES: C PROGRAMMING & DATA STRUCTURES LAB

B.Tech. I Year I Sem. **L T P C**
0 0 2 1

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

Course Outcomes:

1. Develop modular and readable C Programs
2. Solve problems using strings, functions
3. Handle data in files
4. Implement stacks, queues using arrays, linked lists.
5. To understand and analyze various searching and sorting algorithms.

List of Experiments:

1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
3. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a C program to find the roots of a quadratic equation.
5. Write a C program to find the factorial of a given integer.
6. Write a C program to find the GCD (greatest common divisor) of two given integers.
7. Write a C program to solve Towers of Hanoi problem.
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
9. Write a C program to find both the largest and smallest number in a list of integers.
10. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices
    ii) Multiplication of Two Matrices
11. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T.
14. Write a C program to count the lines, words and characters in a given text.
15. Write a C program to generate Pascal's triangle.
16. Write a C program to construct a pyramid of numbers.
17. Write a C program that uses functions to perform the following operations:
    i) Reading a complex number
    ii) Writing a complex number
    iii) Addition of two complex numbers
    iv) Multiplication of two complex numbers
    (Note: represent complex number using a structure.)
18.
    i. Write a C program which copies one file to another.
    ii. Write a C program to reverse the first n characters in a file.
    (Note: The file name and n are specified on the command line.)
19.
    i. Write a C program to display the contents of a file.

ii. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

20. Write a C program that uses functions to perform the following operations on singly linked list.:
    i) Creation ii) Insertion iii) Deletion iv) Traversal

21. Write C programs that implement stack (its operations) using
    i) Arrays ii) Pointers

22. Write C programs that implement Queue (its operations) using
    i) Arrays ii) Pointers

23. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order i) Bubble sort ii) Selection sortiii)Insertion sort

24. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:
    i) Linear search ii) Binary search

TEXT BOOKS:

1. C Programming & Data Structures, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Let us C, Yeswanth Kanitkar
3. C Programming, Balaguruswamy.

ME108ES: ENGINEERING WORKSHOP

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Practical skill

Course Objectives:

1. To introduce students to basic manufacturing processes and workshop practices.
2. To provide hands-on training in carpentry, fitting, welding, sheet metal, and machining
3. To develop skills in using hand tools and measuring instruments.
4. To enhance safety awareness and proper handling of workshop equipment.
5. To build a foundational understanding of industrial production and fabrication.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the basic manufacturing processes and operations.
2. Use hand tools and equipment safely and efficiently.
3. Perform basic operations in carpentry, fitting, welding, sheet metal work, and machining
4. Read and interpret workshop drawings
5. Develop teamwork, time management, and quality awareness in a workshop environment.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

i. **Carpentry:** T- Lap Joint, Dovetail Joint, Mortise and Tenon Joint
ii. **Fitting:** V- Fit, Dovetail Fit and Semi- circular fit
iii. **Tin Smithy**: Square Tin, Rectangular Tray and Conical Funnel
iv. **Foundry**: Preparation of Green Sand Mould using Single Piece and Split Pattern
v. **Welding Practice:** Arc Welding and Gas Welding
vi. **House wiring**: Parallel and Series, Two-way Switch and Tube Light
vii. **Black Smithy**: Round to Square, Fan Hook and S- Hook

2. TRADES FOR DEMONSTRATION AND EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

TEXT BOOKS:

1. Workshop Practice, B. L. Juneja, Cengage Learning India, 1st edition, 2015.
2. Workshop Practice Manual, K. Venkata Reddy, BS Publication,6th Edition, Rpt.2025.

REFERENCE BOOKS:

1. Workshop Manual, K. Venugopal, Anuradha Publications, 2012th edition, 2012.

EN109HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

The **English Language and Communication Skills (ELCS) Lab** focuses on listening and speaking skills, particularly on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Listening Skills:

Objectives

1. To enable students develop their active listening skills
2. To equip students with necessary training in listening, so that they can comprehend the speech of people from different linguistic backgrounds

Speaking Skills:

3. To improve their pronunciation and neutralize accent
4. To enable students express themselves fluently and appropriately
5. To practise speaking in social and professional contexts

Learning Outcomes: Students will be able to:

1. Listen actively and identify important information in spoken texts
2. Interpret the speech and infer the intention of the speaker
3. Improve their accent for intelligibility
4. Speak fluently with clarity and confidence
5. Use the language in real life situations

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:

a. **Computer Assisted Language Learning (CALL) Lab which focusses on listening skills**
b. **Interactive Communication Skills (ICS) Lab which focusses on speaking skills**

The following course content is prescribed for the **English Language and Communication Skills Lab**.

Exercise – I

CALL Lab:

Instruction: Speech Sounds-Listening Skill - Importance – Purpose - Types- Barriers- Active Listening

Practice: Listening to Distinguish Speech Sounds (Minimal Pairs) **-** *Testing Exercises*

ICS Lab:

❖ **Diagnostic Test – Activity titled '*Express Your View*'**

Instruction: Spoken and Written language - Formal and Informal English - Greetings - Introducing Oneself and Others

Practice: Any Ice-Breaking Activity

Exercise – II

CALL Lab:

Instruction: Listening vs. Hearing - Barriers to Listening

Practice: Listening for General Information - Multiple Choice Questions - *Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)*

ICS Lab:

Instruction: Features of Good Conversation – Strategies for Effective Communication

Practice: Role Play Activity - Situational Dialogues –Expressions used in Various Situations –Making Requests and Seeking Permissions – Taking Leave - Telephone Etiquette

Exercise - III

CALL Lab:

Instruction: Errors in Pronunciation – Tips for Neutralizing Mother Tongue Influence (MTI)

Practice: Differences between British and American Pronunciation –*Listening Comprehension Exercises*

ICS Lab:

Instruction: Describing Objects, Situations, Places, People and Events

Practice: Picture Description Activity – Looking at a Picture and Describing Objects, Situations, Places, People and Events *(A wide range of Materials / Handouts are to be made available in the lab.)*

Exercise – IV

CALL Lab:

Instruction: Techniques for *Effective* Listening

Practice: Listening for Specific Details - Listening - Gap Fill Exercises - *Listening Comprehension Exercises*

(It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: How to Tell a Good Story - Story Star- Sequencing-Creativity

Practice: Activity on Telling and Retelling Stories - Collage

Exercise – V

CALL Lab:

Instruction: Identifying the literal and implied meaning

Practice: Listening for Evaluation - Write the Summary – Listening Comprehension Exercises

(It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: Understanding Non-Verbal Communication

Practice: Silent Speech - Dumb Charades Activity

❖ **Post-Assessment Test on 'Express Your View'**

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V. or LCD, a digital stereo – audio & video system and camcorder etc.

✍ **Note: English Language Teachers are requested to prepare Materials / Handouts for each Activity for the Use of those Materials in CALL & ICS Labs.**

Suggested Software:

- Cambridge Advanced Learners' English Dictionary with CD.

- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).

REFERENCE BOOKS:

1. Shobha, KN & Rayen, J. Lourdes. (2019). *Communicative English – A workbook.* Cambridge University Press
2. Board of Editors. (2016). *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient BlackSwan Pvt. Ltd.
3. Mishra, Veerendra et al. (2020). *English Language Skills: A Practical Approach.* Cambridge University Press
4. (2022). *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd.
5. Ur, Penny and Wright, Andrew. 2022. *Five Minute Activities – A Resource Book for Language Teachers.* Cambridge University Press.

MA201BS: ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

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

Course outcomes: After learning the contents of this paper, the student must be able to

1. Identify whether the given differential equation of first order is exact or not
2. Solve higher differential equation and apply the concept of differential equation to real world problems.
3. Use the Laplace Transforms techniques for solving Ordinary Differential Equations.
4. Evaluate the Line, Surface and Volume integrals and converting them from one to another

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

Exact differential equations – Equations reducible to exact differential equations – linear and Bernoulli's equations – Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling – Law of natural growth and decay.

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

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

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

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

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

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CH202BS: APPLIED CHEMISTRY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To develop adaptability to new advances in Engineering Chemistry and acquire the essential skills to become a competent engineering professional.
2. To understand the industrial significance of water treatment, fundamental principles of battery chemistry, and the impact of corrosion along with its control methods for structural protection.
3. To impart foundational knowledge of various energy sources and their practical applications in engineering.
4. To equip students with an understanding of smart materials, biosensors, and analytical techniques applicable in engineering, industrial, environmental, and biomedical fields.

Course Outcomes:

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

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

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

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

Unit-II: Electrochemistry and Corrosion: [8]

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

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

UNIT–III: Energy Sources: [8]

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

Fuels: Introduction and characteristics, Calorific value of fuel - HCV, LCV- Dulongs formula -Numerical

problems.
Fossil fuels: Introduction, classification, Petroleum - Refining of Crude oil, Cracking - Moving bed catalytic cracking. LPG and CNG - composition and uses.
Synthetic Fuels: Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen.

UNIT - IV: Polymers: [8]
Definition, classification of polymers: Based on origin and tacticity with examples - Types of polymerization - Addition (free radical addition mechanism) and condensation polymerization.
Plastics, Elastomers and Fibers: Definition and applications (PVC, Buna-S, Nylon-6,6). Themoplastics and thermo setting plastics, Fiber reinforced plastics (FRP).
Conducting polymers: Definition and classification with examples - Mechanism of conduction in trans-polyacetylene and applications of conducting polymers.
Biodegradable polymers: Polylactic acid(PLA) and its applications.

UNIT-V - Applications of Materials: [8]
Cement: Portland cement, its composition, setting and hardening.
Phase rule: Definition – Phase, component, degrees of freedom. Phase rule equation. Phase diagrams - One component system - water. Two component system - Lead silver system.
Lubricants: Definition and characteristics of a good lubricant – thin film mechanism of lubrication, properties of lubricants - viscosity, cloud and pour point, flash and fire point.
Interpretative spectroscopic applications of UV-Visible spectroscopy for Analysis of pollutants in dye industry, IR spectroscopy in night vision-security, Pollution Under Control- CO sensor (Passive Infrared detection).

SUGGESTED TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010.
2. Engineering Chemistry by Rama Devi, Dr.P.Aparna and Rath, Cengage learning, 2025.

