



K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech. (R&A /Mechanical) Pattern 2023 Semester: III/ IV Code 2300201D: Applied Mathematics			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses: - Linear Algebra, Vector algebra, Differential calculus and Integral calculus.			
Course Objectives: Find General solution of higher-order linear differential equation with constant & Variable coefficient using different Methods. Find Laplace transform and Fourier transform of functions using definition & properties & solve Ordinary D.E. using L.T. Recognize nature of vector fields, use different vector differential operators& able to evaluate Line, surface &Volume integrals& its application Solve boundary value problems for Laplace’s equation, heat equation, the wave equation by separation of variables. Find Laplace transform and Fourier transform of functions using definition & properties & solve Ordinary D.E. using L.T			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Define and understand basic concept of L.D.E, PDE, Transforms, Statistics, Probability and Vector Calculus.		2-Understanding
CO2	Solve the problems on LDE, PDE, vector calculus using appropriate method.		3- Apply
CO3	Apply Statistics, Probability distributions and transforms to solve real life problems.		3- Apply
CO4	Analyze complex engineering problems by using concepts of differential calculus, Statistics, Probability distributions and Transforms.		4- Analyze
CO5	Evaluate the real life problems by using concepts of differential calculus, Statistics, Probability distributions and Transforms.		5 -Evaluate
COURSE CONTENTS			
Unit I	Transforms	(08hr)	COs Mapped CO1, CO3,CO4,CO5
Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT,			

Application of LT to solve LDE. Fourier Transform (FT): Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.			
Unit II	Linear Differential Equations with Constant Coefficient	(08hrs)	COs Mapped CO1, CO2,CO4,CO5
LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous DE.			
Unit III	Applications of Linear Differential Equations& Partial Differential Equations	(08hrs)	COs Mapped CO1, CO2,CO4,CO5
Modeling of Mass-spring systems, Free & Forced Damped and undamped systems. Basic concepts, method of separation of variables, modeling of Vibrating String, Wave equation, one- and two-dimensional Heat flow equations.			
Unit IV	Statistics and Probability	(08hrs)	COs Mapped CO1, CO3, CO4, CO5
Measures of central tendency, Measures of dispersion: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates. Probability, Probability distributions: Binomial, Poisson and Normal distributions			
Unit V	Vector Calculus	(08hrs)	COs Mapped – CO1, CO2,CO4,CO5
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoid and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stokes theorem.			
Text Books			
1. B.V. Ramana, “ Higher Engineering Mathematics ”, Tata McGraw-Hill. 2. B. S. Grewal, “ Higher Engineering Mathematics ”, Khanna Publication, Delhi. 3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley Eastern Ltd.			
Reference Books			
1. Advanced Engineering Mathematics, 7e, by peter V.O. Neil(Thomson Learning) 2. P. N. Wartikar and J. N. Wartikar, “Applied Mathematics” (Volumes I and II), Pune Vidyarthi Griha Prakashan, Pune. 3. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education). 4. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).			

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	--	--	--	--	--	--	--	--	--	2
CO2	3	2	1	--	1	--	--	--	--	--	--	2
CO3	3	2	1	--	1	--	--	--	--	--	--	2
CO4	3	2	1	1	1	--	--	--	--	--	--	2
CO5	3	2	1	1	1	--	--	--	--	--	--	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 15 M and total will be converted out of 05 M)	05
2	Problem solving through Computational Software	05
3	Tutorial (1 tutorial on each unit for 15 marks and total will be converted out of 05 M)	05
4	Group Presentation on real life problem	05

Topics for Tutorial		
Sr. No.	Title	CO Mapped
1	Examples on transforms	CO1, CO3, CO4, CO5
2	Examples on LDE of nth order with constant coefficients.	CO1, CO2, CO4, CO5
3	Examples on Applications of LDE & PDE	CO1, CO2, CO4, CO5
4	Examples on Statistics & Probability distributions.	CO1, CO3, CO4, CO5
5	Examples on Vector Calculus.	CO1, CO2, CO4, CO5

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S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312202 : Name of Subject: Electrical and Electronics System			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	In Sem Exam: 20 Marks End Sem Exam: 60 Marks CCE: 20 Marks
Prerequisite Courses: Fundamentals of Electronics Engineering, Fundamentals of Electrical Engineering			
Course Objectives: The Electrical and Electronics System solves challenges which are related to design of robots. This subject therefore provide sound foundation for robotics and automation engineering students which basically deals with the study of various electronics and electrical components and their application in robots.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Demonstrate a solid understanding of fundamental electronic concepts		2,3
CO2	Demonstrate the knowledge, skills, and practical experience necessary to effectively utilize the various electronic applications in robotics		2,3
CO3	Understand the basics fundamentals of DC machine.		2,3
CO4	Demonstrate machine performance for robotic applications		2,3
COURSE CONTENTS			
Unit I	Basics of Electronics Engineering	(07 hrs)	COs Mapped: CO1
Review of p-n junction diode, Introduction to BJT and MOSFETS (depletion & enhancement), Switching Devices, hybrid model for transistor at low frequencies. Digital and analog signals, number systems(ASCII, EBCDIC) Boolean algebra, Switching Theory: - Boolean Algebra Postulates and Theorems, De’ Morgan’s Theorem, Switching Functions- Canonical Forms- logic gates with simple applications, Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods.			

Unit II	Combinational Logic Circuits	(07 hrs)	COs Mapped: CO1, CO2
Review of basic gates- Universal gates, Adder, Subtractor. Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, Registers, ALU, PLA and PAL			
Unit III	Integrated circuits and Switching Devices	(07 hrs)	COs Mapped: CO1, CO2
Introduction, OPAMP as comparator, integrator, differentiator, buffer. Overview of IC 555 timer: pin configuration, internal block diagram, and operating modes (astable, monostable, and bistable), Understanding the timing functions of IC 555: frequency, duty cycle, and pulse width modulation (PWM). Introduction to relays: types of relays (electromechanical, solid-state), working principle, and applications			
Unit IV	D. C. Machines	(07 hrs)	COs Mapped: CO3
Introduction, Construction, working principle of D.C. generator, emf equation of D. C. generator, working principle of D.C. motor, types of D.C. motor, back emf, torque equation for D.C. motor, characteristics of D.C. motor (series and shunt only), methods for speed control of D.C. shunt and series motors, Braking of DC Motors, Effect of saturation and armature reaction on losses, Permanent Magnet DC Motors, Industrial applications.			
Unit V	Motors in robotics	(07 hrs)	COs Mapped: CO3, CO4
Introduction, Constructional feature, working principle of three phase induction motors, types, torque slip characteristics, efficiency, starters , methods of speed control, Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C(digital & core less) servomotors, universal motors, brushless DC motors, linear induction motors , industrial applications.			
Reference Books			
1."Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky Publisher: Pearson, ISBN-13: 978-0133983449 2. A.E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans, “Electric Machinery”, Tata McGraw Hill Publication, sixth edition, 2002. 3. P. C. Sen, “Principles of Electric Machines and Power Electronics “, John Wiley and Sons Publication, second edition 1997. 4. "Practical Electronics for Inventors" by Paul Scherz and Simon Monk ,Publisher: McGraw-Hill Education TAB , ISBN-13: 978-1259587542 5. "Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer, and Greg Moss, ISBN-13: 978-0134638942			

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Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 20 M and total will be converted out of 10 M)	10
2	Timely Assignment Submission	10

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S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312203: Name of Subject: Manufacturing Technology			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	In Sem Exam: 20 Marks End Sem Exam: 60 Marks CCE: 20 Marks
Prerequisite Courses: - Applied and Modern Physics			
Course Objectives: Understand the sand-casting process. Analyze the various metal forming processes. Understand the metal joining process. Understand advanced manufacturing process			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Classify various casting processes.		2. Understand
CO2	Describe various forming processes		2. Understand
CO3	Classify various metal joining processes		2. Understand
CO4	Explain various machining processes.		2. Understand
CO5	Apply robotics in manufacturing.		3. Apply
COURSE CONTENTS			
Unit I	Sand casting process	(07 hrs)	COs Mapped: CO1, CO5
Introduction of sand casting. Patterns, Pattern materials, pattern allowances and design. Core prints and core seats. Mould strength, Ingredients of molding materials and their effect on mould strength, testing of moulding sand. Melting: types of melting furnace, Solidification: progressive and directional solidification; rate of solidification Casting Design consideration, Metal pouring, Gating system. Principles of gating, design of gating system, solidification time, riser design, cleaning, finishing of casting. Defects and respective remedies in casting. Special Casting Process. Application of Robot in Sand Casting.			

