Detailed Curriculum for Undergraduate Degree
B.Tech in Automobile Engineering
(w.e.f. AY: 2025-26)
Part III: Detailed Curriculum

Course Name:	**Mathematics-II**		
Course Code:	BS-M201	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn concepts of Matrices & Determinants.
2	To learn how to solve different types of ordinary differential equation.
3	To comprehend Laplace transform & inverse Laplace transform.
4	To understand basic concept of graph theory.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Matrices and Determinants** • Matrix & types of matrices. • Introduction to determinant, properties (proofs of identities are excluded). • Rank of a matrix, inverse of a matrix, Linear systems of equations, eigen-values and eigen-vectors, Caley-Hamilton theorem.	**8L**
2	**Ordinary Differential Equations of First order:** • Solution of first order and first degree differential equations: Exact equations and their solution, Non-exact equations, Integrating Factors. Linear and Bernoulli's equations. • Solution of first order and first degree differential equations: Solvable for $\boldsymbol{p}$, solvable for $\boldsymbol{x}$, solvable for $\boldsymbol{y}$; Clairaut's form.	**8L**
3	**Higher Order Ordinary Differential Equations:** • Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI). • Cauchy-Euler's homogeneous equations. • Method of variation of parameters. • Solution of simultaneous first order ordinary differential equations.	**10L**
4	**Laplace Transforms (LT):** • Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of $t^n F(t)$ and $F(t)/t$; LT of unit step and periodic functions; LT of	**10L**

	derivatives. • Inverse LT: Method of partial fractions, Convolution theorem. • Solutions of initial and boundary value problems by LT.	
5	**Graph Theory:** • Introduction: Definitions of graphs, walks, path & circuits. • Connected and disconnected graphs, directed and non-directed graphs, simple graphs, complete and bi-partite graphs; Some related theorems on graph. • Incidence and adjacency matrix; Graph isomorphism. • Shortest path: Dijkstra's algorithm. • Definition of tree, binary tree; Some related theorems on trees. • Spanning tree: BFS and DFS algorithms. • Minimal spanning tree: Kruskal's and Prim's algorithms.	**12L**
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concept of matrix and determinants in different fields.
2	Determine eigen values, eigen vectors and utilize them to solve physical and engineering problems.
3	Apply different techniques to solve first and second order ordinary differential equations to address the modelling of systems and problems of Engineering field.
4	Apply Laplace Transform in analyzing physical problems.
5	Utilize graph algorithms for solving different network and other problems.

Learning Resources:	
1	'An Introduction to Differential Equation' by Maity & Ghosh, NCBA.
2	'Introduction to Graph Theory' by Dipak Kumar Ghosh, NCBA.
3	'Advanced Engineering Mathematics' by H. K. Dass, S. Chand Publication.
4	'Mathematical Methods of Science and Engineering' by Kanti B. Dutta, Cengage Learning.
5	'Higher Engineering Mathematics' by B.S. Grewal, Khanna Publishers.
6	'Advanced Engineering Mathematics' by Erwin Kreyszig, John Wiley.
7	'Advanced Differential Equation' by M.D Raisinghania, S. Chand Publication.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Engineering Mathematics - II	Prof. Jitendra Kumar	IIT Kharagpur

Course Name:	**Physics**		
Course Code:	BS-PH201	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	4.0

L-T-P:	3-1-0	**Pre-Requisites:**	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the core principles of Quantum Mechanics and its potential applications in Engineering.
2	To demonstrate interaction between fields and charges and analyze the effect of medium properties on Electromagnetic Field propagation.
3	To understand the working principle of LASER and properties of Optical Fiber for effective communication systems.
4	To actively engage in understanding various physical laws and their applications through interactive learning tools.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Topic: Quantum Mechanics** **Historical Background** • Concept of Black Body Radiation, Its failures: From data to law, Ultraviolet Catastrophe and its implications, Planck's Radiation law: The beginning of Quantization. *Do to learn:* Simulate Black Body radiation curves at different temperatures and estimate Wien's constant and Stefan's constant from simulated data. **Particle or Wave: A Tug of war** • Compton Scattering: Failure of wave nature. • Explaining the shift (Particle nature to the rescue): Relativistic energy and momentum conservation equations, recoil energy, Origin of unmodified and modified lines. *Do to learn:* Simulate Compton scattering for various incoming photon energies and scattering angles and estimate Compton wavelength from data.	**11L**
	Dynamics of the Small • Postulates of Quantum Mechanics: Rules of the Game, Quantum Mechanical Operators, Concept of Wave Function. • Schrödinger's Equation and its analytical solution to a particle in an infinite 1-D well. Concept of degeneracy and non-degeneracy of a particle enclosed in a 3-D box, Qualitative analysis of particle in a barrier and the concept of Tunneling. *Do to learn:* Simulate particle scattering by a barrier and recognize	

