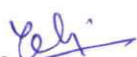


 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence								
Course Information:									
Class, Semester		SY. B. Tech, Semester - III					Category	BS	
Course Code, Course Title		0RABS201, Applied Mathematics for Robotics and AI					Type	T1	
Prerequisites		0RABS101, 0RABS108							
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self-study		Credits	
		3	1		-	4		4	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE	
			40	20	40		-	-	
Course Outcomes (COs) :									
Upon successful completion of this course, the student will be able to:									
CO1		Apply vector calculus and partial differential equations to engineering applications using suitable analytical methods.							
CO2		Perform numerical differentiation and integration for solving engineering problems with acceptable accuracy.							
CO3		Apply fuzzy set theory and probability distributions to model uncertain and random phenomena using appropriate mathematical techniques.							
CO4		Analyze data using hypothesis testing techniques for statistical decision making with valid statistical interpretation.							
Syllabus:									
Module		Contents						Lecture Hours	
I		Vector Calculus: Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential. Applications of vector calculus in robotics and artificial intelligence.						7	
II		Partial Differential Equations and Its Application: Introduction, Formation of partial differential equation, solution of partial differential equation, linear equation of the first order (Lagrange's method). Method of separation of variables, wave equation and one dimensional heat equation.						8	
III		Numerical Differentiation and Integration: Numerical Differentiation – Newton's Forward Difference, Newton's Backward Difference, Central Difference. Numerical Integration - Trapezoidal Rule, Simpson's 1/3rd And 3/8th Rule and Weddles rule.						8	
IV		Fuzzy Set Theory: Basic concepts of fuzzy sets, membership functions, alpha cut and strong alpha cut and its properties, operations on fuzzy sets, fuzzy numbers, fuzzy cardinality.						8	
V		Probability Distributions: Random Variable, Types, Probability mass function, Probability density function. Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution. Continuous Probability Distribution: Exponential Distribution, Uniform Distribution, Normal Distribution						7	
VI		Testing of Hypothesis: Introduction to Population and Sample, Parameters and Statistics, Concept of Hypothesis Testing, Large Sample Tests: Tests for single population mean, Tests for equality of two population means. Small Sample Tests: t-tests, Chi-Square Test: Test for single population variance, Test for goodness of fit of given probability distribution.						7	
						Total Lecture Hours		45	

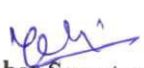

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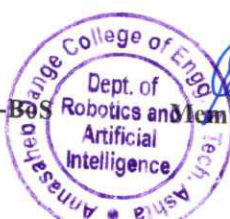

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List of Tutorial with CO Mapping			
S.No	Title / Topic of the Tutorial		CO Mapped
1	Vector Differential Calculus-I		CO1
2	Vector Differential Calculus-II		CO1
3	Numerical Differentiation		CO2
4	Numerical Integration		CO2
5	Partial Differential Equation		CO3
6	Applications of Partial Differential Equations		CO3
	Review		
7	Fuzzy Set Theory – I		CO4
8	Fuzzy Set Theory -II		CO4
9	Probability Distribution-I		CO5
10	Probability Distribution-II		CO5
11	Statistical Interference- Test of Hypothesis-I		CO5
12	Statistical Interference- Test of Hypothesis-II		CO5
	Review		
	Final Submission		
Total Practical Sessions		15	Total Practical Hours
			30
Text Books			
1. N.P. Bali and Manish Goyal , A text book of Engineering Mathematics , 8th Edition, Laxmi Publications ,2011.			
2. H. K. Das , Advanced Engineering Mathematics , 22th Edition, S. Chand ,2018.			
3. B. V. Ramana, Higher Engineering Mathematics, 6th Edition, Tata McGraw Hill Publ., 2010			
4. George J. Klir and Bo Yuan, Fuzzy Sets & Fuzzy Logic Theory and Applications, PHI Learning Private Limited, 2013			
References:			
1. Dr. B. S. Grewal , Higher Engineering Mathematics , 44th Edition, Khanna Publishers ,2018.			
2. N. P. Bali, Manish Goyal , Advanced Engineering Mathematics , 7th Edition, Infinity science press ,2010.			
3. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Vol-I, 9th Edition Pune Vidyarthi Griha Prakashan,1984			
4. James L. Johnson, Probability and Statistics for Computer Science, 1 Edition, Wiley Publication, 2008.			