Unit II	Material Forming 1	(07 hrs)	COs Mapped: CO2, CO5
Fundamentals of Material Forming: Introduction of forming processes. Concept of plastic deformation Classification of material forming process, Theory of plasticity, Rolling of Metals: Scope and importance of rolling. Types of Rolling Mills - Construction and working. Defects in rolling. Application of Robot in Rolling. Forging: Introduction, Classification of forging processes. Forging equipment- Hammers, presses, Upstter etc., construction, working Basic forging operations, Types of forging dies, Cleaning and finishing of forgings, Forging defects and the remedies. Application of Robot in Forging.			
Unit III	Material Forming 2	(07 hrs)	COs Mapped: CO2, CO5
Sheet Metal working processes: Classification of cutting and forming, Types of dies, Elements of press tools, Application of Robot in press working, Wire Drawing: Introduction to rod and wire drawing machines - construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Maximum reduction in wire in one pass, forces required in drawing. Extrusion: Types: Direct, Indirect, impact, hydrostatic extrusion. Dies for extrusion, stock preparation. Extrusion ratio, Circumscribing circle diameter (CCD), Shape factor. Equipment (with and without friction), extrusion defects. Application of Robot in Wire Drawing and Extrusion.			
Unit IV	Metal Joining Process	(07 hrs)	COs Mapped: CO3, CO5
Welding: Introduction & classification of welding processes, Types of Electrodes, coding of Electrodes, Electrode efficiency, fluxes, welding symbols. Arc welding processes, Tungsten inert gas (TIG), Metal Inert gas (MIG), Plasma arc, stud welding, Gas welding, Electric resistance welding: processes and equipment used, Spot, Seam, Projection welding, Resistance tube welding, - merits, limitations and applications. Solid state welding, Special welding processes: Laser, electron Beam welding, Thermit welding. Application of Robot in welding.			
Unit V	Machining Processes	(07 hrs)	COs Mapped: CO4, CO5
Turning, Milling, drilling Processes, Abrasive jet machining, Ultrasonic machining, Chemical machining, Electrochemical machining, Electro discharge machining, Electron beam machining, laser beam machining, Plasma arc machining, Ion Beam machining, wire cut EDM. Application of Robot in machining process			
Text Books			
1. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, “Elements of Workshop Technology” Vol I, II, Media Promoters, ISBN-10: 8185099154 2. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, “Elements of Workshop Technology” Vol I, Media Promoters, ISBN-10: 8185099154 3. R.K Jain., “Production Technology”, Khanna Publishers, 2008, ISBN 81-7409-099-1. 4. P.C Sharma., “A Text Book of Production Technology- Manufacturing Processes”, S.Chand & Co., 2008, ISBN: 81-219-111-4-1.			

Reference Books
1. Rao P.N., “Manufacturing Technology, Foundry, Forming and welding”, Tata McGraw-hill publishing, 2006, ISBN 0-07-463180-2.
2. Dieter, “Mechanical Metallurgy”, McGraw hill, ISBN0071004068.
3. Rowe G.W., “Principles of Industrial Metal Working Process”, Edward Arnold, ISBN8123904282.
4. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co., ISBN8176190020
5. KalpakjianSerope and Schmid Steven, “Manufacturing Engineering & Technology”, 2004. ISBN 10: 0131976397 ISBN 13: 9780131976399
6. Little Richard., “Welding & Welding Technology”, Tata Mc-graw hill, 1992,ISBN 0-07-099409-9.
7. Parmar R.S., “Welding Process and Technology”, 2ed., Khanna Publishers, ISBN-10: 8174091262, ISBN-13: 978-8174091260
8. HMT, “Production Technology”, Tata McGraw Hill Publishing Co., 1980. ISBN: 0-07- 096443-2
9. Degarmo, Black and Kosherth, “Materials & Processes in manufacturing”, 8thEdition, Prentice Hall of India Ltd, Delhi, 2002. ISBN: 8126525223

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	-	1	-	-	-	1	-	-	-	-	-
CO2	2	1	1	-	-	-	2	-	-	-	-	-
CO3	1	1	-	1	-	-	-	-	-	-	-	-
CO4	-	-	1	-	1	-	-	-	-	-	-	-
CO5	5	3	3	1	1	-	4	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 20 M and total will be converted out of 10 M)	10
2	Timely Assignment Submission (total will be converted out of 10 M)	10

S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312204 : Name of Subject: Computer Aided Design Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical:02hrs./week	02	Term work : 25Marks Oral :25 Marks
Prerequisite Courses: Engineering Graphics		
Course Objectives:		
Course Objectives	Description	
1	The course aims : Understand Fundamentals of Computer Aided Design.	
2	Understand Ability to use the software packers for drafting and modeling	
3	To Ability to create 2D and 3D models of Engineering Component	

Course Outcomes	Description	Blooms Level
	On completion of the course, students will be able to–	
CO1	Understand Ability to use the software packers for drafting and modeling.	2-Understand
CO2	Ability to read engineering drawings	4-Analyze
CO	Ability to create 2D and 3D models of Engineering Component	4-Analyze

Course context, Relevance, Practical Significance:

Computer Aided Drafting is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences. In the fields of mechanical or aeronautical engineering, the drawings of machine components and the layouts of them are prepared.

Course Contents: (Perform any 7)

Assignment/E xperiment	Contents	Pr.Hrs.
1	Introduction to CAD	2
2	CAD – Basics	2
3	2 - D Figures Using ACAD	2
4	Isometric Drawings Using ACAD	2
5	3-D Figures Using ACAD commands	2
6	Introduction to CREO	2
7	Exercises on CREO	2

Course Mapping:

Experiment	Contents	CO-mapped	PO mapped	PSO mapped
1	Introduction to CAD	1,2	1,2	1
2	CAD – Basics	1,2	1,2	1
3	2 - D Figures Using ACAD	2	1,2,	1
4	Isometric Drawings Using ACAD	2,3	1,2,	1
5	3-D Figures Using ACAD commands	2,3	1,2	1
6	Introduction to CREO	2,3	1,2	1
7	Exercises on CREO	2,3	1,2	1

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S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312205 : Name of Subject: Electrical and Electronics System Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03hrs/week	03	TW: 50 PR:50
Prerequisite Courses: Fundamentals of Electronics Engineering, Fundamentals of Electrical Engineering		
Course Objectives: The Electrical and Electronics System solves challenges which are related to design of robots. This subject therefore provide sound foundation for robotics and automation engineering students which basically deals with the study of various electronics and electrical components and their application in robots.		
Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level
CO1	Demonstrate a solid understanding of fundamental electronic concepts	2
CO2	Demonstrate the knowledge, skills, and practical experience necessary to effectively utilize the various electronic applications in robotics	2,3
CO3	Understand the basics fundamentals of DC machine.	3,4
CO4	Demonstrate machine performance for robotic applications	3,4

Sr. No.	Contents	Pr. Hrs.
1	To identify various electronic components with specifications	2
2	Study of different switches with power supply module.	2
3	To Study Transistor Input / Output Characteristics	2
4	Study of Relays.	2
5	Build and test op-amp as buffer circuit	2
6	Build and test op-amp as integrator circuit	2
7	Implementation of adder using logic gates.	2
8	Study of IC 555 (astable , monostable)	2
9	Speed control of DC motor	2
10	Load test on 3 phase Induction Motor	2
11	Study of DC servo motors	2
12	Study of stepper motors	2

Strength of CO-PO Mapping

	PO												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	-	1	-	-	-	1	-	-	-	-	-	2	1