	how reflection and transmission probabilities are related to the incoming particle energy, barrier height and width.	
2	**Topic: Steady Electric and Magnetic Fields** **The Game of Causality** • Idea of gradient, divergence and curl from the perspective of vector field. How charges can be felt? Gauss law of Electrostatics. • Curl-less field: Concept of Electric Potential, KVL, Laplace and Poisson's equations. • What happens when charges move? Ampere's Circuital law, Divergence-less field: Concept of Magnetic vector potential. *Do to learn:* Simulate Electric and Magnetic lines of forces from different charge and current distributions. **How Fields Effect Charges** • Lorentz Force law, Motion of charged particles in Electric and Magnetic fields. *Do to learn:* Simulate shooting charged particle in electric and magnetic fields to study its trajectory and demonstrate relationships between field strengths, radius and specific charge.	**9L**
3	**Topic: Time Varying Electromagnetic Field and Maxwell's Equations** **Nature abhors change** • Faraday's Law of Electromagnetic Induction in Integral and Differential forms. • Applications in devices like Transformers, Generators, Electromagnetic breaking. *Do to learn:* Simulate Electromagnetic Induction and identify the conditions that produce it. Predict how the induced current will change when the experimental conditions are varied. **Disturbances that travel** • Symmetry restored: Concept of Displacement Current, Maxwell's equation in different media under various conditions. • Wave of What?: The Wave equation, Transverse nature of Light in vacuum, Concept of Impedance and its relation to Reflection and Transmission coefficient of EM waves at the boundary between two media. Relation between electric and magnetic fields of an electromagnetic wave. • EM waves in conducting medium, Concept of skin depth, Electromagnetic shielding. • Poynting theorem, Average Power of an EM field. *Do to learn:* Simulate various medium parameters to demonstrate and record attenuation, reflection and transmission of EM fields across different media.	**9L**
4	**Topic: Wave Optics**	**9L**

	Light plus light always doesn't give more light • Concept of Coherence: Temporal and Spatial. • Interference by division of Amplitude, Newton's Ring, Calculation of film thickness for anti-reflection coatings. • Diffraction: Fresnel and Fraunhofer, Comparative Study: Single, Double and N-Slit Diffraction. • Polarization of light: Linear, Circular and Elliptical Polarization, Malus's Law, Half wave and Quarter wave plate. *Do to learn:* Simulate superposition of waves to demonstrate Interference and Diffraction and analyze the effect of different control parameters on the Intensity distribution.	
5	**Topic: LASER and Fiber Optics** **A Coherent Symphony** • Properties of LASER beams: monochromaticity, coherence, directionality and intensity. • Interaction between matter and radiation: Transition Probabilities, Einstein's A and B Coefficients and inter-relationship among them. • Essential Conditions for Lasing, Components, Concept of Metastable State, Pumping, Population Inversion, Relation between Linewidth and Bandwidth of a pulse. • Differences between various solid state and gas LASERs and their applications in science, engineering and medicine. *Do to learn:* Simulate spontaneous and stimulated emissions and explain the requirements for lasing in terms of intensity and wavelength of light, lifetime of the exited states etc. **The Messenger** • Salient Features of Optical Fibers, Communication through Optical Fiber, Numerical Aperture and Acceptance Angle, Step-index and Graded-index fibers. • Concept of Mode, Intermodal Dispersion, Material and Waveguide Dispersion, Design Considerations on Dispersion Management, Fiber Losses. • Concept of Sampling, Bit Rate, Signal Bandwidth and Nyquist Theorem. *Do to learn:* Simulate the lateral and longitudinal positions of detector and measure detector current to estimate numerical aperture of a given fiber.	**10L**
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate between various black body curves, analyze Compton scattering, estimate physical constants pertaining to the subatomic world and apply the rules of quantum mechanics in the estimation of probabilities and expectations for a given state vector.