REFERENCE TEXT BOOKS:

1. Engineering Chemistry: by Thirumala Chary Laxminarayana & Shashikala, Pearson Publications (2020)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011.
3. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi 2015.
4. Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007.
5. Challenges and Opportunities in Green Hydrogen by **Editors:** Paramvir Singh, Avinash Kumar Agarwal, Anupma Thakur, R.K Sinha.
6. Raman Spectroscopy in Human Health and Biomedicine, https://www.worldscientific.com/ doi/epdf/10.1142/13094
7. E-Content- https://doi.org/10.1142/13094 | October 2023
8. E-books: https://archive.org/details/EngineeringChemistryByShashiChawla/page/n11/mode/2up

CS203ES: PYTHON PROGRAMMING

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Basic knowledge of computer fundamentals, C programming.

Course Objectives:

Introduce the fundamentals of Python programming for problem-solving.

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

Course Outcomes:

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

CO–PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	1	0	0	2	2	1	3
CO2	3	3	3	2	3	1	0	0	2	2	1	3
CO3	3	3	3	2	3	1	0	1	2	2	1	3
CO4	3	3	2	2	3	1	0	1	2	2	1	3
CO5	3	3	3	2	3	1	1	1	3	3	2	3

UNIT-1 – Introduction to Python and Basics of Programming

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

UNIT-2 – Data Structures in Python

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

UNIT-3 – Functions and Modules

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

UNIT-4 – File Handling and Exception Handling

File Handling: Opening, Reading, Writing, Appending, File Modes, File Methods, Working with CSV and

JSON Files, Exception Handling: try, except, else, finally, Built-in Exceptions, Raising Exceptions, Introduction to Regular Expressions (re module).

UNIT-5 – Object-Oriented Programming and Applications

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EE204ES: ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

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

Course Outcomes:

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

UNIT - I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL and KCL, analysis of simple circuits with dc excitation.

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits, Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II:

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

UNIT - III:

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

UNIT - IV:

P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt, Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

Rectifiers and Filters: P-N junction as a rectifier, Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V:

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

Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ME205ES: THERMODYNAMICS

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisite: Engineering Chemistry and Physics

Course Objective:

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

Course Outcomes:At the end of the course, the student will be able to

1. Understand the basic thermodynamic concepts, systems, and properties.
2. Apply the first law to both closed and open systems.
3. Analyze thermodynamic processes using property diagrams and tables.
4. Apply the second law and evaluate entropy changes and efficiency.
5. Examine the performance of power and refrigeration cycles.
6. Solve real-world thermodynamic problems related to mechanical systems.

Tables, Codes: Steam Tables and Mollier Chart, Refrigeration Tables

UNIT – I: Basic Concepts and First Law of Thermodynamics

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

UNIT – II: Second Law of Thermodynamics and Availability

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

UNIT – III: Pure Substance and Perfect Gas

Pure Substances, P - V- T surfaces, T- S and h- s diagrams, Mollier Charts, Phase Transformations: Triple point at critical state properties during change of phase, Dryness Fraction, Clausius - Clapeyron Equation, Property tables and application of these concepts in various thermodynamic processes, including steam calorimetry.

Perfect Gas Laws, Equation of State, Specific and Universal Gas constants, various Nonflow processes, Properties, end states, Heat and Work Transfer, changes in Internal Energy, Throttling and Free Expansion Processes, Flow processes.

UNIT – IV: Real Gas models and Perfect Gas Mixtures

Deviations from perfect Gas Model, Vader Waals Equation of State, Compressibility charts, variable specific Heats, Gas Tables. Mixtures of perfect Gases: Mole Fraction, Mass friction Gravimetric and volumetric Analysis. Dalton's Law of partial pressure, Avogadro's Laws of additive volumes. Mole

fraction, Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT – V: Psychrometry and Thermodynamic Cycles

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

Thermodynamic Cycles: Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Description and representation on P–V and T- S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis, Comparison of Cycles. Refrigeration Cycles: Bell Coleman cycle, Vapour compression cycle, Ammonia, Water Vapor Absorption Cycle, Performance Evaluation.

TEXTBOOKS:

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

REFERENCE BOOKS:

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

ME206ES: ENGINEERING DRAWING AND COMPUTER AIDED DRAFTING

B.Tech. I Year II Sem.

L	T	P	C
2	0	2	3

Course Objectives:

1. To introduce the fundamentals of engineering drawing and projection systems.
2. To develop skills in constructing orthographic, isometric, and sectional views.
3. To train students in interpreting and creating technical drawings using CAD tools.
4. To familiarize students with dimensioning standards and drafting conventions.
5. To bridge manual drafting techniques with computer-aided drafting practices.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand and apply the principles of orthographic and isometric projections.
2. Create sectional views and dimensioned drawings using BIS standards.
3. Use CAD software to generate 2D engineering drawings.
4. Visualize and construct solid models from 2D views.
5. Interpret and produce engineering drawings of mechanical components and assemblies.
6. Demonstrate drafting skills for practical and industrial applications.

UNIT – I: Introduction to Engineering Graphics (Conventional)
Principles of Engineering Graphics and their Significance, Geometrical Constructions, Scales, Plain and Diagonal, Conic Sections including the Rectangular Hyperbola, General method only. Cycloid, Epicycloid and Hypocycloid.

UNIT - II: Orthographic Projections (Conventional and Computer Aided)
Principles of Orthographic Projections, Conventions, Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes. Computer aided orthographic projections, points, lines and planes. Introduction to Computer aided drafting, views, commands and conics.

UNIT – III: Projections of Regular Solids (Conventional and Computer Aided)
Auxiliary Views, Sections or Sectional views of Right Regular Solids, Prism, Cylinder, Pyramid, Cone, Auxiliary views, Computer aided projections of solids, sectional views

UNIT – IV: Development of Surfaces (Conventional)
Prism, Cylinder, Pyramid and Cone.

UNIT – V: Isometric Projections (Conventional and Computer Aided)
Principles of Isometric Projection, Isometric Scale, Isometric Views, Conventions, Isometric Views of Lines, Plane Figures, Simple and Compound Solids, Isometric Projection of objects having non, isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice- versa, Conventions. Conversion of orthographic projection into isometric view.

Note:

1. The End Semester Examination will be in conventional mode.
2. CIE – I will be in conventional mode.
3. CIE – II will be using Computer.

TEXT BOOKS:

1. Engineering Drawing, N. D. Bhatt, Charotar, 54th Edition, 2023.
2. Engineering Drawing and graphics Using AutoCAD, T. Jeyapoovan and Vikas, S. Chand and company Ltd., 3rdEdition,2010.

REFERENCE BOOKS:

1. Engineering Drawing, Basant Agrawal and C.M. Agrawal, McGraw Hill, 3rd Edition, 2019.
2. Engineering Graphics and Design, WILEY, John Wiley and Sons Inc, 3rdEdition, 2020.
3. Engineering Drawing, M. B. Shah and B.C. Rane, Pearson, 2nd Edition, 2009.
4. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford, 1st Edition, 2015.
5. Computer Aided Engineering Drawing, K. Balaveera Reddy, CBS Publishers, 2nd Edition, 2015.

CH207BS: CHEMISTRY LAB FOR ENGINEERS

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Course Description: The course includes experiments based on fundamental principles of chemistry essential for engineering students, aiming to develop practical skills and reinforce theoretical concepts.

Course Objectives

1. Students will understand and perform experiments based on core chemical principles relevant to engineering applications.
2. Students will learn to estimate the hardness of water to assess its suitability for drinking purposes.
3. Students will acquire the ability to perform acid-base titrations using instrumental methods such as conductometry, potentiometry, and pH metry.
4. Students will gain hands-on experience in synthesizing polymers like Bakelite and Nylon – 6, 6 in the laboratory.

Course Outcomes:

1. Students will develop practical skills through hands-on chemistry experiments relevant to engineering.
2. Students will learn to determine important parameters such as water hardness and the corrosion rate of mild steel under various conditions.
3. Students will be able to apply techniques like conductometry, potentiometry, and pH metry to determine concentrations or equivalence points in acid-base reactions.
4. Students will gain experience in synthesizing polymers such as Bakelite and Nylon-6,6.

List of Experiments:

I. Volumetric Analysis: Estimation of Hardness of water by EDTA Complexometry method.

II. Conductometry:
1. Estimation of the concentration of strong acid by Conductometry.
2. Estimation of the concentration of strong and weak acid in an acid mixture by Conductometry.

III. Potentiometry:
1. Estimation of concentration of Fe^{+2}ion by Potentiometry using $KMnO_4$.
2. Estimation of concentration of strong acid with strong base by Potentiometry using quinhydrone

IV. pH Metry: Determination of an acid concentration using pH meter.

V. Preparations:
1. Preparation of Bakelite.
2. Preparation Nylon – 6, 6.

VI. Corrosion: Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.

VII. Lubricants:
1. Estimation of acid value of given lubricant oil.
2. Estimation of viscosity of lubricant oil using Ostwald's Viscometer.

VIII. Virtual lab experiments
1. Construction of Fuel cell and it's working.
2. Smart materials for Biomedical applications
3. Batteries for electrical vehicles.
4. Functioning of solar cell and its applications.

REFERENCE BOOKS:

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

CS208ES: PYTHON PROGRAMMING LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives:

- To install and run the Python interpreter
- To learn control structures.
- To Understand Lists, Dictionaries in python
- To Handle Strings and Files in Python

Course Outcomes: After completion of the course, the student should be able to

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

Note: The lab experiments will be like the following experiment examples.

List of Experiments:

1.
   I. Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.
   II. Start the Python interpreter and type help() to start the online help utility.
1. Start a Python interpreter and use it as a Calculator.
2. Write a program to calculate compound interest when principal, rate and number of periods are given.
3. Read the name, address, email and phone number of a person through the keyboard and print the details.
4. Print the below triangle using for loop.
   5
   4 4
   3 3 3
   2 2 2 2
   1 1 1 1 1
5. Write a program to check whether the given input is digit or lowercase character or uppercase character or a special character(use 'if-else-if' ladder)
6. Python program to print all prime numbers in a given interval (use break)
7. Write a program to convert a list and tuple into arrays.
8. Write a program to find common values between two arrays.
9. Write a function called palindrome that takes a string argument and returnsTrue if it is a palindrome and False otherwise. Remember that you can use the built-in function len to check the length of a string.
10. Write a function called is_sorted that takes a list as a parameter and returns True if the list is sorted in ascending order and False otherwise.
11. Write a function called has_duplicates that takes a list and returns True if there is any element that appears more than once. It should not modify the original list.
12. Write a function called remove_duplicates that takes a list and returns a new list with only the unique elements from the original. Hint: they don't have to be in the same order.
13. The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add "I", "a", and the empty string.
14. Write a python code to read dictionary values from the user. Construct a function to invert its content. i.e., keys should be values and values should be keys.
15. Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'
16. Remove the given word in all the places in a string?