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S. Y. B. Tech.			
Pattern 2023 Semester : III			
Course Code: 2312206		Course Name: Numerical Methods	
Teaching Scheme:	Credit Scheme:	Examination Scheme:	
Theory :03hrs/week	03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks	
Prerequisite Courses: - Basic Mathematics			
Course Objectives: 1. Understand statistical hypothesis testing and its use in decision-making. 2. Learn to design experiments and analyze data using ANOVA and factorial designs. 3. Apply numerical methods to solve real-world algebraic, transcendental, and linear equations. 4. Develop skills in curve fitting, including the least squares criterion and interpolation methods. 5. Master numerical techniques for differentiation, integration, and solving differential equations for engineering and scientific problem-solving.			
Course Outcomes: On completion of the course, students will be able to			
	Course Outcomes	Bloom's Level	
CO1	Perform hypothesis testing in statistics	2	
CO2	Design the experiments based on the processes parameters.	3	
CO3	Establish the co-relation between input factors and performance measure using regression analysis and interpolation methods	3	
CO4	Use numerical method to solve the simultaneous equations, complex algebraic & transcendental equation, integration and differentiation.	3	
COURSE CONTENTS			
Unit I	Statistical hypothesis and tests	(7hrs)	Cos Mapped CO1
Testing of Hypothesis Sampling distributions - Estimation of parameters, Statistical hypothesis, Large sample tests based on Normal distribution for single mean and difference of means,-Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit			
Unit II	Design and Analysis of Experiments	(7hrs)	Cos Mapped CO2
Design and Analysis of Experiments: Importance of experiments, Experimental strategies, Basic Principles of Design Terminology, ANOVA, steps in experimentation, two and three full Factorial experiments, Taguchi Methods, Design using Orthogonal Arrays, S/N ratios, Data Analysis			

Unit III	Numerical Solutions of algebraic, transcendental and Linear Simultaneous Equations	(7hrs)	Cos Mapped CO3
Errors and error propagation in numerical techniques, Numerical solution of algebraic and transcendental equations: Bisection method, Newton Raphson Method. Numerical solution of Linear Simultaneous Equations: Gauss Elimination Method, Gauss-Seidel Method			
Unit IV	Methods of curve fitting	(7hrs)	Cos Mapped CO4
Numerical methods - Curve Fitting, methods of curve fitting. Least square criterion- 1st and 2nd order Interpolation: Lagrange's formula, Newton forward difference method. Methods of moment for curve fitting, Interpolation techniques: Newtons forward difference method, Lagrange interpolation polynomial			
Unit V	Numerical Differentiation and integration	(7hrs)	Cos Mapped CO4
Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules, Ordinary Differential Equations: Runge-Kutta Method. Partial Differential Equations -Finite difference method			
Text Books			
1. Jaan Kiusalaas, Numerical Methods in Engineering with Matlab, Cambridge University press. 2. S. S. Rao, Engineering Optimization: Theory and Practice, New Age International, 2000, ISBN: 9788122411492			
Reference Books			
1. Douglas C. Montgomery, Design and analysis of experiments, John Wiley and sons inc. New York 8th edition. 2. S.C. Chapra, R.P. Canale, —Numerical Methods for engineers with programming and software applications, Tata McGraw Hill Co. Ltd, New Delhi, ISBN 0071158952. 3. Dr. Sadhu Singh, Computer aided Design and Manufacturing , Khanna Publication, New Delhi. 4. Ramin S. Esfandiari, Numerical Methods for Engineers and Scientists Using MATLAB, CRC press, Taylor and Francis group.			

Strength of CO-PO Mapping														
	PO													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	1	-	-	1	-	-	2	-	-	-	1	-
CO2	3	3	2	-	-	2	-	1	3	-	-	2	1	-
CO3	2	1	3	1	-	2	-	1	3	-	-	2	1	-
CO4	2	1	1	3	3	1	-	2	2	1	-	2	1	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on each Unit	10
2	LMS Test on Each Unit	10
	Total	20

S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III Course Code: 2312207 Course Name: Numerical Method Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 hrs. /week	01	Term work : 25 Marks Practical : 25 Marks
Prerequisite Courses: Basic Mathematics		
Course Objectives:		
Course Objectives	Description	
1	Understand statistical hypothesis testing and its use in decision-making.	
2	Learn to design experiments and analyze data using ANOVA and factorial designs.	
3	Apply numerical methods to solve real-world algebraic, transcendental, and linear equations.	
4	Develop skills in curve fitting, including the least squares criterion and interpolation methods.	
5	Master numerical techniques for differentiation, integration, and solving differential equations for engineering and scientific problem-solving.	

Course Outcomes:

Course Outcomes	Description
1	Perform hypothesis testing in statistics
2	Design the experiments based on the processes parameters.
3	Establish the co-relation between input factors and performance measure using regression analysis and interpolation methods
4	Use numerical method to solve the simultaneous equations, complex algebraic & transcendental equation, integration and differentiation.

Course context, Relevance, Practical Significance:

The Statistical and Numerical Methods course teaches students fundamental skills in data analysis, experimental design, and mathematical problem-solving. It covers statistical hypothesis testing for informed decision-making, experimental design techniques such as ANOVA, and factorial designs. Additionally, students learn numerical methods for solving equations and curve fitting techniques for accurate data modeling. The course also includes numerical techniques for differentiation, integration, and solving differential equations. Overall, it emphasizes the practical application of statistical and numerical methods across diverse fields.

Course Contents:

Sr. No.	Contents	Pr. Hrs.
1	Practical on parameter optimization of any one process using Taguchi based design of experiment. Validation of results using any statistical software	2
2	Practical on determination of significant factors for any one process using ANOVA. Validation of results using any statistical software.	2
3	Practical case study on regression analysis. (Data should be collected for some real life case). Validation of results Validation of results using any statistical software.	2
4	Practical case study on regression analysis. (Data should be collected for some real life case).	2
5	C/python Programming for any one Interpolation method	2
6	C/python Programming for numerical integration and differentiation	2

Course Mapping:

Assignment/ Experiment	Contents	CO- mapped	PO mapped	PSO mapped
1	Practical on parameter optimization of any one process using Taguchi based design of experiment. Validation of results using any statistical software	1	1,2	1
2	Practical on determination of significant factors for any one process using ANOVA. Validation of results using any statistical software.	2	1,2	1
3	Practical case study on regression analysis. (Data should be collected for some real life case). Validation of results Validation of results using any statistical software.	3	1,2	1
4	Practical case study on regression analysis. (Data should be collected for some real life case).	3	1,2	1
5	C/python Programming for any one Interpolation method	4	1,2	1
6	C/python Programming for numerical integration and differentiation	4	1,2	1

S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312208: Name of Subject: Sociology of tourism			
Teaching Scheme	Course Type	Credit Scheme	Examination Scheme:
Theory :02 hrs/week	Open Elective	02	Continuous Comprehensive Evaluation: 50 Marks
Prerequisite Courses: NA			
Course Objectives:			
Sr.No.	Description		
1	Explain the impacts of tourism on communities and environments, and analyze them critically.		
2	Explore power dynamics and social interactions within tourism contexts, considering issues of gender, race, and class.		
3	Develop sustainable tourism strategies and ethical practices to minimize negative impacts and empower local communities.		
4	Evaluate tourism policy frameworks and propose recommendations for enhancing destination management and sustainability.		
5	Apply theoretical knowledge and empirical research to address emerging trends and challenges in tourism sociology, and effectively communicate recommendations.		
Course Outcomes:			
Course Outcomes	Description Student will be able to:		
CO1	Describe the theoretical perspectives commonly used to analyse tourism phenomena, and explain their relevance in understanding tourist behaviour.		
CO2	Apply theoretical frameworks to analyse power dynamics within tourism contexts, and propose strategies for promoting social equity and inclusivity.		
CO3	Analyse the socio-cultural impacts of tourism on local communities, and propose strategies for cultural preservation and community empowerment.		
CO4	Assess the environmental impacts of tourism activities, and devise action plans to minimize ecological footprints and promote conservation efforts		
CO5	Develop effective communication skills to engage with stakeholders and advocate for responsible tourism practices, considering ethical and cultural sensitivities.		

Course context, Relevance, Practical Significance:

Sociology provides invaluable insights into tourism by examining the social dynamics that shape travel patterns, behaviors, and experiences. It explores how tourism intersects with issues such as culture, identity, inequality, and globalization, shedding light on the complex relationships between tourists, host communities, and the industry. Through sociological perspectives, researchers and practitioners in tourism can better understand the societal impacts of tourism development, including its effects on local economies, environments, and social structures.