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Annasaheb Dange College of Engineering and Technology
 Ashta - 416301, Dist.: Sangli, Maharashtra
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 Department of Robotics and Artificial Intelligence

**Course Information:**

Class, Semester	SY B. Tech, Semester - I				Category	PC
Course Code, Course Title	0RAPC202, Fundamentals of Robotics and AI				Type	T1
Prerequisites						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits	
	3	1	-	4	4	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA
		40	20	40		-

Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

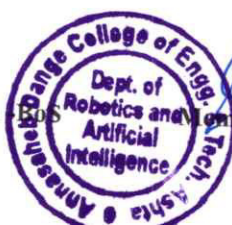
CO1	Explain robot configurations, subsystems, joints, end effectors, and robot specifications using appropriate classification and operating principles.
CO2	Apply basic robotics concepts to manipulator motion, workspace analysis, and industrial applications using suitable kinematic and programming concepts.
CO3	Analyze artificial intelligence techniques and intelligent agents for problem-solving applications using appropriate search and reasoning methods.
CO4	Evaluate machine learning concepts and AI applications in robotics and intelligent systems considering their capabilities, limitations, and future trends.

Syllabus:

Module	Contents	Lecture Hours
I	Introduction to Robotics: Definition and History of Robotics, Components of a Robot System, Basic Robot Anatomy and Degrees of Freedom (DOF), Classification of Robots based on Structure and Application, Cartesian Robot, Cylindrical Robot, Spherical Robot, Articulated Robot, SCARA Robot, Industrial Robot Specifications, Workspace, Payload, Speed, Accuracy, Repeatability	6
II	Robot Architecture and Subsystems Motion System, Recognition System, Control System, Power Supply System, Introduction to End Effectors, Mechanical Grippers, Vacuum Grippers, Magnetic Grippers, Selection of Grippers, Applications of Grippers	8
III	Basics of Robot Kinematics and Applications: Introduction to Robot Manipulators, Coordinate Systems and Reference, Robot Motion and Path Planning (Introduction), Robot Programming Concepts, Industrial Applications of Robots, Material Handling, Pick and Place Operations, Welding, Painting, Assembly, Inspection, Emerging Applications, Medical Robots, Agricultural Robots, Service Robots	8
IV	Introduction to Artificial Intelligence Introduction and History of AI, Need and Scope of AI, Characteristics of Intelligent Systems Types of AI, Narrow AI, General AI, AI Applications, Healthcare, Education, Manufacturing Robotics, Smart Assistants, Introduction to Intelligent Agents, Simple Reflex Agents, Goal-Based Agents, Learning Agents, AI Development Tools and Platforms (Overview)	6
V	AI Problem Solving and Search Techniques: Problem Solving in AI, State Space Representation, Search Strategies, Breadth First Search (BFS), Depth First Search (DFS), Best First Search (Concept Only), Heuristic Search, Introduction to Game Playing in AI, Minimax Concept, Simple AI Applications and Case Studies	9
VI	Knowledge Representation and Machine Learning Basics: Introduction to Knowledge Representation, Facts, Rules, and Semantic Networks, Introduction to Reasoning in AI, Handling Uncertainty (Basic Concepts), Introduction to Machine Learning Supervised Learning, Unsupervised Learning, Reinforcement Learning, AI in Robotics and Computer Vision (Overview), Ethical Issues and Future Trends in AI	8
Total Lecture Hours		45