17. Write a function that takes a sentence as an input parameter and replaces the first letter of every word with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?
18. Writes a recursive function that generates all binary strings of n-bit length
19. Write a python program that defines a matrix and prints
20. Write a python program to perform multiplication of two square matrices
21. How do you make a module? Give an example of construction of a module using different geometrical shapes and operations on them as its functions.
22. Use the structure of exception handling all general-purpose exceptions.
23. Write a function called draw_rectangle that takes a Canvas and a Rectangle as arguments and draws a representation of the Rectangle on the Canvas.
24. Add an attribute named color to your Rectangle objects and modify draw_rectangle so that it uses the color attribute as the fill color.
25. Write a function called draw_point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas.
26. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw_circle that draws circles on the canvas.
27. Write a python code to read a phone number and email-id from the user and validate it for correctness.
28. Write a Python code to merge two given file contents into a third file.
29. Write a Python code to open a given file and construct a function to check for given words present in it and display on found.
30. Write a Python code to Read text from a text file, find the word with most number of occurrences
31. Write a function that reads a file *file1*and displays the number of words, number of vowels, blank spaces, lower case letters and uppercase letters.
32. Import numpy, Plotpy and Scipy and explore their functionalities.
33. Install NumPypackage with pip and explore it.
34. Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR
35. Write a GUI program to create a window wizard having two text labels, two text fields and two buttons as Submit and Reset.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EE209ES: ELEMENTS OF ELECTRICAL AND ELECTRONIC ENGINEERING LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Basic Electrical and Electronics Engineering

Course Objectives:

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

Course Outcomes:

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

List of Experiments:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a SinglePhase Transformer
   (ii) Verification of Relationship between Voltages and Currents (StarDelta, DeltaDelta, Delta Star, StarStar) in a Three Phase Transformer
3. Measurement of Active and Reactive P ower in a balanced Threephase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Threephase Induction Motor
6. NoLoad Characteristics of a Threephase Alternator

PART B: ELECTRONICS

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI, 9th Edition, 2006.

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

MA301BS: PROBABILITY, STATISTICS AND COMPLEX VARIABLES

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses of first year of study.

Course Objectives: To learn

- The ideas of random variables and various discrete and continuous probability distributions and their properties.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper, the student must be able to

- Apply the concepts of Random variable and distributions to some case studies.
- Correlate the concepts of one unit to the concepts in other units.
- Understood sampling theory and apply hypothesis testing in real-world scenarios
- Analyze the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
- Taylor's and Laurent's series expansions in complex function.

UNIT - I: Random Variables and Probability Distributions **8 L**

Concept of a Random Variable – Discrete Probability Distributions – Continuous Probability Distributions – Mean of a Random Variable – Variance of a Random Variable

Discrete Probability Distributions: Binomial Distribution – Poisson distribution

UNIT - II: Continuous Distributions and sampling **10 L**

Uniform Distribution – Normal Distribution – Areas under the Normal Curve – Applications of the Normal Distribution – Normal Approximation to the Binomial Distributions. **Fundamental Sampling Distributions:** Random Sampling – Some Important Statistics – Sampling Distributions – Sampling Distribution of Means – Central Limit Theorem.

UNIT - III: Tests of Hypotheses (Large and Small Samples) **10 L**

Statistical Hypotheses: General Concepts – Testing a Statistical Hypothesis. Single sample: Tests concerning a single mean.Two samples: Tests on two mean (Unknown for equal variance). One sample: Test on a single proportion. Two samples: Tests on two proportions. Two- sample tests concerning variances: F-distribution

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

Differentiation of Complex functions – Analyticity – Cauchy-Riemann equations (without proof) – Harmonic Functions – Finding harmonic conjugate – Milne Thomson method – Elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

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

Line integral – Cauchy's theorem – Cauchy's Integral formula – Zeros of analytic functions – Singularities – Taylor's series – Laurent's series. Residues – Cauchy Residue theorem (All theorems without Proof).

TEXT BOOKS

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
2. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications.

REFERENCE BOOKS

1. T.T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, Ltd, 2004.
2. Sheldon M Ross, Probability and statistics for Engineers and scientists, academic press.

ME302PC: MECHANICS OF SOLIDS

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Engineering Mechanics

Course Objectives: The objectives of this course are to:

1. Understand the concepts of internal forces, moments, stress, strain, and deformation of solids with applications to bars, beams, and columns.
2. Learn the fundamentals of applying equilibrium, compatibility, and force - deformation relationships to structural elements.
3. Study twisting of circular bars and hollow shafts acted on by torsional moments.
4. Define the state of stress at a point on a body and to develop stress transformations.
5. Introduce the concept of theories of elastic failure and their significance in the design.

Course Outcomes: At the end of the course, students will be able to:

1. Evaluate the internal forces, moments, stresses, strains, and deformations in structures made of various materials acted on by a variety of loads.
2. Draw axial force, shear force and bending moment diagrams for beams and frames.
3. Develop the Bending and Torsion formula and apply to the design of beams and shafts.
4. Use the stress transformation equations to find the state of stress at a point for various rotated positions of the stress element and display the same in graphical form as Mohr's circle.
5. Understand the different criteria for the safety of the component by applying the theories of elastic failure.

UNIT – I:

Stress and Strain: Elasticity and plasticity, Types of stresses and strains, Hooke's law, Stress – strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them, Bars of varying sections, Composite bars, Temperature stresses. Strain energy and Resilience: Gradual, sudden, impact and shock loadings.

UNIT – II:

Shear Force and Bending Moment: Definition of beam, Types of beams, Concept of shear force and bending moment, S.F and B.M diagrams for cantilever, Simply supported and overhanging beams subjected to point loads and Uniformly Distribute Load, Uniformly varying loads and combination of these loads, Point of contra flexure, Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III:

Flexural Stresses: Theory of simple bending, Assumptions, Derivation of pure bending equation, Determination of bending stresses. Section modulus for rectangular and circular sections of Solid and Hollow: I, T, Angle and Channel sections, Design of simple beam sections.

Shear Stresses: Derivation of formula, Shear stress distribution across various beams sections: Rectangular, Circular, Triangular, I, T and Angle sections.

UNIT – IV:

Principal Stresses and Strains: Introduction, Stresses on inclined sections of a bar under axial loading, Compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses, two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses, Principal stresses and strains, Analytical and graphical solutions.

Theories of Failure: Introduction, Various theories of failure: Maximum Principal Stress Theory, Maximum Shear Stress Theory, Maximum Principal Strain Theory, Maximum Strain Energy Theory,

Distortion Energy Theory (Von Mises Theory).

UNIT – V:

Torsion of Circular Shafts: Theory of pure torsion, Derivation of Torsion equations, Assumptions made in the theory of pure torsion, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion and end thrust, Design of shafts according to theories of failure.

Columns and Struts: Euler's Theory, Limitations of Euler's theory, Equivalent Length, Rankine's Formula, Secant Formula.

TEXT BOOKS:

1. Strength of Materials, S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing, 20th Edition, 2020.
2. Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, CBS Publishers, 5th Edition, Reprint 2020.

REFERENCE BOOKS:

1. Mechanics of Materials, Barry J. Goodno and James M. Gere, Cengage,9thEdition, 2018.
2. Strength of Materials, S. S. Rattan, Tata McGraw Hill, 2ndEdition,2011.
3. Strength of Materials, U.C. Jindal, Pearson Education India, 1st Edition, 2012.
4. Engineering Mechanics of Solids, Egor P. Popov and Toader A. Balan, PHI Learning, 2nd Edition, 2010.
5. Strength of Materials, G. H. Ryder, Macmillan Long Man Publications, 3rd Edition, 1961.
6. Strength of Materials, W. A. Nash and M. C. Potter, McGraw Hill, 5th Edition, 2011.

ME303PC: MATERIAL SCIENCE AND METALLURGY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand the structure and properties of engineering materials.
2. To study phase diagrams and heat treatment processes of ferrous and non-ferrous alloys.
3. To analyze the mechanical behavior of materials under various loading conditions.
4. To identify microstructures and predict material performance in service conditions.
5. To introduce testing methods and failure mechanisms of materials.

Course Outcomes: At the end of the course, student will be able to

1. Explain the structure-property relationships in engineering materials.
2. Interpret binary phase diagrams and understand the solidification behavior of alloys.
3. Understand heat treatment processes and their influence on mechanical properties.
4. Identify microstructures of ferrous and non-ferrous alloys.
5. Analyze mechanical testing results and failure mechanisms like fatigue, creep, and fracture.
6. Select suitable materials for mechanical applications based on their behavior and performance.

UNIT – I:
Crystal Structure: Unit cells, Metallic and Ceramic crystal structures. **Imperfection in solids:** Point, line, surface and volume defects, dislocations, strengthening mechanisms, slip systems, Critical resolved shear stress.

UNIT – II:
Hume – Rothery Rules: Alloys, substitutional and interstitial solid solutions. **Phase diagrams:** Interpretation of binary phase diagrams and microstructure development, Eutectic, Peritectic, Eutectiod, Peritectoid and monotectic reactions. Iron, Iron carbide phase diagrams and microstructural aspects of ledeburite, Austenite, Pearlite, Ferrite and Cementite.

UNIT –III:
Heat treatment: Isothermal transformation diagrams for FeC alloys and microstructures development: Martensite, Bainite, Annealing, Normalising, Hardening, Tempering and Spheroidising.

UNIT – IV:
Cooling Curves and Surface Hardening: Continuous cooling curves and interpretation of final microstructures and properties, Thermo mechanical treatments: Austempering, Martempering. Surface hardening methods: Case hardening, Carburizing, Nitriding, Cyaniding, Carbo Nitriding. Flame and induction hardening, Vacuum and plasma hardening.

UNIT – V:
Alloys and Composites: Alloy steels, Properties and applications of stainless steels and tool steels, Maraging steels. Types of cast irons: Grey, White, Malleable and Spheroidal Graphite cast irons. Copper and its alloys: Brass and bronze. Aluminium and its alloys: Al-Cu Alloys. Ceramics and Composites: Types, properties and applications.

TEXT BOOKS:

1. Introduction to Physical Metallurgy, Sidney H. Avner, McGraw Hill,2nd Edition, 2017
2. Material Science and Engineering, V. Raghavan, Prentice Hall of India Private Limited, 5th Edition, 2004.