Course Contents:

Unit	Contents	Lecture Hrs.
1	Unit 1: Introduction to Sociology and Tourism Introduction to Sociology and Tourism: Definitions and Scope, Theoretical Foundations: Sociological Perspectives on Tourism, Understanding Tourist Behaviour: Motivations and Decision-making Processes, Socio-cultural Impacts of Tourism: Identity, Authenticity, and Commodification	7
2	Unit 2: Tourism Development and Social Change Historical Evolution of Tourism: From Pilgrimages to Mass Tourism, Tourism and Economic Development: Employment, Income, and Inequality, Tourism and Social Change: Modernization vs. Dependency Perspectives, Case Studies: The Role of Tourism in Shaping Local Communities.	7
3	Unit 3: Tourism and Society Social Interactions in Tourist Spaces: Host-Guest Relationships, Power Dynamics in Tourism: Gender, Race, and Class, Tourism and Social Integration: Bridging Cultural Divides, Tourism and Social Conflict: Environmental Concerns and Resistance Movements.	7
4	Unit 4: Sustainable Tourism and Ethical Considerations Principles of Sustainable Tourism Development, Ecotourism and Community-Based Tourism Initiatives, Responsible Tourism Practices: Minimizing Negative Impacts, Ethical Issues in Tourism: Human Rights, Cultural Appropriation, and Exploitation.	7
5	Unit 5: Tourism Policy and Governance Tourism Policy Formation and Implementation, Destination Management Organizations and Tourism Planning, Governance Structures in Tourism: Public-Private Partnerships, Future Trends and Challenges in Sociology of Tourism	7

Course Mapping:

Unit	Contents	Blooms Taxonomy Level	CO-mapped	PO mapped	PSO mapped
1	Introduction to Sociology and Tourism	2	1	1,6	--
2	Tourism Development and Social Change	2,3	3	3,6,9	--
3	Tourism and Society	2,3	2	2,6,9	--

4	Sustainable Tourism and Ethical Considerations	3,4	4	4,7,11	--
5	Tourism Policy and Governance	3,4	5	5,8,10	--

References Books:

1. Title: "Sociology of Tourism: An Introduction" Author: Nigel Morgan and Annette Pritchard Publisher: Routledge ISBN: 978-1138010760.
2. Tourism: Principles, Practices, Philosophies" by Charles R. Goeldner and J.R. Brent Ritchie
ISBN-13: 978-0470648470.
3. "Tourism: A Critical Business" by Jean-Christophe Graz and Charles W. Hunt
ISBN-13: 978-0415631075.
4. "The Sociology of Tourism: Theoretical and Empirical Investigations" by Yiorgos Apostolopoulos, Stella Leivadi, and Andrew Yiannakis, ISBN-13: 978-0415349165.
5. "Tourism and Leisure Research Methods: Data Collection, Analysis, and Interpretation" by Mick Cope, ISBN-13: 978-1910158835.



K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: III 2312209: Name of Subject: Democracy			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :02 hrs/week		Tutorial: 02	CCE: 50 Marks
Prerequisite Courses: - Introduction to Political Science, Introduction to Law and Governance			
Course Objectives: - Understand the concept, principles, and various forms of democracy. - Analyse the functioning of democratic institutions and their roles in governance. - Evaluate the importance of rights, liberties, and citizenship in democratic societies. - Critically assess challenges and critiques faced by democratic systems.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Understand the concept, principles, and various forms of democracy.		2. Understand
CO2	To critically analyze the roles and mechanisms of democratic institutions in the governance process.		2. Understand
CO3	Evaluate the importance of rights, liberties, and citizenship in democratic societies.		2. Understand
CO4	Critically assess challenges and critiques faced by democratic systems		2. Understand
CO5	Apply theoretical knowledge to real-world democratic contexts and issues.		3. Apply
COURSE CONTENTS			
Unit I	Introduction to Democracy	(07 hrs)	COs Mapped: CO1
Definition and conceptual understanding of democracy, Historical evolution of democracy, Different forms of democracy (representative, direct, deliberative, etc.), Theoretical frameworks and ideologies underlying democracy (liberal democracy, social democracy, etc.).			

Unit II	Institutions of Democracy	(07 hrs)	COs Mapped: CO2, CO5
The role and functions of key democratic institutions (legislature, executive, judiciary), Electoral systems and political parties, Civil society organizations and their significance in democratic governance, Media and its role in democracy.			
Unit III	Rights and Liberties in Democracy	(07 hrs)	COs Mapped: CO3, CO4
Fundamental rights and liberties in democratic societies, Human rights and their protection mechanisms, Equality, diversity, and inclusion in democratic contexts, Challenges to rights and liberties in contemporary democracies.			
Unit IV	Democratic Participation and Citizenship	(07 hrs)	COs Mapped: CO1, CO5
Participation mechanisms in democracy (voting, activism, advocacy, etc.), Role of citizens in democratic governance, Citizenship education and civic engagement, Emerging trends in citizen participation (online activism, social movements, etc.)			
Reference Books			
1. Chandra, Bipan. India's Struggle for Independence. New Delhi: Penguin Books India, 1989. 2. Khilnani, Sunil. The Idea of India. New York: Farrar, Straus and Giroux, 1997. 3. Choudhry, Sujit, ed. The Oxford Handbook of the Indian Constitution. Oxford: Oxford University Press, 2016. 4. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. New Delhi: Oxford University Press, 1999.			

Strength of CO-PO Mapping

	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-
CO4	-	-	-	-	1	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	-	1	1	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 20 M and total will be converted out of 30 M)	30
2	Timely Assignments Submission on each unit (5 M for each unit)	20

S. Y. B. Tech. Pattern2023Semester:III ROB2312210: Name of Subject: Basic Robotics Workshop		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial:01 Practical:02hrs./week	02	TU: 25 Marks TW:25Marks
Prerequisite Courses, if any:- Fundamentals of mechanical Engineering, Electronics Engineering.		
Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level (Cognitive domain)
CO1	Identifyvariouselectronicsandmechanicalcomponentsusedinroboticssystems.	2–Understand
CO2	Demonstrate PCB design and manufacturing or simple circuits.	3–Apply
CO3	Execute PLC circuit for simple applications.	3-Apply
CO4	Configure ARDUINO and Raspberry Pi kits for given applications.	4–Analyze

List of Laboratory Experiments/Assignments		
Sr. No.	Laboratory Experiments/Assignments	CO Mapped
1.	Introduction to Input Devices: Demonstration and hands on practice of various types of sensors such as, Temperature sensors, gas sensors, humidity sensors, LVDT, Strain Gauge, IR Sensors, Proximity etc.	CO1
2	Introduction to output Devices: Demonstration and hands on practice of LED and LCD display, servomotors, types of motors, relays.	CO1
3	PCB Design and manufacturing.	CO2
4	Introduction to PLC and hands on training on PLC trainer.	CO3
5	Demonstration of mechanical parts such as gears, bearings, pulleys, drives etc. and their specifications.	CO1
6	Introduction to ARDUINO and RaspberryPi.	CO4

Unit	Contents	CO-mapped	PO mapped	PSO mapped
1	Introduction to Input Devices: Demonstration and hands on practice of various types of sensors such as, Temperature sensors, gas sensors, humidity sensors, LVDT, Strain Gauge, IR Sensors, Proximity etc.	1	1,3,5,9,12	1, 2
2	Introduction to output Devices: Demonstration and hands on practice of LED and LCD display, servomotors, types of motors, relays.	1	1,3,5,9,12	1, 2
3	PCB Design and manufacturing.	2	1,3,5,9,12	1, 2
4	Introduction to PLC and hands on training on PLC trainer.	3	1,3,5,9,12	1, 2
5	Demonstration of mechanical parts such as gears, bearings, pulleys, drives etc. And their specifications.	1	1,3,5,9,12	1, 2
6	Introduction to ARDUINO and Raspberry Pi.	4	1,3,5,9,12	1, 2

S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: IV 2312211: Name of Subject: Robot Operating System		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks
Prerequisite Courses: Programming in C		
Course Objectives:		
Course Objectives	Description	
1	To introduce students with fundamental concepts and theory of robotic automation	
2	To articulate the use of different types of devices to which robotic modules are connected	
3	To demonstrate the knowledge about understanding of various types of robotic applications	
4	To apply and analyses industry based project & advanced learning.	