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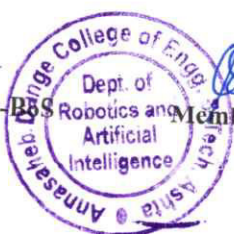
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List of Tutorial with CO Mapping		
Sr. No	Title / Topic of the Tutorial	CO Mapped
1	Basic Robot Anatomy and Degrees of Freedom (DOF)	CO1
2	Classification of Industrial Robots and Their Applications	CO1
3	Industrial Robot Specifications and Performance Parameters	CO1, CO2
4	Robot Subsystems and End Effectors	CO1
5	Robot Kinematics, Coordinate Systems and Motion Planning	CO2
6	Industrial and Emerging Applications of Robotics	CO2
	Review	
7	Fundamentals of Artificial Intelligence and Real-World Applications	CO3
8	Solving AI Search Problems using BFS and DFS	CO3
9	Heuristic Search and Game Playing Exercises	CO3
10	Machine Learning Basics through Real-Life Examples	CO4
11	Supervised and Unsupervised Learning: Concepts and Applications	CO4
12	Mini Case Study on AI in Healthcare, Education or Manufacturing	CO3
	Review	
	Final Submission	
Text Books		
1.	S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2 nd Edition, 2010.	
2.	Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, McGraw-Hill Education (India) Pvt. Ltd., 3 rd Edition, 2009.	
3.	Introduction to Robotics – S. K. Saha, McGraw Hill Education. 2 nd Edition, 2014	
References:		
1.	John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education International, 3rd Edition, 2005	
2.	Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley & Sons, 1st Edition, 2006.	
3.	Chandra S. S. V. N. Murthy, Artificial Intelligence and Machine Learning, Wiley India Pvt. Ltd., 1st Edition, 2010.	
4.	George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th Edition, 2008.	
Online Learning Resources		
1.	https://nptel.ac.in/courses/107106090 Introduction To Robotics, IIT Madras, Prof. Asokan T Prof. Balaraman Ravindran Prof. Krishna Vasudevan	
2.	https://nptel.ac.in/courses/106102220 An Introduction to Artificial Intelligence, IIT Delhi, Prof. Mausam	

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 Established: 1999		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:								
Class, Semester		SY. B. Tech, Semester - III					Category	PC
Course Code, Course Title		0RAPC203, Digital Systems & Microprocessor					Type	LIT1
Prerequisites		-						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		2	-	2	2	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		50	50
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Apply Boolean algebra and digital logic principles to combinational circuits using appropriate simplification and design techniques.							
CO2	Build sequential circuits and finite state machines using flip-flops, counters, registers, and memory elements.							
CO3	Analyze logic families, semiconductor memories, and programmable logic devices based on their characteristics and implementation requirements.							
CO4	Develop microprocessor-based programs and digital system applications using appropriate instructions, addressing modes, and programming techniques.							
Syllabus:								
Module	Contents							Lecture Hours
I	Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 4 variables, Binary codes, Code Conversion. MSI devices like Multiplexers, Encoder, Decoder, Comparators, Half and Full Adders, Subtractors.							5
II	Sequential Logic Design: Building blocks like S-R, JK and D latch, Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM.							6
III	Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of PLDs like PAL, PLA, CPLDs, FPGA etc. Logic implementation using Programmable Devices (ROM, PLA).							4
IV	Introduction to Microprocessor: The microprocessor Architecture and its operations, memory map and addresses, Memory and instruction Fetch, memory classification, Memory mapped I/O Vs I/O mapped I/O.,							3
V	8085 Microprocessor Architecture: The 8085-Pin diagram, Microprocessor communication and bus timing, De-multiplexing address and Data bus, generating control signals, 8085 based machine cycles and bus timing, op-code fetch machine cycle, memory read and write machine cycle.							6
VI	8085 Programming: The 8085- programming model, instruction classification, instruction format, 8085 addressing modes, flag register, data transfer instructions, Arithmetic instructions and Logic instruction., Programming with Assembly & C language, Evolution of Microprocessors, Introduction to 8051 Microcontroller							6
Total Lecture Hours							30	
List of Experiments with CO Mapping								
Sr. No	Title / Topic of the Experiment							CO Mapped
1	Introduction to Lab and implementation of NAND or NOR as an Universal logic gate							CO1
2	Design and implementation of combinational circuits (Half Adder, Full Adder, Subtractor, BCD Adder)							CO1
3	Implementation of logic functions using MSI devices (Multiplexer, Encoder, Decoder, Comparator)							CO1, CO3