REFERENCE BOOKS:

1. Mechanical Metallurgy, George E. Dieter, Tata McGraw Hill, 3rd Edition, 2013.
2. Engineering Materials, Kenneth G. Budinski and Michael K. Budinski, Prentice Hall of India Private Limited, 9th Edition, 2009.
3. Engineering Materials and Metallurgy, U. C. Jindal, Pearson, 1st Edition, 2011.
4. Materials Science and Engineering: An Introduction, William. D. Callister and David G. Rethwisch, John Wiley and Sons, 10th Edition, 2018.

ME304PC: PRODUCTION TECHNOLOGY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Engineering Workshop

Course Objectives:

1. To expose the students to understand the concept of basic casting processes and furnaces.
2. To provide a technical understanding of various joining processes used in the manufacturing industry.
3. To impart the students to the concepts of solidstate welding processes.
4. To teach the concepts of rolling and various press working operations.
5. To provide a technical understanding of different metal forming processes like extrusion, forging and high energy rate forming processes.

Course Outcomes: Student will be able to:

1. Elaborate the fundamentals of various moulding, casting techniques and furnaces.
2. Identify the importance of permanent joining and principle behind different welding processes.
3. Explain the concepts of solidstate welding processes.
4. Understand the concepts of rolling and sheet metal operations in metal working.
5. Elaborates the uniqueness of extrusion, forging and high energy rate forming processes in metal working.

UNIT – I:

Casting: Steps involved in making a casting, Advantage of casting and its applications, Patterns, Pattern making, Types, Materials used for patterns, Pattern allowances, Properties of moulding methods. Methods of Melting, Crucible melting and cupola operation, Defects in castings, Principles of Gating, Requirements, Types of gates, Design of gating systems, Riser, Function, Types of Riser and Riser design. Casting processes, Types, Sand moulding, Centrifugal casting, Die, Casting, Investment casting, Shell moulding.

UNIT – II:

Arc Welding: Classification, Types of welds and welded joints and their characteristics, Welding Positions, Arc welding, shielded metal arc welding, Submerged arc welding, Resistance welding, Thermit welding.

UNIT – III:

Gas Welding: Gas welding, Types, Oxyfuel gas cutting, Standard time and cost calculations. Inert Gas Welding, TIG Welding, MIG welding, Friction welding, Friction Stir Welding, Induction welding, Explosive welding, Laser Welding.

Soldering, Brazing, Heat affected zone in welding. Welding defects, Causes and remedies, Destructive and non, Destructive testing of welds.

UNIT – IV:

Hot Working and Cold Working: Strain hardening, Recovery, Recrystallization and grain growth. Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning, Bending and deep drawing. Rolling fundamentals, Theory of rolling, Types of Rolling mills and products. Forces in rolling and power requirements. Drawing and its types, Wire drawing and Tube drawing, Types of presses and press tools. Forces and power requirement in the above operations.

UNIT – V:

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion, Forward extrusion and backward extrusion, Impact extrusion, Extruding equipment, Tube extrusion, Hydrostatic extrusion. Forces in extrusion.

Forging Processes: Forging operations and principles, Tools, Forging methods, Smith forging, Drop Forging, Roll forging. Forging hammers: Rotary forging, Forging defects, Cold forging, Swaging, Forces in forging operations.

High Energy Rate Forming Processes: Principles of Explosive Forming, Electrohydraulic Forming, Electro, Magnetic forming and rubber pad forming.

TEXT BOOKS:

1. A Textbook of Production Technology (Manufacturing Processes), Dr. P.C. Sharma, S. Chand Publishing, 11th Revised Edition, 2022.
2. Manufacturing Technology: Foundry, Forming and Welding, P.N. Rao, McGraw Hill Education, Vol. 1, 5th Edition, 2018.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Schmidt, Pearson, 7th Edition, 2014.
2. Elements of Workshop TechnologyVol.1, S.K. Hajra Choudhury, A.K. Hajra Choudhury and Nirjhar Roy, Media Publishers and Promoters Pvt. Ltd., 1st Edition,2008.
3. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley, 7th Edition, 2023.
4. Production Technology Vol. 1, Sreeramulu, WILEY, 1st Edition, 2018.
5. Production Engineering, P.C. Sharma, S. Chand Publishing, 8th Edition, 1999.
6. Manufacturing processes H. S. Shan, Cambridge University Press, 2nd Edition,2017.
7. Production Technology: Manufacturing Processes, Technology and AutomationVol.1, R. K. Jain, Khanna Publishers, 19th Edition, 2009.

ME305PC: FLUID MECHANICS AND HYDRAULIC MACHINES

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Engineering Mechanics, Thermodynamics

Course Objectives: To enable the student:

1. To understand the basic principles of fluid mechanics.
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes.
4. To evaluate the performance of hydraulic turbines.
5. To understand the functioning and characteristic curves of pumps.

Course Outcomes:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts.

UNIT – I: Fluid statics

Dimensions and units: Physical properties of fluids, Specific gravity, Viscosity and surface tension, Vapour pressure and their influence on fluid motion, Atmospheric, Gauge and vacuum pressures, Measurement of pressure, Piezometer, U-tube and differential manometers.

UNIT – II: Fluid kinematics

Stream line, Path line and streak lines and stream tube. Classification of flows: Steady and unsteady, Uniform and non, Uniform, Laminar and turbulent, Rotational and irrotational flows, Equation of continuity for one dimensional flow and three-dimensional flows.

Fluid dynamics: Surface and body forces, Euler's and Bernoulli's equations for flow along a stream line, Momentum equation and its application on force on pipe bend.

UNIT – III: Boundary Layer Concepts

Definition, Thicknesses, Characteristics along thin plate, Laminar and Turbulent boundary layers (No derivation), Boundary layer in transition, Separation of boundary layer, Submerged objects, Drag and lift.

Closed conduit flow: Reynold's experiment, Darcy Weisbach equation, Minor losses in pipes, Pipes in series and pipes in parallel, Total energy line, Hydraulic gradient line. **Measurement of flow:** Pitot tube, Venturi meter and Orifice meter, Flow nozzle.

UNIT – IV: Basics of Turbo Machinery

Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, Jet striking centrally and at tip, Velocity diagrams, Work done and efficiency, Flow over radial vanes.

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, Impulse and Reaction Turbines, Pelton wheel, Francis turbine and Kaplan turbine, Working proportions, Work done, efficiencies, Hydraulic Design, Draft tube theory, Functions and efficiency.

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, Characteristic curves, Governing of turbines, Selection of type of turbine, Cavitation, Surge tank, Water hammer.

UNIT – V: Centrifugal Pumps

Classification, Working, Work done, Barometric head, Losses and efficiencies, Specific speed, Performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, Slip, Indicator diagrams.

TEXT BOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery, Modi and Seth, standard Book House, 22nd Edition, 2019.
2. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Laxmi Publications, 10th Edition, 2020.

REFERENCE BOOKS:

1. Fluid Mechanics and Hydraulic Machines, Er. R. K. Rajput, S. Chand,2019.
2. Hydraulic Machines: Fluid Machinery, Jagdish Lal, Metropolitan Book Co., 6th Edition, 2016.
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria and Sons, 22nd Edition, 2018.
4. Fluid Mechanics and Machinery, D. Rama Durgaiah, New Age International publishers, 1st Edition, 2002.
5. Hydraulic Machines, T.R. Banga and S.C. Sharma, Khanna Publishers, 7th Edition, Rpt. 2019.

MA306PC: COMPUTATIONAL MATHEMATICS LAB
(Using Python/MATLAB software)

B.Tech. II Year II Sem. **L T P C**
0 0 2 1

Pre-requisites: Matrices, Iterative methods and ordinary differential equations

Course Objectives: To learn
1. Solve problems of Eigen values and Eigen Vectors using Python/MATLAB.
2. Solution of Algebraic and Transcendental Equations using Python/MATLAB
3. Solve problems of Linear system of equations
4. Solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

Course outcomes: After learning the contents of this paper, the student must be able to
1. Develop the code to find the Eigen values and Eigen Vectors using Python/MATLAB.
2. Develop the code find solution of Algebraic and Transcendental Equations and Linear system of equations using Python/MATLAB
3. Write the code to solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

* **Visualize all solutions Graphically through programmes**

UNIT - I: Eigen values and Eigenvectors: **6P**
Programs:
- Finding real and complex Eigen values.
- Finding Eigen vectors.

UNIT-II: Solution of Algebraic and Transcendental Equations **6P**
Bisection method, Newton Raphson Method
Programs:
- Root of a given equation using Bisection method.
- Root of a given equation Newton Raphson Method.

UNIT-III: Linear system of equations: **6P**
Jacobi's iteration method and Gauss-Seidal iteration method
Programs:
- Solution of given system of linear equations using Jacobi's method
- Solution of given system of linear equations using Gauss-Seidal method

UNIT-IV: First-Order ODEs
8P
Exact and non-exact equations, Applications: exponential growth/decay, Newton's law of cooling.
Programs:
- Solving exact and non-exact equations
- Solving exponential growth/decay and Newton's law of cooling problems

UNIT-V: Higher order linear differential equations with constant coefficients **6P**
Programs:
- Solving homogeneous ODEs
- Solving non-homogeneous ODEs

TEXT BOOKS:
1. MATLAB and its Applications in Engineering, Rajkumar Basal, Ashok Kumar Geo, Manoj Kumar Sharma, Pearson publication.
2. Kenneth A. Lambert, The fundamentals of Python: First Programs, 2011, Cengage Learnings.

3. Think Python First Edition, by Allen B. Downey, Orielly publishing.
4. Introduction to Python Programming, William Mitchell, Povel Solin, Martin Novak et al., NCLab Public Computing, 2012.
5. Introduction to Python Programming, ©Jacob Fredslund, 2007.

REFERENCE BOOKS:

1. An Introduction to Python, John C. Lusth, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

ME307PC: PRODUCTION TECHNOLOGY LAB

B.Tech. II Year I Sem.
Prerequisites: Production Technology

L	T	P	C
0	0	2	1

Course Objectives:

1. To provide hands-on experience with casting, welding, forming, and machining operations.
2. To help students understand the working principles of manufacturing processes.
3. To expose students to tools, machines, and equipment used in production workshops.
4. To develop safety awareness and quality control in manufacturing practices.
5. To bridge theoretical knowledge with practical application of manufacturing methods.

Course Outcomes: After completion of the course, the student will be able to

1. Demonstrate casting practices such as pattern making and sand molding.
2. Perform welding operations like arc welding, gas welding, and spot welding.
3. Operate basic machining tools such as lathe, drilling, and milling machines.
4. Understand sheet metal fabrication, bending, and joining processes.
5. Analyze process parameters and their influence on product quality.
6. Practice safety, accuracy, and productivity in production environments.