Course Outcomes	Description Student will be able to:	Blooms level
1	Describe message communication of robot operating system.	2 – Understand
2	Demonstrate robot operating commands.	3 – Apply
3	Program and simulate robot applications.	3 – apply
4	Write the program for G-mapping in robot.	3 – Apply
5	Interface robot with embedded systems.	3 – Apply
6	Differentiate between process of ROS 1 and ROS2.	4- Analyze

Course context, Relevance, Practical Significance:

Robot Operating System provides libraries and tools to help software developers create robot applications. It includes hardware abstraction, device drivers, libraries, visualizers, message passing, package management, and more. ROS is being used for many of the world's most exciting and capable robots. The developer community and support for using ROS with robots now makes this an excellent choice for a large variety of industrial applications.

Course Contents:

Unit	Contents	Lecture Hrs.
1	Introduction to Robot Operating System Introduction, Meta-operating system , Objective of Ros ,Components of Ros, Ros ecosystem , History of Ros , Ros versions ,Ros Terminology , Message Communication, Coordinate Transformation, File system, Build System.	7
2	ROS Commands and Tools	7

Unit	Contents	Lecture Hrs.
	Ros differnet Command list Ros shell commands ,Ros execution commands, Ros Information commands Ros catkin commands Ros package commands,Basic ROS Programming, Standard Unit, Coordinate Representation, Programming Rules.Creating and Running Publisher and Subscriber Nodes Tools:3D Visualisation Tool (Rviz) , Ros GUI development Tool (rqt): Installing and Running rqt ,rqt Plugins ,rqt_image_view ,rqt_graph ,rqt_plot, Introduction, Manipulator Structure and Control, Manipulator and ROS, Open Manipulator Modelling and Simulation, Gazebo Setting Move It, move group, Move It , Setup Assistant, Gazebo Simulation Applying to the Actual Platform, Service robots: Delivery service robots.	
3	ROS Embedded system OpenCR: Characteristics, Board Specification, Establish Development Environment, Rosserial: roserial server, roserial client, roserial Protocol, Constraints of roserial, Installing roserial, Examples of roserial.TurtleBot3 Firmware: Hardware, Software, Development environment, Remote Control, Simulation using RViz.	7
4	Navigation and Slam Navigation and Components, Navigation of Mobile Robot, Map, Pose of Robot, Sensing, Path Calculation and Driving, SLAM Practice, Robot hardware Constraints for SLAM, Measured Target Environment of SLAM,ROS Package for SLAM, Execute SLAM,SLAM Application, SLAM process, Coordinate Transformation (TF). Actual Platform, Service robots: Delivery service robots	7
5	Introduction to ROS 2 Overview of ROS 2-Introduction to ROS 2 , its key features & Comparison between ROS 1 and ROS 2 , ROS 2 Architecture, ROS 2 Development Tools, ROS 2 command-line tools for package management, Introduction to ROS 2 launch system and launch files, Building and deploying ROS 2 nodes and packages	7

Course Mapping:

Unit	Contents	Blooms Taxonomy Level	CO-mapped	PO mapped	PSO mapped
1	Introduction to Robot Operating system	1,2	1,5	1,3,7	1, 2
2	ROS Commands and Tools	2,3	2,5	1,3,7	1, 2
3	ROS Embedded system	2,3,4	3,5	1,2,4	1, 2
4	Navigation and Slam	2,3,4	4,5	1,2,3,5,7	1, 2
5	Introduction to ROS 2	2,4	6	1,2,3,5	1, 2

Reference Books:

1. Jason M. O’Kane, A Gentle Introduction to ROS, independently published, ISBN 9781492143239
2. Lentin Joseph, “Robot Operating System (ROS) for Absolute Beginners”, Apress Publication, ISBN: 9781484234044.
3. Morgan Quigley, Brian Gerkey, William D. Smart, “Programming Robots with ROS”, O’ReillyMedia Inc., ISBN: 9781449325503
4. C. Fairchild, T. L. Harman, “ROS Robotics by Example” Pakt Publishing, ISBN: 9781785286704



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S. Y. B. Tech.			
Pattern 2023 Semester: IV			
Course Code : 2312212		Course Name : Computer Graphics for Robotics	
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses: - Applied Mathematics I, Applied Mathematics II, Engineering Drawing, Computational Thinking and C- programming,			
Course Objectives: 1. To introduce students with fundamental concepts and theory of computer graphics. 2. To articulate the use of 2D and 3D interpolation methods for computer graphics 3. To demonstrate the applications of 2D and 3D transforms for robot kinematics 4. To present mathematical elements of important curves and surfaces			
Course Outcomes: On completion of the course, students will be able to			
	Course Outcomes		Bloom's Level
CO1	Describe the basics of different graphics systems and analytic geometry.		2 – Understand
CO2	Use of geometric transformations on graphics objects and their application in robot kinematics analysis.		3- apply
CO3	Demonstrate the application of Bezier curves and interpolation in robot path planning		3- apply
CO4	Apply concept of geometric algebra for modelling in robotic physics		3- apply
COURSE CONTENTS			
Unit I	Analytic geometry	(7hrs)	Cos Mapped CO1
2D analytic geometry - mathematical representation of line, conic sections, intersection of 2D lines intersection of line and circle, 3D analytic geometry - mathematical representation of 3D line, planes intersection of 3D lines, intersection of planes. Hidden surface removal.			
Unit II	Transforms:	(7hrs)	Cos Mapped CO2
Introduction to 2D and 3D transforms: Scaling, shear, rotation, reflection, Concept of homogenous co ordinates, General Rotation and general reflection matrix, Concatenated matrices, Application of 3D transformation to robotics: Cylindrical robot, Application of 3D transformation to robotics: Spherica robot/SCARA robot			
Unit III	Interpolation:	(7hrs)	Cos Mapped CO2

Linear interpolation, Lagrange interpolation, Spline interpolation, Spatial interpolation: Inverse distance weighted method, Nearest neighbour, Natural neighbour, Shape function, Cubic interpolation, Interpolating quaternion

Unit IV	Curves and Surfaces	(7hrs)	Cos Mapped CO3
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Bezier curves. B-spline, 3D surfaces, Surfaces of revolution, Seep surfaces, Bezier Surface Patch, Applications of Bezier and Beta spline curves for robot path planning

Unit V	Geometric Algebra	(7hrs)	Cos Mapped CO4
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Geometric products in 2D, geometric product in 3D, outer product of 3D vectors, axioms, inverse of vectors, reflection and rotation, applied geometric algebra for modelling of robotics physics

Reference Books

1. Jon Vince, Mathematics for Computer Graphics, Springer, ISBN: : 978-1-84628-034-4
2. Chopra Rajiv, "Computer Graphics", S. Chand and Co. Pvt. Ltd., ISBN: 81-219-3581-4
3. Roger D, Adams A. J. "Mathematical elements for computer graphics", McGraw Hill Education, ISBN: 978- 0070486775
4. Davis Martin J, "Computer Graphics", Nova science Publishers, ISBN: 9781617618116

Strength of CO-PO Mapping														
	PO													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	2	2	3	-	-	2	2	3	-	2	1	-
CO2	2	-	3	3	3	3	-	2	2	3	-	2	1	-
CO3	2	-	3	3	3	3	-	2	2	3	-	3	1	-
CO4	2	-	3	3	3	3	-	2	2	3	-	3	1	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on each Unit	10
2	LMS Test on Each Unit	10
	Total	20



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S. Y. B. Tech. Robotics and Automation Pattern 2023, Semester: IV 2312213: Name of Subject: Design of Machines and Mechanisms			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	In Sem Exam: 20 Marks End Sem Exam: 60 Marks CCE: 20 Marks
Prerequisite Courses: - Basic knowledge of physics and mathematics, Understanding of mechanics and kinematics, Familiarity with CAD software (preferred)			
Course Objectives: Understand the fundamental principles of machine and mechanism design. Apply kinematic and dynamic analysis techniques to evaluate and design mechanisms. Design and analyse various types of gearing systems for specific robotic applications. Develop proficiency in CAD software for modelling and simulating machine components. Design robotic manipulators with consideration for performance, accuracy, and workspace. Apply optimization techniques to enhance the efficiency and functionality of robotic systems.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Understand the fundamental principles of machine and mechanism design.		2. Understand
CO2	Understand kinematic and dynamic analysis techniques for evaluating and designing mechanisms.		2. Understand
CO3	Understand the design and analysis of gearing systems for specific robotic applications.		2. Understand
CO4	Understand the principles of CAD software for modeling and simulating machine components.		2. Understand
CO5	Apply optimization techniques to enhance the efficiency and functionality of robotic systems.		3. Apply
COURSE CONTENTS			
Unit I	Introduction to Machine Design and Kinematic Analysis	(07 hrs)	COs Mapped: CO1, CO2
Introduction to machine design process, Design considerations and constraints, Material selection and properties, Safety factors and reliability, Degrees of freedom and mobility analysis, Position, velocity, and acceleration analysis, Graphical and analytical methods for kinematic analysis, Application to robotic manipulators.			