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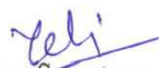
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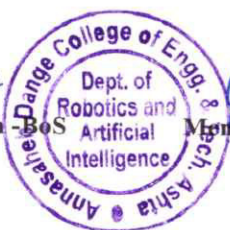
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4	Design and verification of sequential circuits (SR, JK, D Flip-Flops and Shift Registers)	CO2
5	Design and implementation of counters and finite state machines (Ripple counter, Synchronous counter, FSM design)	CO2
6	Study of logic families and implementation using programmable logic devices (TTL, CMOS characteristics; ROM / PLA / FPGA based logic implementation)	CO3
	Review	
7	Develop program for arithmetic operation of two 16 bit numbers.	CO4
8	Develop program for logical operation of two 16 bit numbers.	CO4
9	Develop program that is based on branching operation.	CO4
10	Develop program to perform 1 byte BCD addition	CO1, CO4
11	Develop program to move a block of data bytes in memory from one location to another location	CO4
12	Develop a program to perform logical operations on data bytes	CO4
	Review	
	Final Submission	
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1.	Anand Kumar, Fundamentals of Digital Circuits, 2nd Edition, PHI Learning, 2009	
1.	Enoch O. Hwang, Digital Logic and Microprocessor Design with Interfacing, 2nd Edition, Cengage, 2018	
2.	Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, 2nd Edition, PHI / Eastern Economy Edition, 2014	
3.	R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, 3rd Edition, Wiley Eastern Ltd., 1995	
References:		
2.	M. Morris Mano, Michael D. Ciletti, Digital Design, 5th Edition, Pearson, 2014	
3.	Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, 2011	
4.	Santanu Chattopadhyay, Microprocessors & Microcontrollers, 1st Edition, McGraw Hill Education, 2025.	
5.	A. P. Godse & D. A. Godse, Microprocessor and Interfacing: 8085 Architecture, Programming & Applications, Technical Publications, 2021 Edition.	
Online Learning Resources		
1.	Digital Circuits by Prof. Santanu Chattopadhyay, https://onlinecourses.nptel.ac.in/noc23_ee115/preview	
2.	Microprocessors and Microcontrollers by Prof. Santanu Chattopadhyay https://onlinecourses.nptel.ac.in/noc24_ee46	
Note: From the above experiment list students may perform experiments through virtual labs.		


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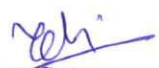

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 Established: 1999		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:								
Class, Semester		SY. B. Tech, Semester - III					Category	PC
Course Code, Course Title		0RAPC204, Sensor and Actuators for Robotics					Type	LIT1
Prerequisites		0RSES104						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		2	-	2	2	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		50	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain sensor characteristics, classification, and sensing principles used in robotic systems using appropriate performance parameters and operating concepts.							
CO2	Analyze vision systems and intelligent sensor technologies for robotic applications based on their functional characteristics and applications.							
CO3	Select suitable sensors and intelligent sensing devices for robotic and automation systems according to application requirements and performance specifications.							
CO4	Apply electrical, pneumatic, hydraulic, and advanced actuators in robotic systems using appropriate selection criteria and operating characteristics.							
Syllabus:								
Module	Contents							Lecture Hours
I	Introduction to Sensors- Definition, Role of Sensors in Robotics, Sensor Characteristics-Accuracy, Precision, Sensitivity, Range, Resolution, Selection of Sensor, Classification of Sensors, Contact and Non-Contact Sensors, Signal Conditioning							5
II	Sensors: Pressure/contact. Resistive position. Infrared. Light. Position Sensors, optical encoders, proximity sensors, Range sensors, Ultrasonic sensors, Touch and Slip sensors. sensors for motion and position, Force, torque and tactile sensors, Flow sensors, Temperature sensing devices.							5
III	Vision Sensors: Vision System Devices, Elements, Steps in Vision System, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation., Hierarchy in Vision System, Difficulties in Vision and Remedies							5
IV	Advanced Sensor Technology: Smart sensors, MEMS based sensors, Innovations in sensor technology, Intelligent Sensors-Introduction to Intelligent (Smart) Sensors, Characteristics of Intelligent Sensors, Components of Intelligent Sensors, Functions of Intelligent Sensors: Self-Calibration, Self-Diagnosis, Data Processing, Digital Communication, Advantages and Limitations of Intelligent Sensors, Applications of Intelligent Sensors in Robotics and Automation							6
V	Electric Actuators: Direct current motor, Permanent magnet stepper motor, Servo Control DC motors, Linear and latching linear actuators, Rotary actuators, Piezoelectric actuators, Actuator parameters and characteristics, Stepper motors, Specifications and characteristics of Stepper Motors Servo Motors.							4
VI	Pneumatic & Hydraulic actuators: Hydraulic and pneumatic power actuation devices: Hydraulic Actuators, selection of linear actuating cylinders, Hydraulic Motors, Pneumatic actuators, design considerations and selection, pneumatic cylinders, pneumatic drive system, Linear & rotary actuators. Advanced actuators – Piezoelectric actuators, elastomeric actuators, soft actuators, shape memory alloy-based actuators, under actuated robotic hand.							5
Total Lecture Hours							30	