2	Interpret the effect of fields on charges and evaluate the conditions required for electromagnetic induction.
3	Analyze electromagnetic wave propagation in different media pertaining to its reflection, transmission and attenuation.
4	Comprehend the wave nature of light through interference, diffraction and polarization, and apply these concepts to solve related engineering problems.
5	Understand working principles of LASER, key features of optical fibers, fundamentals of sampling and bit rate concepts.

Learning Resources:	
1	'Introduction to Quantum Mechanics' by David J. Griffiths.
2	'Quantum Mechanics' by Leonard I. Schiff.
3	'Quantum Physics' by A. N. Konar.
4	'Concepts of Modern Physics' by Arthur Beiser.
5	'Introduction to Electrodynamics' by David J. Griffiths.
6	'Electricity and Magnetism' by Chattopadhyay and Rakshit.
7	'Optics' by E. Hecht.
8	'Lasers: Theory and Applications' by K. Thyagarajan and A. Ghatak.
9	'Understanding Lasers' by Jeff Hecht.
10	'Introduction to Fiber Optics' by A.Ghatak and K. Thyagarajan.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Introduction To Electromagnetic Theory	Prof. Manoj Harbola	IIT Kanpur
2	Quantum Mechanics I	Prof. P Ramdevi	IIT Bombay
3	Wave Optics	Prof. Samudra Roy	IIT Kharagpur
4	Introduction to Laser	Prof. M.R.Shenoy	IIT Dellhi

Course Name:	**Programming for Problem Solving**		
Course Code:	ES-CS201	**Category:**	Engineering Science Courses
Semester:	Second	**Credit:**	3.0
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To provide students with a foundational understanding of the C programming

	language and its core concepts.
2	To cultivate the skills necessary to apply programming techniques for solving scientific and engineering problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Computer Fundamentals:** Basic anatomy of computer system and functionalities of each component. **Flowchart, Algorithm and Pseudocode:** Concept and applications of Flow Chart, Algorithm and Pseudocode with examples. Conversion of algorithms to programs or source code. **C Programming fundamentals:** Characteristics and structure of a C program, Preprocessor directives and header files, Syntax and logical errors in compilation, Object and executable code, Keywords, Identifiers, Datatypes, Variables and memory locations, Storage classes, Constants, Managing I/O operations. Operators and expressions, Precedence and Associativity of operators.	**7L**
2	**Decision Making using Branching and Looping:** Concept and applications of if, if – else, if – else if ladder, and switch case. Concept and applications of while, for and do-while loop, application of keywords break and continue.	**8L**
3	**1D and 2D Arrays and String:** declaration and initialization of 1D and 2D arrays, operations and applications, basic concept of searching and sorting algorithms (linear search and bubble sort only), declaration and initialization of character array and string, operations and applications, standard string functions and their use.	**8L**
4	**Functions:** Necessity and use of function in programming, prototype declaration, definition and function call, passing arguments (call by value). Concept of recursion.	**4L**
5	**Pointers:** Declaration and initialization, pointer arithmetic and operations, relationship between pointers and array, passing argument (call by address).	**4L**
6	**Structure:** Defining a structure, declaration and use of structure variables, array of structures, self-referential structure. **File handling:** open, read, write, and close a file and application of file handling operations in programming.	**5L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain computer fundamentals, problem-solving techniques using flowchart and algorithm and methods to develop basic C programs.

2	Implement decision-making and looping concepts to solve basic computational problems.
3	Implement arrays, strings, and basic algorithms like linear search and bubble sort to solve computational problems.
4	Apply functions and recursion to modularize and solve computational problems.
5	Apply pointers for efficient memory access, array manipulation, and function calls using address passing.
6	Apply structures and file handling concept to perform disk I/O operations efficiently.