Unit II	Linkage Synthesis and Gearing Systems	(07 hrs)	COs Mapped: CO1, CO3
Design requirements and specifications, Four-bar linkage synthesis, Function generation and path synthesis, Optimization techniques in linkage design, Types of gears and gear trains, Gear tooth profiles and design considerations, Gear ratio and transmission efficiency, Design of gearboxes for robotic applications.			
Unit III	Design of Robotic Manipulators	(07 hrs)	COs Mapped: CO1, CO5
Classification of robotic manipulators, Forward and inverse kinematics, Jacobian matrix and velocity analysis, Trajectory planning and control strategies.			
Unit IV	Mechanism Dynamics and Design Optimization	(07 hrs)	COs Mapped: CO2, CO5
Analysis of dynamic forces and moments, Inertia forces and torques in mechanisms, Dynamic balancing techniques, Vibration analysis and control, Introduction to optimization methods, Single and multi-objective optimization, Optimization algorithms and their applications, Case studies in design optimization for robotics.			
Unit V	CAD Modeling for Machine Design	(07 hrs)	COs Mapped: CO1, CO4
Introduction to CAD software, 2D and 3D modeling techniques, Assembly modeling and kinematic simulation, Finite element analysis for structural analysis, Review of real-world examples of machine and mechanism design in robotics and automation, Analysis of successful design solutions and challenges faced.			
Text Books			
1. Norton, Robert L. Design of Machinery. McGraw-Hill Education, 2020. 2. Shigley, Joseph E., and John J. Uicker Jr. Theory of Machines and Mechanisms. Oxford University Press, 2016. 3. Sclater, Neil, and Nicholas Chironis. Mechanisms and Mechanical Devices Sourcebook. McGraw-Hill Professional, 2011. 4. Siciliano, Bruno, and Lorenzo Sciavicco. Robotics: Modelling, Planning and Control. Springer, 2016.			
Reference Books			
1. Erdman, Arthur G., and George N. Sandor. Mechanism Design: Analysis and Synthesis. Pearson, 2001. 2. Uicker, John J., Gordon R. Pennock, and Joseph E. Shigley. Theory of Machines and Mechanisms. Oxford University Press, 2003.			

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	-	1	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	1	-	-	-	-	-	-	-
CO4	-	1	-	-	1	-	-	-	-	-	-	-
CO5	1	-	-	1	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 20 M and total will be converted out of 10 M)	10
2	Timely Assignment Submission on each unit (total will be converted out of 10 M)	10

S. Y. B. Tech. Robotics and Automation Pattern 2022, Semester: IV 2312214: Name of Subject: Robot Operating System Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02 hrs./week	01	Term work : 25 Marks Practical : 25 Marks
Prerequisite Courses: Programming in C		
Course Objectives:		
Course Objectives	Description	
1	To introduce students with fundamental concepts and theory of robotic automation	
2	To articulate the use of different types of devices to which robotic modules are connected	
3	To demonstrate the knowledge about understanding of various types of robotic applications	
4	To apply and analyses industry based project & advanced learning.	

Course Outcomes	Description	Blooms level
	Student will be able to:	
1	Describe message communication of robot operating system.	2 – Understand
2	Demonstrate robot operating commands.	3 – Apply
3	Program and simulate robot applications.	3 – apply
4	Implement 3D models in any CAD tools to interface with ROS visualization.	3 – Apply
5	Interface robot with embedded systems.	3 – Apply
6	Differentiate between process of ROS 1 and ROS2.	4- Analyze

Course context, Relevance, Practical Significance:

Robot Operating System provides libraries and tools to help software developers create robot applications. It includes hardware abstraction, device drivers, libraries, visualizers, message passing, package management, and more. ROS is being used for many of the world's most exciting and capable robots. The developer community and support for using ROS with robots now makes this an excellent choice for a large variety of industrial applications.

Course Contents:

Sr. No.	Contents	Pr. Hrs.
1	ROS Essentials: Introduction to ROS Topics, Services, Actions and Nodes.	2
2	Simple interaction with the course simulation environment. I) Creating Catkin workspace & Packages. ii) Perform message communication by using ROS publishing and subscribing Model.	2
3	Implement STL files for any 3 D Models in any CAD tool.	2
4	Building robot environment: Software representation of a Robot using Unified Robot Description Format (URDF), ROS parameter server and adding real-world object representations to the simulation environment	2
5	Autonomous Navigation: Map creation with G Mapping package, autonomously Navigate a known map with ROS navigation.	2
6	Manipulation: Motion planning, pick and place behaviors using industrial robots with ROS Move It	2
7	Simple interaction with ROS 2 simulation Environment Setup.	2

Course Mapping:

Assignment/ Experiment	Contents	CO-mapped	PO mapped	PSO mapped
1	ROS Essentials: Introduction to ROS Topics, Services, Actions and Nodes.	1,5	1,3,5,7	1, 2
2	Simple interaction with the course simulation Environment. i) Creating Catkin workspace & Packages. ii) Perform message communication by using ROS publishing and subscribing Model.	2,5	1,3,5,7	1, 2
3	Implement STL files for any 3 D Models in any CAD tool.	4	1,3,5	1,2
4	Building robot environment: Software representation of a Robot using Unified Robot Description Format (URDF), ROS parameter server and adding real-world object representations to the simulation environment	3,5	1,2,4,5,6,7, 9,12	1, 2
5	Autonomous Navigation: Map creation with G Mapping package, autonomously navigate a known map with ROS navigation.	4,5	1,2,3,5,6,7, 9,12	1, 2
6	Manipulation: Motion planning, pick and place behaviors using industrial robots with ROS Move It	4,5	1,2,3,5,6,7, 9,12	1, 2
7	Simple interaction with ROS 2 simulation Environment Setup.	6	1,2,3,5,9,12	1, 2

S. Y. B. Tech. Pattern 2023 Semester: IV Course Code : 2312215 Course Name : Computer Graphics for Robotics Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 hrs. /week	01	Term work : 50 Marks Practical : 50 Marks
Prerequisite Courses: Applied Mathematics I, Applied Mathematics II, Engineering Drawing, Computational Thinking and C- programming,		
Course Objectives:		
Course Objectives	Description	
1	To introduce students with fundamental concepts and theory of computer graphics.	
2	To articulate the use of 2D and 3D interpolation methods for computer graphics	
3	To demonstrate the applications of 2D and 3D transforms for robot kinematics	
4	To present mathematical elements of important curves and surfaces	

Course Outcomes:

Course Outcomes	Description
1	Describe the basics of different graphics systems and analytic geometry.
2	Use of geometric transformations on graphics objects and their application in robot kinematics analysis.
3	Demonstrate the application of Bezier curves and interpolation in robot path planning
4	Apply concept of geometric algebra for modelling in robotic physics

Course context, Relevance, Practical Significance:

This course, "Computer Graphics for Robotics," provides students with foundational knowledge and skills in computer graphics tailored to robotics applications. In today's technological landscape, robotics is increasingly prevalent across industries, driving the demand for engineers with expertise in designing, simulating, and optimizing robotic systems. Computer graphics are integral to visualizing and analyzing these systems.