List of Experiments:

I. Metal Casting:

1. Pattern Design and making - 1 Exercise (one casting drawing).
2. Sand properties testing - 1 Exercise (strengths, and permeability)
3. Moulding Melting and Casting -1 Exercise

II. Welding:

1. ARC Welding Lap and Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

III. Mechanical Press Working:

1. Blanking and Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV. Processing of Plastics:

1. Injection Moulding
2. Blow Moulding

TEXT BOOK:

1. Dictionary of Mechanical Engineering, G.H.F. Nayler, Jaico Publishing House, 1st Edition, 1999.

Note: Minimum of 12 Exercises need to be performed

ME308PC: MATERIAL SCIENCE AND MECHANICS OF SOLIDS LAB

B.Tech. II Year I Sem.

Prerequisites: Material Science and Metallurgy; Mechanics of Solids

L	T	P	C
0	0	2	1

MATERIAL SCIENCE:

Course Objectives:

1. Learn the fundamental concepts of Metallurgy and Material Science in the context of manufacturing processes.
2. Understand how raw materials are converted into useful products.
3. Gain knowledge of the basic structure and crystal arrangements of materials.
4. Classify and distinguish between different microstructures of steels, cast irons, and non-ferrous alloys.

Course Outcomes: At the end of the lab, the student will be able to

1. Design different crystal structures and their models.
2. Infer the microstructures developed for different ferrous and nonferrous metals.
3. Correlate the microstructures, properties, performance and processing of alloys.

MATERIAL SCIENCE

List of Experiments:

1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high Carbon steels.
4. Study of the Microstructures of Various Cast Irons.
5. Study of the Microstructures of Non,Ferrous alloys. (Al, Cu, Mg)
6. Hardenability of steels by Jominy End Quench Test.

MECHANICS OF SOLIDS LAB:

Course Objectives:

1. Understand the fundamental concepts of stress, strain, and deformation in solids.
2. Apply the principles to analyze structural elements such as bars, beams, and columns.
3. Study the engineering properties of materials in detail.
4. Emphasize the application of equilibrium, compatibility, and force-deformation relationships.
5. Introduce advanced methods of structural analysis, including the flexibility and stiffness methods.
6. Build upon foundational knowledge from the Engineering Mechanics course.

Course Outcomes: At the end of the lab, the student will be able to:

1. Analyze the behavior of the solid bodies subjected to various types of loading.
2. Apply knowledge of materials and structural elements to the analysis of simple structures.
3. Undertake problem identification, formulation and solution using a range of analytical methods
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning.

MECHANICS OF SOLIDS LAB

List of Experiments:

1. Tension test
2. Bending test
3. Torsion test
4. Brinell's hardness and Rockwell hardness test
5. Test on springs
6. Izod Impact and Charpy Impact test

TEXT BOOKS:

1. Laboratory Manual in Engineering Materials, S.K. Hajra Choudhury, Asian Books Pvt. Ltd.
2. Laboratory Manual for Strength of Materials, J.P. Singh, Katson Books.

ME309PC: FLUID MECHANICS AND HYDRAULIC MACHINES LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To understand the basic principles of fluid mechanics.
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes.
4. To evaluate the performance of hydraulic turbines.
5. To understand the functioning and characteristic curves of pumps.

Course Outcomes:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts.

List of Experiments:

Fluid Mechanics:

1. Venturimeter.
2. Orifice meter.
3. Friction factor for a given pipe line.
4. Loss of head due to sudden contraction in a pipeline.
5. Application of Bernoulli's Theorem.

Hydraulic Machinery: Performance Test on

1. Impact of jets on Vanes.
2. Pelton Wheel.
3. Francis Turbine.
4. Kaplan Turbine.
5. Single Stage Centrifugal Pump.
6. Multi Stage Centrifugal Pump.
7. Reciprocating Pump.

LAB MANUALS:

1. Fluid Mechanics and Machinery Laboratory Manual, Sadhu Singh, Khanna Publishers, 2022.
2. Fluid Mechanics and Hydraulic Machines, K. Subramanya, McGraw Hill Education, 2022.

ME310SD: DESIGN THINKING AND IDEATION

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To introduce the concept and importance of design thinking in solving complex problems.
2. To enable students to empathize with users and identify genuine needs.
3. To facilitate ideation and creative thinking for problem solving.
4. To guide students in developing prototypes and testing solutions.
5. To build storytelling and communication skills for presenting ideas effectively.

Course Outcomes:

1. Understand the principles and stages of the design thinking process.
2. Apply empathy and user research tools to understand user needs.
3. Use ideation techniques like brainstorming and mind mapping to generate solutions.
4. Develop and refine prototypes through iterative testing.
5. Present solutions using storytelling and plan for implementation.
6. Collaborate on real, world challenges using end to end design thinking.

UNIT - I:

Fundamentals of Design Thinking: Design Thinking Process: Types of the thinking process, Common methods to change the human thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, the need of design thinking; An approach to design thinking, Design thinking Process model, Design thinking tools.

Case Studies: General, Engineering and Service applications

Activities: Identify an Opportunity and Scope of the Project Explore the possibilities and prepare a design brief.

UNIT - II:

Empathize and Understanding User Needs: Design thinking phases, how to empathize, Role of empathy in design thinking, the purpose of empathy maps, Things to be done prior to empathy mapping, Activities during and after the session, Understanding empathy tools: Customer Journey Map, Personas.

Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success

Activities: Apply the methods of empathizing and Define Phases Finalize the problem Statement (User Interview practice, empathy mapping, shadowing or observation study).

UNIT - III:

Ideation and Generating Solutions: Challenges in idea generation, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating, Applying the method, Create Thinking, Generating Design Ideas, Lateral Thinking, Analogies, Brain storming, Mind mapping, National Group Technique, Synectic's, Development of work, Analytical Thinking, Group Activities. Ideation Tools: How Might We? (HMW), Storyboard, Brainstorming. What is design innovation? A mindset for innovation, and asking "What if?" asking "What wows?" and "What works?"

Activities, Apply the methods of Ideate Phase: Generate Lots of Ideas (Brain Storming Sessions, SCAMPER Technique Activity and Rapid Sketching.

UNIT - IV:

Prototyping and Building the Solution: What is a prototype? Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping, Minimum Viable prototype.

Activities: Apply the Methods of the Prototype Phase: Create prototypes for selected ideas (Paper prototyping, digital prototyping and story board creation).

UNIT - V:

Testing Prototypes and Validation: Prototyping for digital products: What's unique for digital products, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users. Create a Pitch Plan for scaling up Road map for Implementation, Fine tuning and Submission of the project report

Activities: Collect feedback; iterate and improve the ideas Present your solution using the Storytelling method (Usability testing, Feedback Grid Exercise and Iteration Activity)

Capstone Activity:

Mini Design Challenge: Apply all stages of design thinking on a real-world problem provided by industry/community.

TEXT BOOKS:

1. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown, HarperCollins Publishers Ltd., 2009.
2. Design Thinking for Strategic Innovation, Idris Mootee, John Wiley and Sons Inc., 2013.

TOOLS AND TECHNIQUES USED:

Sticky Notes, Whiteboards, Canva, Figma, TinkerCAD, Mind Mapping tools, Sketching Kits, Empathy Maps, Journey Maps and related softwares.

ME401PC: KINEMATICS OF MACHINERY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Basic principles of Mechanics

Course Objectives: The objectives of this course are

1. To introduce the concept of machines, mechanisms and related terminologies and the relative motion, velocity, and accelerations of the various elements in a mechanism.
2. To make the students become familiar with the most commonly used mechanisms such as four bar, slider crank, double slider crank mechanisms and their inversions.
3. To provide an overview of straightline motion mechanisms, steering mechanisms and Hooke's joint.
4. To familiarize higher pairs like cams and principles of cams design.
5. To understand the kinematic analysis of gears and gear trains.

Course Outcomes: At the end of the course, students will be able to:

1. Understand the various elements in mechanism and the inversions of commonly used mechanisms such as four bar, slider crank and double slider crank mechanisms.
2. Draw the velocity and acceleration polygons for a given configuration of a mechanism.
3. Understand the conditions for straight line motion mechanisms, steering mechanism and the usage of Hooke's joint.
4. Draw the displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Calculate the number of teeth and velocity ratio required for a given combination of gears.

UNIT – I:

Mechanisms: Elements or Links, Classification, Rigid Link, Flexible and Fluid link, Types of kinematics pairs, Sliding, Turning, Rolling, Screw and spherical pairs, Lower and Higher pairs, Closed and open pairs, Constrained motion, Completely, Partially or successfully and incompletely constrained.

Mechanism and Machines: Mobility of Mechanisms: Grubler's criterion, classification of machines, Kinematics chain, Inversions of mechanism, Inversions of quadric cycle chain, Single and double slider crank chains, Mechanical Advantage.

UNIT – II:

Kinematics: Velocity and acceleration, Motion of link in machine, Determination of Velocity and acceleration, Graphical method, Application of relative velocity method.

Plane motion of body: Instantaneous center of rotation, Centrodes and Axodes, Three centers in line theorem, Graphical determination of instantaneous center, Determination of angular velocity of points and links by instantaneous center method. Kliens construction, Coriolis acceleration, Determination of Coriolis component of acceleration.

Analysis of Mechanisms: Analysis of slider crank chain for displacement, Velocity and Acceleration of slider, Acceleration diagram for a given mechanism.

UNIT – III:

Straight Line Motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff's and Robert Mechanism, Pantographs.

Steering Gears: Conditions for correct steering, Davis Steering gear, Ackerman's steering gear.

Hooke's Joint: Single and double Hooke's joint, Velocity ratio, Application, Problems.

UNIT – IV:

Cams and Followers: Definitions of cam and followers and their uses, Types of followers and cams, Terminology, Types of follower motions, Uniform velocity, Simple harmonic motion, Uniform

acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes.
Tangent cam with Roller follower, Circular arc cam with straight, Concave and Convex flanks.

UNIT – V:

Gears and Gear Trains: Friction wheels and toothed gears, Types, Law of gearing, Condition for constant velocity ratio for transmission of motion, Velocity of sliding.
Forms of teeth, Cycloidal and involutes profiles, Phenomena of interferences, Methods of interference. Condition for minimum number of teeth to avoid interference, Expressions for arc of contact and path of contact of Pinion, Gear, Pinion and Rack Arrangements, Introduction to Helical, Bevel and worm gearing.
Introduction to Gear Trains, Types, Simple, Compound and reverted gear trains, Epicyclic gear trains. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box, Differential gear for an automobile.