Learning Resources:	
1	'Schaum's Outline of Programming with C' by Byron Gottfried, McGraw-Hill.
2	'Programming in ANSI C' by E. Balaguruswamy, Tata McGraw-Hill.
3	'Let Us C' by Yashavant Kanetkar, BPB Publication.
4	'Computer Fundamentals and Programming in C' by Reema Thereja, Oxford.
5	'The C Programming Language' by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall of India.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Problem Solving through Programming in C	Prof. Anupam Basu	IIT Kharagpur

Course Name:	**Inculcation of Human Values and Professional Ethics (Mulya Pravah)**		
Course Code:	HM-HU203	**Category:**	Humanities and Social Sciences including Management Courses
Semester:	Second	**Credit:**	2.0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic managerial acumen
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To create an awareness on Indian Ethos.
2	To instill moral and social values and loyalty.
3	To appreciate the rights of others.
4	To create awareness on Constitutional Values and Global Citizenship.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	**Introduction to Indian Ethos:** Meaning of ethos and cultural essence of India; Scriptures as the base of the Indian Knowledge System (IKS); Integrating the two methodologies– interiorization process for self-exploration, and exterior scientific pursuit for the prosperity of world; The Law of Karma and Nishkama Karma (The Law of action and selfless action).	**4L**
2	**Human Values and Ethics:** Knowing the Self and the universal values that we stand for; Morals, Values and Ethics; Integrity; Work Ethic-Service learning; Respect for others; Spirituality; self-enquiry & self-discovery; Self-identity: distinguishing and embracing oneself (and others) four profiles (inner potential, social, professional, personality).	**6L**
3	**Constitutional Values and Global Citizenship:** Values embedded in the Preamble of the Indian Constitution; Integration of Human Rights and duties; Directive principles and responsibilities as citizens of India; Justice; Sensibility and responsibilities towards global environment, Loksangraha and Vasudhaiva Kutumbakam. Globalization; Cross culture issues; Environmental Ethics.	**6L**
4	**Values and Skills for Youth:** Value spectrum of good life; Listening for commitment behind complaints to transform contentious arguments and create a space for listening and change; Distinguishing judgement from discernment; Being assertive and confident (assertiveness incorporates self-confidence).	**4L**
5	**Integrated Personality and Well-being:** The three gunas (qualities of sattva, purity and harmony; the four antah-karanas (inner instruments), and panch kosha (five sheaths); Stress management – meditated personality and agitated personality; Physical, mental, social, and spiritual well-being.	**4L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field and the multiple ethical interests at stake in a real-world situation or practice.
2	Assess their own ethical values and the social context of problems and articulate what makes a particular course of action ethically defensible.
3	Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human.
4	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and

	interdisciplinary research.

Learning Resources:	
1	'Engineering Ethics includes Human Values' by M. Govindarajan, S. Natarajananad, and V.S. Senthil Kumar, PHI Learning Pvt. Ltd.
2	'Professional Ethics and Human Values' by A. Alavudeen, R. Kalil Rahman and M. Jayakumaran, Laxmi Publications.
3	'Ethics in Engineering' by Mike W. Martin and Roland Schinzinger, Tata McGraw- Hill–2003.
4	'Professional Ethics and Morals' by Prof. A.R. Aryasri, Dharanikota Suyodhana, Maruthi Publications.
5	'Professional Ethics and Human Values' by Prof. D.R. Kiran, Tata McGraw-Hill Education.
6	'Indian Culture, Values and Professional Ethics' by P.S.R. Murthy, BS Publication.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Exploring Human Values: Visions of Happiness and Perfect Society	Prof. A.K. Sharma	IIT Kanpur
2	Ethics in Engineering Practice	Prof. Susmita Mukhopadhyay	IIT Kharagpur

Course Name:	**Physics Laboratory**		
Course Code:	BS-PH291	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Concept of least count
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To apply the concepts of Physics in carrying out experiments on quantum physics, magnetism, optics and general properties of matter and interpret the same for deduction of results.
2	To habituate with the perceptions of errors, significant digits and interpret experimental results through graphs using eye-estimation and linear regression as tools.
3	To work as a team and report the findings in an organized manner.