Course Contents:

Sr. No.	Contents	Pr. Hrs.
1	Creating 2D and 3D graphic elements	2
2	Forward kinematics of planer robot using 2D transformation	2
3	Forward kinematics of articulated/SCARA robot using 2D transformation	2
4	Generating Curves and Surfaces using Interpolation	2
5	2D curve generation: Bazier, β spline	2
6	3D surface generation: Surface of revolution, sweep surface	2
7	Algorithm for hidden surface removal	2

Course Mapping:

Assignment/ Experiment	Contents	CO- mapped	PO mapped	PSO mapped
1	Creating 2D and 3D graphic elements	1	1,2	1
2	Forward kinematics of planer robot using 2D transformation	2	1,2	1
3	Forward kinematics of articulated/SCARA robot using 2D transformation	2	1,2	1
4	Generating Curves and Surfaces using Interpolation	3	1,2	1
5	2D curve generation: Bezier, β spline	3	1,2	1
6	3D surface generation: Surface of revolution, sweep surface	4	1,2	1
7	Algorithm for hidden surface removal	4	1,2	1



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S. Y. B. Tech. Pattern 2023 Semester: IV Course Code : 2312216 Course Name : Artificial Neural Network and Fuzzy System			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses: - Linear algebra, differential calculus, statistical and numerical methods			
Course Objectives: 1. Understand how neural networks mimic the brain's behavior and learn about their basic structure and training methods. 2. Master the backpropagation algorithm used in multi-layer neural networks to adjust weights and improve learning. 3. Explore fuzzy logic's approach to handling uncertainty using fuzzy sets and linguistic variables. 4. Learn how fuzzy logic is applied in controllers for reasoning and decision-making in uncertain environments. 5. Discover how neural networks and fuzzy logic are used in robotics for tasks like motion control, vision systems, and path planning.			
Course Outcomes: On completion of the course, students will be able to			
	Course Outcomes		Bloom's Level
CO1	Comprehend the concepts of feed forward neural networks and fuzzy logic		1
CO2	Analyze the various feedback networks		3
CO3	Apply the concept of fuzziness involved in various systems and fuzzy set theory		3
CO4	Analyse the application of fuzzy logic control to real time systems		3
COURSE CONTENTS			
Unit I	Neural Network Fundamentals	(08hrs)	Cos Mapped CO1
Biological Neural network, framework for distributed representation, Network topologies, training of ANN, Perceptron learning rules and convergence theorem			
Unit II	Back Propagation	(8hrs)	Cos Mapped CO2

Multi-Layer feed forward networks, weight adjustment with sigmoid activation function, other activation functions, back propagation in fully recurrent network, Hopfield network,			
Unit III	Fuzzy set and fuzzy logic	(8hrs)	Cos Mapped CO3
Fuzzy sets, operations of fuzzy sets, fuzzy relations, operations of fuzzy relations. Fuzzy implications, Linguistic variables			
Unit IV	Fuzzy Logic Controllers	(8hrs)	Cos Mapped CO4
Theory of approximate Reasoning Translation rules, rationale properties, fuzzy rule based systems, fuzzy reasoning schemes, fuzzy logic controllers, de-fuzzification methods			
Unit V	Applications of Neural Network and Fuzzy Logic in Robotics	(8hrs)	Cos Mapped CO4
Applications of Neural Network and Fuzzy Logic for forward and inverse kinematics of robots, dynamic control of robots, trajectory generation, robot vision system, robot path planning etc.			
Reference Books			
1. C. R. Alavala, Fuzzy Logic and Neural Networks: basic concepts and applications, New Age International Publishers 2. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002. 3. Zimmerman H.J., "Fuzzy set theory and its Applications", Kluwer Academic Publishers Dordrecht, 2001. 4. Lorraine Fausett, Englewood cliffs, N.J., Fundamentals of Neural Networks, Pearson Education, New Delhi, 2008.			

Strength of CO-PO Mapping														
	PO												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	2	1	2	-	2	-	-	-	-	-	-	1	1	-
CO2	2	1	2	-	2	-	-	-	-	-	-	1	1	-
CO3	2	1	2	-	2	-	-	-	-	-	-	1	1	-
CO4	2	1	2	-	2	-	-	-	-	-	-	1	1	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on each Unit	10
2	LMS Test on Each Unit	10
	Total	20

S. Y. B. Tech. Pattern 2023 Semester: IV Course Code : 2312217 Course Name : Artificial Neural Network and Fuzzy System Lab		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 hrs. /week	01	Term work : 25 Marks Oral : 25 Marks
Prerequisite Courses:---		
Course Objectives:		
Course Objectives	Description	
1	Understand how neural networks mimic the brain's behavior and learn about their basic structure and training methods.	
2	Master the back propagation algorithm used in multi-layer neural networks to adjust weights and improve learning.	
3	Explore fuzzy logic's approach to handling uncertainty using fuzzy sets and linguistic variables.	
4	Learn how fuzzy logic is applied in controllers for reasoning and decision-making in uncertain environments.	
5	Discover how neural networks and fuzzy logic are used in robotics for tasks like motion control, vision systems, and path planning.	

Course Outcomes:

Course Outcomes	Description
1	Comprehend the concepts of feed forward neural networks and fuzzy logic
2	Analyse the various feedback networks
3	Apply the concept of fuzziness involved in various systems and fuzzy set theory
4	Analyse the application of fuzzy logic control to real time systems

Course context, Relevance, Practical Significance:

The course content delves into fundamental principles of neural networks and fuzzy logic, offering insights into their practical applications in various fields. Understanding neural networks aids in modeling complex systems and pattern recognition tasks, while fuzzy logic provides a framework for dealing with uncertain and imprecise information. These concepts are highly relevant in today's technological landscape, where industries seek solutions for data analysis, decision-making, and automation. Mastery of these topics equips individuals with valuable skills applicable in areas such as artificial intelligence, robotics, finance, and healthcare, enhancing their capabilities to tackle real-world challenges effectively.

Course Contents:

Sr. No.	Contents	Pr. Hrs.
1	Implementation of Fuzzy Operations	2
2	Implementation of Fuzzy Controller for robotics application	2
3	Implementation of Perceptron Learning Algorithm	2
4	Robot inverse kinematics using fuzzy logic	2
5	Robot dynamics using neural network	2
6	Robot path planning using fuzzy logic controller	2

Course Mapping:

Assignment/ Experiment	Contents	CO- mapped	PO mapped	PSO mapped
1	Implementation of Fuzzy Operations	1	1,2	1
2	Implementation of Fuzzy Controller for robotics application	1	1,2	1
3	Implementation of Perceptron Learning Algorithm	2	1,2	1
4	Robot inverse kinematics using fuzzy logic	2	1,2	1
5	Robot dynamics using neural network	3	1,2	1
6	Robot path planning using fuzzy logic controller	4	1,2	1



K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Robotics and Automation Pattern 2022, Semester: V 2312218: Name of Subject: Open Elective 2: Comparative Philosophy			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :02 hrs/week		02	CCE: 50 Marks
Prerequisite Courses: ---			
Course Objectives: 1. Explain the perspective of different philosophies of the East and the West. 2. Compare parallel or distinctive worldviews and			
Course Outcomes: On completion of the course, students will be able to			
	Course Outcomes		Bloom’s Level
CO1	Identification of cross-cultural philosophical similarities and differences.		2. Understand
CO2	Critical analysis of diverse philosophical traditions.		2. Understand
CO3	Synthesis of insights to develop a global philosophical perspective.		2. Understand
COURSE CONTENTS			
Unit I	Background of Comparative Philosophy	(07 hrs)	COs Mapped: CO2, CO4
Parallel developments and problem approach comparative attempts in classical period, Tendencies			
Common themes, Major differences			

Unit II	Landscape and Traveling: East and West	(07 hrs)	COs Mapped: CO1, CO3
The True, the Good, and the Beautiful, Tat Tvam Asi and the Realization of self-divinity, Benevolent Government, Laughter: East and West (a) Siddharta Gautama (b) Socrates (c). Zhuang Zi			
Unit III	Intra-Disciplinary Comparative Philosophy	(07 hrs)	COs Mapped: CO2, CO4
Philosophy, Religions and Transcendence, Survey of Western search for transcendence, Chinese search for transcendence, Ascent in the Buddhist Trikaya, Catholicism and Culture (a) The evangelization of China (b) The evangelization of the Philippines (c) The evangelization of India			
Reference Books			
1. P. T. Raju, Introduction to Comparative philosophy, Motilal Banarsidass, 1992 2. Co, Alfredo,. Across the Ancient Philosophical World: Essays in Comparative Philosophy. Manila: UST Publishing House 2015 3. Liat, J. Kwee Swan, Methods of Comparative Philosophy, Philosophy East and West , Vol. 1, No. 1(April 1951): pp. 10-15.			