TEXT BOOKS:

1. Theory of Machines and Mechanisms, Uicker, J.J., Pennock G.R and Shigley, Oxford University Press, 4th Edition, 2014.
2. Theory of Machines, Thomas Bevan, CBS Publishers and Distributors, 3rd Edition,2005.

REFERENCE BOOKS:

1. A Textbook of Theory of Machines, R. K. Bansal and J. S. Brar, Laxmi Publications, 5th Revised Edition, 2010.
2. Theory of Machines, Sadhu Sigh, Pearson Education, 3rd Edition, 2012.
3. Kinematics and Dynamics of Machinery, Robert L. Norton, Tata McGraw Hill, 2009.
4. Mechanisms and Machine Theory, Rao. J.S. and Dukkipati. R.V., Wiley Eastern Ltd., 2nd Edition, 1992.
5. Theory of Machines, S.S. Rattan, Tata McGraw Hill, 4th Edition, 2014.

ME402PC: THERMAL ENGINEERING - I

B.Tech. II Year II Sem.
Prerequisite: Thermodynamics

L	T	P	C
3	0	0	3

Course Objective:

1. Explain the Components of IC Engines and systems.
2. Analyze the stages of combustion to improve the performance of IC engines with respect to fuel economy and control of emissions in global, environmental and social context.
3. Understand and evaluate the performance analysis of the major components and systems of IC engines and their applications.
4. Explore to the components and working principles of rotary, reciprocating, dynamic and axial compressors.
5. Understand the significance of gas turbines in real context in power generation.

Course Outcomes: At the end of the course, the student should be able to

1. Elaborate the working principles of IC Engine systems and its classification.
2. Explore the combustion stages of SI and CI engines, and factors influence for better combustion.
3. Evaluate the testing and performance parameters of IC engines.
4. Explain the function and working principles of rotary, reciprocating, dynamic axial compressors.
5. Understand the working principle of gas turbine and its classification with thermodynamic analysis.

UNIT – I: Power Cycles and IC Engines Classification

Otto, Atkinson, Diesel and Dual Cycles, Description and representation on P-V and T-S Diagrams, Performance Parameters: Mean Effective Pressure and Thermal efficiency evaluation on Air standard basis, Comparison of Cycles, Actual Cycles and Comparison with ideal cycles Classification of IC Engines, Working principles of two and four stroke engines, SI andCI engines, Valve and Port Timing Diagrams.

UNIT – II: Combustion in SI Engines

Types of SI engines, Engine systems, Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry. Normal Combustion and abnormal combustion in SI engines, Importance of flame speed and effect of engine variables, Abnormal combustion, Pre-ignition and knocking in SI Engines, Fuel requirements and fuel rating, Anti-knock additives, Combustion chamber requirements.

UNIT – III: Combustion in CI Engines

Types of CI Engines, Four stages of combustion in CI engines, Delay period and its importance, Effect of engine variables, Diesel Knock, Need for air movement, Suction, Compression and combustion induced turbulence in Diesel engines, Open and divided combustion chambers and fuel injection, Diesel fuel requirements and fuel rating.

UNIT – IV: Testing and Performance

Parameters of performance, Measurement of cylinder pressure, Fuel consumption, Air intake, Exhaust gas composition, Brake power, Determination of frictional losses and indicated power, Performance test, Heat balance sheet and chart.

UNIT – V: Compressors

Classification of compressors, Fans, Blowers and Compressors, Positive displacement and dynamic types, Reciprocating and rotary types.

Reciprocating Compressors: Principle of operation, Work required, Isothermal efficiency, Volumetric efficiency and effect of clearance volume, Staged compression, Under cooling, Saving of work, Minimum work condition for staged compression.
Rotary Compressors: Rotary Compressors (Positive displacement type): Roots Blower, Vane sealed compressor, Mechanical details and principle of working, Efficiency considerations.
Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation, Velocity and pressure variation. Energy transfer, Impeller blade shape, Losses, Slip factor, Power input factor, Pressure coefficient and adiabatic coefficient, Velocity diagrams and power.
Axial Flow Compressors: Mechanical details and principle of operation, Velocity triangles and energy transfer per stage degree of reaction, Work done factor, Isentropic Efficiency, Pressure rise calculations, Polytropic efficiency.

TEXT BOOKS:

1. I.C. Engines, V. Ganesan, Mc Graw Hill, 4th Edition, 2010.
2. Thermal Engineering, Mahesh M Rathore, Tata Mc Graw Hill, 2010

REFERENCE BOOKS:

1. Applied Thermodynamics for Engineering Technologists, Eastop and McConkey, Pearson, 5th Edition, 1993.
2. Fundamentals of Classical Thermodynamics, Vanwylen G.J and Sonntag R.E., Wiley Eastern, 2nd Edition, 1978.
3. Internal Combustion Engines Fundamentals, John B. Heywood, McGraw Hill, 2nd Edition, 2018.

ME403PC: DESIGN OF MACHINE ELEMENTS

B.Tech. II Year, II Sem.

L	T	P	C
3	0	0	3

Note: Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

Prerequisites: Engineering mechanics, mechanics of solids.

Course Objectives:

1. To introduce the basic principles of machine component design.
2. To understand the various modes of failure in mechanical components under different loading conditions.
3. To learn how to apply theories of failure in the safe design of machine elements.
4. To develop the ability to design mechanical components like joints, couplings, shafts, and springs.
5. To familiarize with the use of standard codes and design data books in mechanical design.

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze stress and strain in mechanical components and predict failure using appropriate criteria.
2. Design machine elements like bolts, riveted and welded joints based on static and dynamic loading.
3. Design shafts, couplings, and keys considering strength and rigidity.
4. Select and design helical and leaf springs for energy storage applications.
5. Apply appropriate design standards and codes to real-world design problems.
6. Use design data books and manufacturer's catalogues for component selection and validation.

UNIT – I: Introduction

General considerations in the design of Engineering Materials and their properties, Selection, Manufacturing consideration in design. Tolerances and fits, BIS codes of steels.

Design for Static Strength: Simple stresses, Combined stresses, Torsional and Bending stresses, Impact stresses, Stress - strain relationship, Theories of failure, Factor of safety, Design for strength and rigidity, Preferred numbers. The concept of stiffness in tension, Bending, Torsion and combined situations.

UNIT – II: Design for Fatigue Strength

Stress concentration, Theoretical stress Concentration factor–Fatigue stress concentration factor, Notch Sensitivity, Design for fluctuating stresses, Endurance limit, Estimation of Endurance strength, Gerber's curve, Goodman's line, Soderberg's line.

UNIT – III: Riveted, Welded and Bolted Joints

Riveted joints: Methods of failure of riveted joints, Strength equations, Efficiency of riveted joints, Eccentrically loaded riveted joints.

Welded Joints: Design of fillet welds, axial loads, Circular fillet welds under bending, Torsion. Welded joints under eccentric loading.

Bolted joints: Design of bolts with pre-stresses, Design of joints under eccentric loading – locking devices, bolts of uniform strength.

UNIT – IV: Keys, Cotters and Knuckle Joints

Design of keys, Stresses in keys, Cotter joints, Spigot and Socket, Sleeve and Cotter, Gib and Cotter joints, Knuckle joints.

UNIT – V: Shafts and Couplings

Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined bending and axial loads, Shaft sizes, BIS code. Gaskets and seals (stationary and rotary).

Rigid couplings: Muff, Split muff and Flange couplings. Flexible couplings: Flange coupling (Modified).

TEXT BOOKS:

1. Mechanical Engineering Design, Joseph Edward Shigley, McGraw Hill, 10th Edition, 2022.
2. Design of Machine Elements, V.B. Bhandari, McGraw-Hill, 5th Edition, 2010.

REFERENCE BOOKS:

1. Theory of Machines, Dr. N.C. Pandya and Dr. C.S. Shah, Charotar Publishing House Pvt. Ltd., 21st Edition, 2022.
2. Design of Machine Elements – I, Anup Goel, Technical Publications, 2020.
3. Machine Design, Jindal, Pearson, 1st Edition, 2010.
4. Design of Machine Elements, V. M. Faires, Macmillan, 4th Edition, 1965.
5. Design of Machine Elements - I, M.H Annaiah, New Age International Publishers, 1st Edition, 2010.

ME404PC: INSTRUMENTATION AND CONTROL SYSTEMS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisite: Mathematics - I, Thermodynamics, Basic of Electrical and Electronics Engineering.

Course Objectives:

1. To impart the basic knowledge of the functional blocks of measurement systems.
2. To provide technical understanding of various Temperature and pressure measuring instruments.
3. To expose the students to know the working of various physical variable Level, Flow, Speed and Acceleration measuring instruments.
4. To understand the working of various physical and Electrical Variables Stress, Humidity, Force, Torque and Power measuring instruments.
5. To understand the concept of control system and calculate transfer functions of mechanical and translational systems with different techniques.

Course Outcomes: After completion of the course, the student will be able to:

1. Know the basic knowledge of the functional blocks of measurement systems.
2. Describe the working of various physical variable Temperature and pressure measuring instruments.
3. Explain the working of various physical variable Level, flow, Speed and Acceleration measuring instruments.
4. Understand the working of various physical and Electrical Variables Stress, Humidity, Force, Torque and Power measuring instruments.
5. Understand the concept of control system and calculate transfer functions of mechanical and translational systems with different techniques.

UNIT – I: Principles of measurement

Measurement systems, Generalized configuration and functional description of measuring instruments, Examples. Static and Dynamic performance characteristics, Sources of errors, Classification and elimination of errors.

Measurement of Displacement: Theory and construction of various transducers to measure displacement, Using Piezo electric, Inductive, Capacitance, Resistance, Ionization and Photo electric transducers, Calibration procedures.

UNIT – II: Measurement of Temperature and Pressure

Measurement of Temperature: Various Principles of Measurement, Classification, Expansion Types: Bimetallic Strip, Liquid in glass Thermometer. Electrical Resistance Type: Thermistor, Thermocouple, RTD, Radiation Pyrometry, Optical Pyrometer, Changes in Chemical Phase, Fusible Indicators and Liquid crystals.

Measurement of Pressure: Different principles used, Classification, Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement, Thermal conductivity gauges, Ionization pressure gauges, McLeod pressure gauge.

UNIT – III: Measurement of Level, Flow and Speed

Measurement of Level: Direct methods, Indirect methods, Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators, Bubbler level indicators.

Flow measurement: Rotameter, Magnetic, Ultrasonic, Turbine flowmeter, Hotwire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non-contact type Stroboscope. Measurement of Acceleration and Vibration: Different simple instruments, Principles of Seismic instruments, Vibrometer and accelerometer using this principle, Piezo electric accelerometer.