Course Contents: (Choose 10 experiments from the following)		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Determination of Hall Coefficient of a Semiconductor.	3P/week
	Determination of Band Gap of a Semiconductor by Four Probe Method.	
2	Study of Current Voltage Characteristic, Load Response, Areal	

	Characteristic and Spectral Response of a Photovoltaic Solar Cell.	
3	Verification of Bohr's Atomic Orbital Theory through Frank-Hertz Experiment, and Determination of the First Excitation Potential of a Gas.	
	Determination of Planck Constant and Work Function using Photo-electric Effect.	
	Verifying Stefan's Law Related to Thermal Radiation and hence Determination of the Stefan-Boltzmann Constant.	
	Determination of Rydberg Constant by Studying Hydrogen Spectrum.	
4	Determination of Unknown Resistance using Carey Foster's Bridge.	
	Study of Magnetic Field Variation along the Axis of Helmholtz Coils, the Superposition Principle, and Calculation of the Coil Radius.	
	Determination of Specific Charge (e/m) of Electron by J.J. Thomson's Method.	
	Determination of Thermo-electric Power of a given Thermocouple.	
5	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method.	
	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure.	
	Measurement of the Surface Tension using the 'Break-away' Method.	
6	Determination of Wavelength of the Given LASER Light by Diffraction Method.	
	Determination of Numerical Aperture and Attenuation Coefficients of an Optical Fiber.	
Total		**30P**

Experiments that may be performed through Virtual Labs:		
Sl. No.	**Experiment Name**	**Experiment Link(s)**
1	Frank-Hertz Experiment	https://vlab.amrita.edu/?sub=1&brch=195&sim=355&cnt=1
2	Solar Panel Experiment	https://vlab.amrita.edu/?sub=1&brch=195&sim=360&cnt=1
3	Photoelectric Effect	https://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1
4	Hall Effect Experiments	https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
5	Determination of Rigidity Modulus	https://vlab.amrita.edu/?sub=1&brch=280&sim=1518&cnt=1
6	Determination of Young's Modulus	https://vlab.amrita.edu/?sub=1&brch=280&sim=1509&cnt=1
7	Numerical Aperture of Optical Fiber	https://vlab.amrita.edu/?sub=1&brch=189&sim=343&cnt=1

Course Outcomes:	
After completion of the course, students will be able to:	
1	Estimate semiconductor properties like Hall coefficient and Band gap.
2	Analyze solar cell performance under different conditions.
3	Verify energy quantization in atoms using Frank-Hertz set up and Hydrogen spectrum along with estimation of Stefan's and Planck's constant.
4	Calibrate instruments like thermocouple, magnetometer and Helmholtz coil for measurement of thermo-emf or magnetic field and estimate quantities like specific charge (e/m) of electron, unknown resistances, thermoelectric power.
5	Compute different fundamental elastic constants.
6	Use diffraction to calculate wavelength of light sources and estimate parameters like numerical aperture and attenuation in optical fibers.

Learning Resources:	
1	'An Advanced Course in Practical Physics' by D. Chattopadhyay & P. C. Rakshit.
2	'A Manual of Practical Engineering Physics and Material Science' by A. S. Vasudeva.
3	'A Textbook of Engineering Physics Practical' by R. Das, R. Kumar, C. S. Robinson & P. K. Sahu.