4. Moore, Charles, Some Problems of Comparative Philosophy, in Philosophy East and West , Vol. 1 No.1 (April 1951): pp. 67-70.
5. Nakamura, Hajime. “Methods and Significance of Comparative Philosophy,” in Revue Internationale de Philosophie, Vol. 28, No. 107/108 (1974): pp. 184-193.

Strength of CO-PO Mapping

	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1	1	1	1	-	-	-	-	-	1
CO2	1	1	-	-	1	-	-	-	-	1	-	-
CO3	-	-	-	1	-	-	1	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Tests on each unit using LMS (Each test for 20 M and total will be converted out of 30 M)	30
2	Timely Assignments Submission on each unit (5 M for each unit)	20

S.Y.B.Tech. Robotics and Automation Pattern 2023 Semester: IV 2312219: Name of Subject: Universal Human Values(UHV-2)		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
TU:2Hrs/Week	02	CCE-50Marks
Prerequisite Courses: N3		
Course Objectives: • To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. • To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living natural way. • To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.		
Course Methodology 1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence. 2. The course is in the form of 28 lectures (discussions) and 14 practice sessions. 3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found a truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation – the whole existence is the lab and every activity is a source of reflection. 4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution. 5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.		
Course Outcomes: At the end of the course, the students will be able to		
	Course Outcomes	Bloom's Level
CO1	Recognize the significance of value inputs in formal education and its applications.	2-Understand
CO2	Apply the understanding of ethical conduct to formulate the Strategy for ethical life and profession.	3 - Apply
CO3	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	4-Analyze
CO4	Analyze the value of harmonious relationship based on trust and respect in their life and profession	4-Analyze
CO5	Examine the role of a human being in ensuring harmony in society And nature.	4-Analyze

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COURSE CONTENTS
Unit1:Introduction-BasicHumanAspiration,itsfulfilmentthroughAll-encompassingResolution The basic human aspirations and their fulfilment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution
Unit2:RightUnderstanding(Knowing)-Knower, Known & theProcess The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending upto understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).
Unit3:UnderstandingHumanBeing Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self
Unit4:UnderstandingNatureandExistence A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).
Unit 5: Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence
Text Book
1. RRGaur, RAsthana, GP Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
Reference Books
1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA 2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain. 3. Susan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991 4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books. 5. ANagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak. 6. PL Dhar, RRGaur, 1990, Science and Humanism, Commonwealth Publishers. 7. AN Tripathy, 2003, Human Values, New Age International Publishers. 8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati. 9. EG Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press 10. MGovindrajran, SNatrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

11. "Nonviolent Communication: A Language of Life" by Marshall B. Rosenberg - This book offers practical tools and strategies for fostering empathic communication, resolving conflicts, and cultivating understanding and compassion in relationships.

12. "The Road Less Traveled: A New Psychology of Love, Traditional Values and Spiritual Growth" by M. Scott Peck - Peck explores the significance of discipline, responsibility, and spiritual growth in achieving fulfillment and authentic human connection.

S.Y. B. Tech. Robotics and Automation Pattern 2023, Semester:IV 2312220: Name of Subject: Soft skills			
Teaching Scheme	Course Type	Credit Scheme	Examination Scheme:
TU:01 hrs/week PR :02 hrs/week	AEC	02	TU:25 marks TW:25 marks
Prerequisite Courses: Communication Skills			
Course Objectives: By the end of the course, students should be able to			
Sr.No.	Description		
1	Enhance oral and written communication skills tailored to engineering contexts, encompassing technical presentations, meetings, documentation, and active listening techniques.		
2	Implement effective teamwork and collaboration strategies specific to engineering environments, focusing on roles, conflict resolution, and trust-building, and collaborative project execution.		
3	Strengthen problem-solving and critical thinking abilities through structured methodologies and creative approaches, applied to engineering challenges and scenarios.		
4	Cultivate adaptability, resilience, and time management techniques to navigate the dynamic engineering landscape, addressing setbacks, competing priorities, and stressors effectively.		
Course Outcomes:			
Course Outcomes	Description Student will be able to:		
CO1	Demonstrate proficient oral and written communication skills tailored to engineering contexts, fostering effective technical exchanges and collaboration.		
CO2	Implement teamwork and collaboration abilities, navigating diverse team dynamics and contributing effectively to engineering projects.		
CO3	Explain advanced problem-solving and critical thinking capabilities, applying structured methodologies and creative approaches to engineering challenges.		
CO4	Develop strong leadership qualities and a commitment to professional development, equipped to navigate ethical dilemmas, make informed decisions, and pursue career advancement in engineering fields.		
Course context, Relevance, Practical Significance:			
In today's rapidly evolving engineering landscape, professionals require a multifaceted skill set beyond technical expertise. This course aims to address the holistic development of engineering students by focusing on essential areas such as communication, teamwork, problem-solving, adaptability, and leadership. Through a structured curriculum comprising theoretical frameworks, practical exercises, and real-world applications, students will cultivate the competencies needed to thrive in diverse engineering projects and environments. By emphasizing these critical skills, the course endeavors to prepare students to meet the challenges and demands of the modern engineering profession effectively.			

Course Contents:

Unit	Contents	Lecture Hrs.
1	Unit 1: Communication Skills Understanding the importance of effective communication in engineering projects. Developing oral communication skills: presenting technical information, leading meetings, and participating in discussions. Enhancing written communication skills: writing technical reports, emails, and documentation. Practicing active listening and feedback techniques. Role-playing exercises to simulate real-world communication scenarios.	7
2	Unit 2: Teamwork and Collaboration Exploring the dynamics of effective teamwork in engineering environments. Understanding team roles and responsibilities. Strategies for conflict resolution and managing team dynamics. Building trust and fostering a positive team culture. Collaborative project work with peers to apply teamwork principles.	7
3	Unit 3: Problem-Solving and Critical Thinking Introduction to problem-solving methodologies in engineering. Developing critical thinking skills to analyse and evaluate complex problems. Applying structured problem-solving techniques, such as root cause analysis and brainstorming. Incorporating creativity and innovation into problem-solving processes. Case studies and hands-on exercises to practice problem-solving in engineering contexts.	7
4	Unit 4: Adaptability and Resilience Recognizing the importance of adaptability in a rapidly changing engineering landscape. Strategies for embracing change and uncertainty. Developing resilience to overcome setbacks and failures. Time management techniques to balance competing priorities and deadlines. Stress management and self-care practices for maintaining well-being.	7
5	Unit 5: Leadership and Professional Development Exploring leadership styles and qualities relevant to engineering roles. Developing skills in decision-making, delegation, and conflict resolution as a leader. Understanding ethical considerations and responsibilities in engineering practice. Strategies for career planning, goal setting, and professional networking. Guest lectures from industry professionals and alumni sharing their experiences and insights.	7

Course Mapping:

Unit	Contents	Blooms Taxonomy Level	CO-mapped	PO mapped	PSO mapped
1	Communication Skills	1,2,3	1	1,2,3,10	--
2	Teamwork and Collaboration	2,3	1,2	1,2,9,10,11	--
3	Problem-Solving and Critical Thinking	2,3	1,2,3	1,2,5,12	--
4	Adaptability and Resilience	2,3	1,4	1,7,10	---
5	Leadership and Professional Development	2,3	1,2,3,4	1,2,11,12	--

References Books:

1. "Communication Skills for Engineers and Scientists" by Whiting, H.G., and Rycroft, D. ISBN-13: 978-0471938719
2. "Teamwork and Project Management" by Karl A. Smith and Ruth W. Crumbly ISBN-13: 978-0073381477
3. "Engineering Problem Solving: A Classical Perspective" by Delores M. Etters ISBN-13: 978-0131429159
4. "Leadership in Engineering: A Concise Guide to the Roles, Responsibilities, and Challenges of Engineering Managers" by Peter C. Haynes ,ISBN-13: 978-110846547