UNIT – IV: Stress, Strain Measurements

Various types of stress and strain measurements, Selection and installation of metallic strain gauges, Electrical strain gauge, Gauge factor, Method of usage of resistance strain gauge for bending, Compressive and tensile strains, Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter. Measurement of Force, Torque and Power, Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V: Elements of Control Systems

Introduction, Importance, Classification, Open and closed systems, Servomechanisms, Examples with block diagrams, Temperature, speed and position control systems, Transfer functions, First and Second order mechanical systems.

TEXT BOOKS:

1. Principles of Industrial Instrumentation and Control Systems, Chennakesava R Alavala, Cengage Learning, 1st Edition, 2009.
2. Instrumentation – Operations, Measurement, Scope and Application of Instruments, N.V.S. Raju, B.S. Publications, 2016.

REFERENCE BOOKS:

1. Measurement Systems: Applications and design, E. O. Doebelin, TMH, Tata Mcgraw Hill, 6th Edition, 2017.
2. Mechanical Measurements and Control, D. S. Kumar, Metropolitan Book Co. Pvt. Ltd., 2015.
3. Instrumentation, Measurement and Analysis, B.C. Nakra and K.K. Choudhary, TMH, 4th Edition, 2016.
4. Experimental Methods for Engineers, Jack P. Holman, Mc Graw Hill, 8th Edition, 2011.
5. Mechanical and Industrial Measurements, R. K. Jain, Khanna Publishers, 11th Edition, 1995.
6. Mechanical Measurements, Sirohi and Radhakrishna, New Age International, 3rd Edition, 2013.

ME405PC: OPERATIONS RESEARCH

B.Tech. II Year II Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To introduce the principles of Operations Research and its applications in engineering and management.
2. To develop problem-solving skills for linear programming, transportation, and assignment problems.
3. To understand and apply models for decision making, queuing theory, and inventory control.
4. To formulate real-world problems using operations research tools.
5. To use optimization techniques for resource allocation and scheduling.

Course Outcomes: At the end of the course, the student will be able to

1. Formulate and solve linear programming problems using graphical and simplex methods.
2. Apply transportation and assignment models to practical situations.
3. Use decision-making tools like game theory and decision trees under uncertainty.
4. Analyze waiting lines and inventory systems using queuing and inventory models.
5. Solve project scheduling problems using PERT and CPM techniques.
6. Utilize operations research methods for optimization in manufacturing and service systems.

UNIT – I:

Introduction and LPP: Definition of Operations Research, Characteristics and phases of OR, Types of models, Operations Research models, applications.

Linear Programming Problem Formulation, Graphical solution, Simplex method. Artificial variable techniques: Two-phase method, Big- M method.

UNIT – II:

Transportation problem: Formulation, Optimal solution, Unbalanced transportation problem, Degeneracy.

Assignment problem: Formulation, Optimal solution, Variants of Assignment problem, Travelling salesman problem.

UNIT – III:

Sequencing: Introduction, Flow, Shop sequencing, n jobs through two machines – n jobs through three machines, Job shop sequencing, Two jobs through 'm' machines.

Replacement: Introduction, Replacement of items that deteriorate with time, When money value is not counted and counted, Replacement of items that fail completely, Group Replacement.

UNIT – IV:

Theory of Games: Introduction, Terminology, Solution of games with saddle points and without saddle points. 2 x 2 games, Dominance principle, m x 2 and 2 x n games, Graphical method.

Inventory: Introduction, Single item, Deterministic models, Wilson, Harris Model, EOQ Derivation, Shortages model, Continuous Supply Model, P- System and Q- System. Purchase inventory models with one price break and multiple price breaks, Stochastic models.

UNIT – V:

Waiting lines: Introduction, Terminology, Single channel, Poisson arrivals and Exponential service times with infinite population.

Dynamic Programming: Introduction, Terminology, Bellman's principle of optimality, Applications of Dynamic programming, Shortest path problem, Linear programming problem.

TEXT BOOK:

1. Operations Research Theory and Applications, J. K. Sharma, Trinity, 6th Edition, 2016.
2. Operations Research, NVS Raju, BSP Publications, 1st Edition, 2019.

REFERENCE BOOKS:

1. Operations Research, S. D. Sharma, Kedar Nath Ram Nath, 2020th edition, 2014.
2. Operations Research: An Introduction, Hamdy A. Taha, PHI, 10th Edition, 2017.
3. Introduction to Operations Research, Hillierand Lieberman, McGraw Hill, 7th Edition, 2002.
4. Operations Research, A. M. Natarajan, P. Balasubramaniam and A. Tamilarasi, Pearson Education, 3rd Edition, 2020.
5. Operations Research, Wagner, PHI Publications, 2nd Edition, 1975.
6. Operations Research, M.V. Durga Prasad, K. Vijaya Kumar Reddy and J. Suresh Kumar, Cengage Learning, 1st Edition, 2012.

MS406HS: INNOVATION AND ENTREPRENEURSHIP

B.Tech. II Year II Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To familiarize on the basic concepts of innovation, entrepreneurship and its importance.
2. To Identify and analyze the process of problem-opportunity identification, market segmentation, and idea generation techniques.
3. To initiate prototype development and understand minimum viable product.
4. To develop initial Business and financial planning and Go-to-Market strategies
5. To impart knowledge on establishing startups, venture pitching and IPR

Course Outcomes:

1. Understand the entrepreneurship and the entrepreneurial process and its significance in economic development.
2. Assess the problem from an industry perspective and generate solutions using the design thinking principles.
3. Assess market competition, estimate market size, and develop a prototype.
4. Analyze Business and financial planning models and Go-to-Market strategies.
5. Able to build a start-up, register IP and identify funding opportunities.

Unit I: Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation.

Entrepreneurship: Introduction, types of entrepreneurship attributes, mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

Unit II: Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems**,** market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model. Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER, Design thinking principles, Mapping of solution to problem.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

Unit III: Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity.

Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale and analyzing financial performance. Go-To-Market (GTM) approach – Selecting the Right Channel,

creating digital presence, and building customer acquisition strategy.
Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Unit V: Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start-up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features.
Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting, International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.
Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

Suggested Readings:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
6. NISP -Brochure inside pages - startup_policy_2019.pdf

ME407PC: CONVENTIONAL AND COMPUTER AIDED MACHINE DRAWING

B.Tech. II Year II Sem.

L	T	P	C
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Prerequisites: Engineering graphics

Course objectives:

1. To understand the principles and standards of engineering and machine drawing.
2. To develop skills in visualizing and creating orthographic views of machine components.
3. To learn part modeling and assembly drawing using CAD tools.
4. To interpret symbols, tolerances, and fits used in machine drawing.
5. To prepare detailed drawings of mechanical parts and assemblies as per industry standards.

Course Outcomes:

1. Interpret and apply BIS conventions for machine drawing.
2. Draw orthographic views, sectional views, and dimensioned drawings of machine components.
3. Understand the concepts of limits, fits, and tolerances used in engineering design.
4. Create part models and assembly drawings using AutoCAD or other drafting software.
5. Develop detailed production-ready drawings for various machine elements and assemblies.
6. Visualize, model, and document complete assemblies as per standard practice.

List of Experiments:

Drawing of Machine Elements and Simple parts:

Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

1. Screw threads, nuts and bolts, set screws.
2. Keys, cotter joints and knuckle joint.
3. Rivetted joints.
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

Drawing of Machine Elements: Using Computer aided drafting in addition to conventional drawing

Assembly Drawings:

Drawing of assembled views for the part drawing of the following using conventions and easy drawing proportions.

1. Steam engine parts, Stuffing box, Cross head, Eccentric.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts: Screw jack, Connecting rod, Plumber block, Fuel Injector.
4. Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock.

Assembly Drawings: Using Computer aided drafting in addition to conventional drawing

NOTE:

1. First angle projection to be adopted.
2. All the drawing components, Assembly to be drawn using any Computer aided drafting packages.

TEXT BOOKS:

1. Machine Drawing, N.D.Bhatt, Charotar Publication, 51st Edition, 2022.
2. Machine Drawing with Auto CAD, Goutham Pohit and Goutam Ghosh, Pearson, 2016.

REFERENCE BOOKS:

1. Machine Drawing, Bhattacharyya, Oxford, 2011.
2. Machine Drawing, Ajeet Singh, Mc Graw Hill, 2nd Edition, 2012.

Note: External examination is conducted in conventional mode and internal evaluation to be done by both conventional as well as using computer aided drafting.

ME408PC: INSTRUMENTATION AND CONTROL SYSTEMS LAB

B.Tech. II Year II Sem.

Prerequisites: Basic principles of Instrumentation and control systems

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Course Objectives:

1. To provide hands,on experience in calibration and characterization of various measuring instruments.
2. To develop skills in identifying and analyzing measurement errors.
3. To enable students to perform data analysis using regression techniques.
4. To familiarize students with modern instrumentation used in industrial process control**.**

Course Outcomes: At the end of the course, the student will be able to

1. Characterize and calibrate measuring devices.
2. Identify and analyze errors in measurement.
3. Analyze measured data using regression analysis.
4. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

List of Experiments:

Calibration and Study of:

1. Pressure Gauges.
2. Transducer for temperature measurement.
3. LVDT transducer for displacement measurement.
4. Strain gauge for temperature measurement.
5. Thermocouple for temperature measurement.
6. Capacitive transducer for angular displacement.
7. Photo and magnetic speed pickups for the measurement of speed.
8. Resistance Temperature Detector (RTD) for temperature measurement.
9. Rotameter for flow measurement.
10. Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. McLeod gauge for low pressure.

Measurement and control of:

1. Pressure of a process using SCADA system.
2. Level in a tank using capacitive transducer with SCADA.
3. Temperature of a process using resistance temperature detector with SCADA.

Note: Perform a minimum of any 12 out of the 14 Experiments.

LAB MANUALS:

1. Laboratory Manual for Instrumentation and Control Engineering, S. R. Vijayalakshmi, Vikas Publishing House, 2021.
2. Instrumentation and Control Systems Lab Manual, Dr. A. K. Mittal and Dr. A. K. Bandyopadhyay, S. K. Kataria and Sons, 2020.

ME409PC: THERMAL ENGINEERING- I LAB

B.Tech. II Year, II Sem.