Course Name:	**Programming for Problem Solving Laboratory**		
Course Code:	ES-CS291	**Category:**	Engineering Science Courses
Semester:	Second	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Lab 1: Familiarization with C programming environment with simple problems, use of format specifier in printf(), Simple computational problems using different operators, expressions.	4P

2	Lab 2: Problems involving using Conditional Statements (if-else, nested if-else) Lab 3: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 4: Problems to be solved using switch-case, nested loop (pattern).	8P
3	Lab 5 & 6: Concepts of Array and problems using 1-D and 2-D array (array and matrix manipulation, Linear Search and Bubble Sort).	8P
4	Lab 7: Concepts of Functions (call by value) and Recursive function. Lab 8: Problems for String manipulation (using library function and user defined functions). Lab 9: Problems to be solved using concepts of pointer, function call by address, relation between array and pointer.	8P
5	Lab 10: Problems to be solved using concepts of structure. Lab 11: Problems involving File handling operations.	8P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement the syntax and semantics of C programming constructs and demonstrate the use of format specifiers, operators, and expressions. [Lab 1, Lab 2]
2	Implement control structures (conditional and iterative), arrays and functions to solve computational problems. [Lab 2 to Lab 7]
3	Apply string manipulation techniques and pointer concepts to solve basic data processing problems in C. [Lab 8 and Lab 9]
4	Apply the concepts of structures and file handling to store, organize, and retrieve data. [Lab 10 and Lab 11]

Learning Resources:	
1	'Schaum's Outline of Programming with C' by Byron Gottfried, McGraw-Hill.
2	'Programming in ANSI C' by E. Balaguruswamy, Tata McGraw-Hill.
3	'Let Us C' by Yashavant Kanetkar, BPB Publication.
4	'Computer Fundamentals and Programming in C' by Reema Thereja, Oxford.
5	'The C Programming Language' by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall of India.

Course Name:	**Engineering Graphics and Design**		
Course Code:	ES-ME291	**Category:**	Engineering Science Course
Semester:	Second	**Credit:**	2.0
L-T-P:	0-0-4	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination	Semester Examination:	Continuous	Attendance:

Scheme:	60	Assessment: 35	05

Course Objectives:	
1	To make students aware of importance of engineering drawing and to familiarize with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	**4P**
2	**Lettering, Dimensioning, Scales:** Different types of lettering and dimensioning system; Plain scale and Diagonal scale.	**4P**
3	**Geometrical Construction and Curves:** Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spira.	**8P**
4	**Projection of Points, Lines, Surfaces:** Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	**8P**
5	**Projection of Regular Solids:** Regular solids inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	**4P**
6	**Sections and Sectional Views of Right Angular Solids:** Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).	**8P**
7	**Isometric Projections:** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	**4P**
8	**Combination of Regular Solids:** Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base.	**4P**
9	**Overview of Computer Graphics & CAD Drawing:** Listing the computer technologies that impact on graphical communication,	**4P**

	Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids, Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.	
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of Engineering Drawing for lines, geometric construction of curves and different scales.
2	Understand the concepts of orthographic projections and its applications.
3	Apply the principles of Isometric projection for conversion of orthographic to isometric views and vice versa.
4	Construct 2D geometries using AutoCAD software.

Learning Resources:	
1	'Engineering Graphics & Design' by Pradeep Jain, Ankita Maheswari, A.P. Gautam, Khanna Publishing House.
2	'Engineering Drawing' by N. D. Bhatt, V. M. Panchal & P. R. Ingle, Charotar Publishing House, 2014.
3	'Engineering Graphics' by B. Agrawal & C. M. Agrawal, TMH Publication, 2012.
4	'Engineering Drawing and Computer Graphics' by M. B. Shah & B. C. Rana, Pearson Education, 2008.
5	Corresponding set of CAD Software Theory and User Manuals.

Course Name:	**Ideation Laboratory**		
Course Code:	PW-BS281	**Category:**	Project Work
Semester:	Second	**Credit:**	1.0
L-T-P:	0-0-2	**Pre-Requisites:**	High School Subjects
Full Marks:	100		
Examination Scheme:	Presentation: 40	Continuous Assessment: 55	Attendance: 05

Course Objectives:	
1	To introduce students to the fundamentals of research, invention, innovation, and design thinking for addressing real-world societal and technological challenges.

2	To develop the ability to identify problems, conduct literature reviews using scientific databases, and analyze existing solutions to identify research gaps and opportunities for innovation.
3	To familiarize students with the process of transforming innovative ideas into feasible solution concepts through systematic planning, documentation, and effective presentation.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	**Introduction to Ideation, Research, Invention and Innovation** Understanding creativity, invention, innovation, and entrepreneurship. Difference between research, invention, and innovation. Importance of innovation in solving societal and industrial problems. Discussion on successful innovations and their impact on society.	**2P**
2	**Research Methodology and Problem Identification** Introduction to research methodology. Types of research. Characteristics of a good research problem. Identification of societal, environmental, healthcare, agricultural, educational, and industrial problems. Techniques for problem observation and problem statement formulation. • Exercise: Identification of a real-life societal problem and preparation of a preliminary problem statement.	**2P**
3	**Literature Review: Fundamentals and Importance** Purpose and significance of literature review. Identifying research gaps and opportunities for innovation. Techniques for systematic literature survey. • Exercise: Literature search on a selected problem.	**2P**
4	**Literature Review Tools and Databases** Hands-on training on Google Scholar, Google Patents, ScienceDirect, IEEE Xplore, SPIE Digital Library, Optica Publishing, SpringerLink, Wiley, Scopus, Web of Science, and other relevant databases. Citation tracking and reference management tools. • Exercise: Collection and organization of relevant literature.	**2P**
5	**Research Ethics, Plagiarism and AI-Assisted Writing** Research ethics and responsible conduct of research. Understanding plagiarism and its consequences. Plagiarism detection tools. Appropriate use of AI tools in academic writing and innovation. AI-generated content checking and validation. • Exercise: Plagiarism and AI-content analysis of sample documents.	**2P**
6	**Design Thinking and Innovation Framework** Introduction to Design Thinking. Empathize, Define, Ideate, Prototype, and Test stages. User-centric innovation approach. Problem reframing and need assessment. • Activity: Design Thinking exercise based on selected societal problems.	**2P**

7	**Idea Generation and Concept Development** Brainstorming techniques, mind mapping, SCAMPER, reverse thinking, and lateral thinking. Evaluation of innovative ideas based on feasibility, novelty, impact, scalability, and sustainability. • Exercise: Generation and screening of multiple solution concepts.	**2P**
8	**Selection of Problem and Proposed Solution** Finalization of societal problem and innovative solution. Defining project objectives, expected outcomes, scope, and constraints. Feasibility analysis and risk assessment. • Activity: Submission and presentation of project proposal.	**2P**
9	**From Problem Identification to Solution Conceptualization** Development and refinement of innovative ideas to address identified societal or technological challenges. Conceptual design of proposed solutions using block diagrams, flowcharts, sketches, circuits, algorithms, and process workflows, as applicable. Evaluation of novelty, feasibility, societal impact, and scalability of the proposed idea. Discussion on possible pathways for future implementation and development. • Activity: Preparation and presentation of an innovative idea	**2P**
10	**Technology Readiness Levels (TRLs)** Introduction to Technology Readiness Levels. Understanding TRL-1 – TRL-9. Assessment and positioning of projects within appropriate TRL levels. Pathways for technology maturation and commercialization. • Exercise: TRL assessment of selected projects.	**2P**
11	**Project Documentation and Report Writing** Preparation of project report containing: • Abstract • Problem Statement • Literature Review • Proposed/Implemented Solution • Novelty of the Solution • Methodology • Budget Estimation Guidelines for technical writing, figures, tables, references, and citations. • Activity: Report preparation.	**2P**
12	**Concept Validation, Presentation and Evaluation** Refinement of the proposed solution based on mentor feedback. Preparation of conceptual design, workflow, block diagrams, flowcharts, sketches, circuit diagrams (where applicable), and feasibility analysis. Development of a roadmap for future prototype implementation and testing. Preparation of presentation slides and project pitch. Effective communication of innovative ideas to evaluators and stakeholders. • Final Presentation and Evaluation of the proposed innovative solution.	**2P**

Total	**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate between research, invention, and innovation, and apply design thinking principles to identify and define real-world problems.
2	Conduct literature surveys using scholarly databases and repositories, evaluate existing solutions, and identify research gaps for innovation.
3	Develop and evaluate innovative solution concepts for real-world problems through problem identification, research, feasibility assessment, and effective technical communication.
4	Present and defend innovative ideas effectively using appropriate technical documentation, visual aids, and professional communication skills.