L	T	P	C
0	0	2	1

Prerequisite: Thermodynamics and Thermal Engineering – I

Course Objectives:

1. To provide practical knowledge of the working and performance of internal combustion engines and air compressors.
2. To familiarize students with various testing methods like Morse test, retardation test, and heat balance.
3. To enhance the understanding of the effect of different parameters such as airfuel ratio and compression ratio on engine performance.
4. To impart handson experience in dismantling and assembling of engine components.
5. To introduce basic operations and applications of boilers and their accessories.

Course Outcomes: At the end of the course, the student will be able to

1. Understand the working principles of internal combustion engines and air compressors.
2. Perform experiments to evaluate the performance of twostroke and fourstroke SI and CI engines.
3. Conduct various tests like Morse, Retardation, Motoring, and Heat Balance on engines.
4. Analyze the effect of air,fuel ratio and compression ratio on engine performance.
5. Study volumetric efficiency of air compressors and understand their operational characteristics.
6. Disassemble and assemble engine components and study the function of boilers.

List of Experiments:

I.C. Engines:

1. Valve, Port Timing Diagrams.
2. Performance Test for 4 Stroke SI engines.
3. Performance Test for 2 Stroke SI engines.
4. Morse, Retardation, Motoring Tests.
5. Heat Balance – CI, SI Engines.
6. Economical Speed Test on a SI engine.
7. Effect of Air Fuel Ratio in a SI engine.
8. Performance Test on a 4Stroke CI Engine at constant speed.
9. Performance Test on Variable Compression Ratio Engine.

Other Experiments:

1. Volumetric efficiency of Air Compressor Unit.
2. Disassembly, Assembly of Engines.
3. Study of Boilers.

Note: Perform a minimum of any 10 out of the 12 Exercises.

LAB MANUALS:

1. Internal Combustion Engines Laboratory Manual, Dr. K. Sudhakar and Dr. S. Ramasamy, VSRD Academic Publishing, 2021.
2. Thermal Engineering Lab Manual, Er. R.K. Rajput and Er. R.S. Khurmi, S. Chand Publications, 2022.

ME410SD: DATA ANALYTICS AND PYTHON FOR ENGINEERS

B.Tech. II Year II Sem.

L	T	P	C
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Course Objectives:

1. To introduce Python programming for data handling and analysis.
2. To enable data import, cleaning, and transformation.
3. To develop skills in data visualization and statistical analysis.
4. To apply data analytics to engineering problem solving.
5. To introduce realtime data analysis using tools like Jupyter or Streamlit.

Course Outcomes:

1. Write Python programs for engineering computations and data processing.
2. Clean and transform data using Pandas.
3. Create visualizations using Matplotlib and Seaborn.
4. Perform descriptive and predictive statistical analyses.
5. Analyze engineering datasets for performance insights.
6. Apply analytics to realworld problems like predictive maintenance.

UNIT - I:

Python Fundamentals for Engineering Applications

Basic Python Programming: Writing simple Python scripts for arithmetic, loops, and functions. **Application**: Calculate mechanical or electrical parameters (e.g., stress, power, resistance).

Data Types and Structures: Practice using lists, dictionaries, tuples, sets. **Application**: Storing sensor data, part specifications, material properties.

File Handling in Python: Read/write data from .txt, .csv files. **Application**: Reading experimental or log data from machines.

UNIT - II:

Data Handling and Processing

Data Import and Cleaning using Pandas: Load data from Excel/CSV, handle missing data, remove outliers. **Application**: Clean experimental datasets from lab instruments.

Data Transformation and Aggregation: Grouping, filtering, and summarizing data. **Application**: Analyze machine run times, failure logs, or production efficiency.

Data Visualization with Matplotlib and Seaborn: Line plots, bar charts, histograms, box lots. **Application**: Visualize stress, strain graphs, sensor trends, or energy consumption.

UNIT - III:

Statistical Analysis and Engineering Insights

Descriptive Statistics: Mean, median, mode, standard deviation, variance.

Application: Analyze tolerance distribution, process variations.

Correlation and Regression Analysis: Perform and interpret linear regression.

Application: Predict thermal efficiency, or material behavior with respect to time/temp.

Hypothesis Testing: Perform t- tests and ANOVA. **Application**: Test impact of material changes on performance metrics.

UNIT - IV:

Applied Data Analytics

Sensor Data Analysis: Analyze timeseries data from IoT or sensor logs. **Application**: Predict motor failure or anomalies in temperature/humidity.

Real-time Data Dashboard (Optional with Jupyter/Streamlit): Build a basic data dashboard using Python tools. **Application**: Monitor lab machine metrics or simulate process control.

UNIT - V:

Mini Projects / Case Studies

Engineering Case Study – Predictive Maintenance: Analyze historical machine data to predict failure using regression/classification.

Energy Audit Data Analytics: Load and analyze power consumption data from equipment.

Optimization using Python (SciPy): Solve basic optimization problems (e.g., minimize cost, material use).

TEXT BOOKS:

1. Python for Data Analysis, Wes McKinney, O'Reilly Media, 3rd Edition,2022.
2. Think Python: How to Think Like a Computer Scientist, Allen B. Downey, Green Tea Press / O'Reilly Media, 2nd Edition, 2015.
3. Python Programming: An Introduction to Computer Science, John M. Zelle and Franklin,Beedle and Associates Inc.,3rd Edition,2016.
4. Data Analytics: Made Accessible, Anil Maheshwari, Amazon Digital Services / CreateSpace Independent Publishing, 1st Edition, 2014.

Tools and Library to be Use: Python, Jupyter Notebook, Pandas, NumPy, Matplotlib, Seaborn, SciPy, Scikit- learn (introductory).

VA400HS: INDIAN KNOWLEDGE SYSTEM

B.Tech. II Year II Sem.

L	T	P	C
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Bharat is considered one of the oldest civilizations of the world. Some of the archaeological evidences proved the existence of Indus Valley Civilization in 7000 B.C. Bhartiya traditions, culture, cultural activities, rituals, sacraments, painting, art of dancing, art of singing etc. is being practised till the modern times without knowing scientific approaches behind that. Eternity of Indian knowledge system proved itself that not only many rituals but also many traditions, many streams of knowledge like astrology, mathematics, physics, chemistry, biology, language studies, yoga and meditation had been following from the starting till now with some changes, in the form of traditions.

This course is for undergraduate students to inculcate Indian values. It will promote advance study and inter disciplinary research on all aspects of the Indian knowledge system.

Course Objectives: This course aims:

1. To provide a tribune of the rich culture and traditions of Indian knowledge system to students of various disciplines.
2. To introduce historical account on the education and scientific literature available in ancient Indian traditions and its connections with ancient Indian Philosophy
3. To give insights about the applications of Bharatiya Jnana Parampara
4. To introduce Indian approach towards health and wellbeing
5. To elaborate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

Course Outcomes: Students will be able to:

1. Understand nature, scope and related fields of Indian knowledge system.
2. Demonstrate the scientific literature available in ancient Indian traditions
3. Understanding the application of Bharatiya Jnana Parampara
4. Understand Indian approach towards Wellbeing
5. Appreciate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

Unit 1: **Introduction to Indian Knowledge Systems**

Meaning**,** Nature, Scope and Salient Aspects of Bharatiya Jnana Parampara - Introduction to Vedas, Upanishads, Vidya, Kala, Jnana, Shastra - Practices and Continuity of Tradition

Unit 2: Overview of History of Indian Education and Scientific Literature

Gurukul System - Role of Sanskrit in Natural Language Processing - Scientific Literature - Vedic Literature - Available Scientific Treatises - Interlinkings

Unit 3: Introduction to Scientific Theories from Pure Sciences from Ancient Indian Knowledge Systems

Overview of theories from available ancient Indian Literature about Physics, Chemistry and Mathematics - Interlinkings and applications

Unit 4: Introduction to Ancient Indian Wellness Systems

Concept of Wellness – Yoga System - Ayurveda System - Ancient Indian Aesthetics

Unit 5: Development of Engineering, Science, Technology & Fine Arts in India

Various Industries - Silk, Cotton and Ship Building - Evolution of Indian Fine Arts – Cave and Temple Architecture, Vastu - Vidya, Sculpture, Forts and Stepwells, Observatories and Paintings - Music and Natyakala - Cultural Traditions & Folk Arts

❖ **Pedagogy for Teachers: Apart from Class Room Instruction, the following Methods are Suggested.**

1. Project based activities and learning.
2. Presentation and case studies.
3. Film screening and book reviews.
4. Visit to historical places, archives centre, research centre or library nearby.

***Note**: Activities mentioned above are only suggestive. Teacher-educators should encourage students to be innovative.*

Suggested Readings:

1. B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., (2022) '*Introduction to Indian Knowledge Systems: Concepts and Applications*' PHI learning PVT, New Delhi ISBN [9789391818203]
2. Dharmapal (1971) '*Indian Science and Technology in the Eighteenth Century*'. Other India Press, Goa.
3. Kapil Kapoor, Singh Avdhesh Kumar, (2005) '*Indian Knowledge Systems*' D.K. Printworld (P) Ltd. ISBN 10: 8124603367 / ISBN 13: 9788124603369
4. Chakradeo, Ujwala, Temples of Bharat, Aayu Publications, New Delhi, 2024.
5. D.N. Bose, S.N. Sen and B. V. Subbarayappa, *A Concise History of Science in India*, Indian National Science Academy, New Delhi, 2009.
6. Datta B. and A. N. Singh, *History of Hindu Mathematics: Parts I and II*, Asia Publishing House, Bombay, 1962.
7. Kapoor, K. (2021), *Indian Knowledge System: Nature, Philosophy, Character in Indian Knowledge System*, vol. 1, Pub. Indian Institute of Advanced Studies, Shimla
8. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Philosophical Systems, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.
9. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Knowledge: Framework and Classification, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.

Video Resources:

1. Introductory lectures by Prof. Gauri Mahulikar
2. Introductory lectures by Prof. Kapil Kapoor

Websites:

- https://iksin dia.org/index.php
- Official Website of IKS- Indian Knowledge System
- https://www.youtube.com/watch?v=uKcf-hSlcUE
- Address by Prof Kapil Kapoor | Indian Institute of Advanced Study (FDP 2021)
- https://www.youtube.com/watch?v=MDJTXNiH2_A
- Mukul Kanitkar on Bharatiya Knowledge System
- https://www.youtube.com/watch?v=uARMhv97pjk
- https://www.youtube.com/watch?v=oTwgf56GbsA
- Scientific History of India | Mukul Kanitkar Lecture in DTU
- https://youtu.be/gNJNmPJqXJc?si=WFBbuUT65mLZzpOW
- Ancient India's Scientific Achievements & Contribution in Mathematics, Astronomy, Science & Medicine