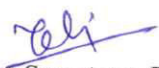

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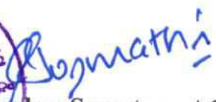

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List of Experiments with CO Mapping			
Sr. No.	Title / Topic of the Experiment		CO Mapped
1	Introduction to trainer kit and Object Detection Using Photoelectric Sensors		CO1, CO3
2	Object Detection & High-Speed Part Counting		CO1, CO3
3	Metal/Non-Metal Sorting with Alarm Logic		CO1, CO3
4	Colour Mark Detection		CO1, CO2, CO3
5	Object Distance Measurement		CO1, CO3
6	Object Weight Measurement		CO1, CO2, CO3
	Review		
7	Automatic Object Sorting Using Multiple Sensors		CO1, CO3
8	Hobby Servo Microcontroller Interfacing		CO4
9	Open-Loop Stepper Distance Calibration		CO4
10	Industrial BLDC Integrated Control Loop		CO4
11	High-Precision AC Servo Open Loop Track		CO4
12	VFD Frequency Scaling & Induction Controls		CO4
	Review		
	Final Submission		
Total Practical Sessions		15	Total Practical Hours
			30
Text Books			
1. Subir Kumar Saha, Introduction to Robotics, 3rd Edition, Tata McGraw Hill Education Private Limited, 2025.			
2. Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, 3rd Edition, Wiley India, 2024.			
3. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer, 2009.			
4. John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson, 2017.			
References:			
1. Bruno Siciliano, Oussama Khatib (Eds.), Springer Handbook of Robotics, Springer Berlin Heidelberg, 2008.			
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, 2nd Edition, Springer, 2017.			
3. Roland Siegwart, Illah R. Nourbakhsh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, 2nd Edition, MIT Press, 2011.			
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox, Probabilistic Robotics, 1st Edition, MIT Press, 2005.			
Online Learning Resources			
1. Sensors and Actuators in Robotics (Online), https://wizape.com/English/Sensors-and-Actuators-in-Robotics?utm_source=chatgpt.com			
2. Robotics by Prof. Dilip Kumar Pratihari, https://elearn.nptel.ac.in/shop/nptel/robotics/?utm_source=chatgpt.com			


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Annasaheb Dange College of Engineering and Technology
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 Department of Robotics and Artificial Intelligence

**Course Information:**

Class, Semester	SY. B. Tech, Semester - III				Category	PC
Course Code, Course Title	0RAPC205, Theory of Machines				Type	T1
Prerequisites	ORSES102					
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits	
	2	-	-	2	2	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA
		40	20	40		ESE
						-

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Explain kinematic links, pairs, robot joints, and workspace of robotic systems using appropriate classification principles.
CO2	Compute joint variables for standard robot manipulators using inverse kinematic techniques.
CO3	Apply forward kinematic analysis of robot manipulators using D-H parameters to determine manipulator position and orientation.
CO4	Analyze inverse kinematics of standard robot configurations to obtain feasible joint variables.

Syllabus:

Module	Contents	Lecture Hours
I	Fundamentals of Kinematics Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Mechanism, Inversion of Mechanism, Position and orientation of the body, linear and angular velocity of links, Robot joints, Robot Degree of freedom, Robot coordinates, Robot reference frames, Workspace analysis, Work envelope of robots, Types of industrial robots and workspace.	4
II	Forward Kinematics Direct kinematics, Displacement matrix for standard matrix, D-H parameters, Arm equations, Forward kinematics of manipulator up to 6 degree of freedom, Representation of forward kinematic equation	5
III	Inverse Kinematics Inverse kinematic analysis of robot with standard configuration, Methods for solution of non linear simultaneous equations, Use of Meta – Heuristics for inverse kinematic solutions, Inverse kinematic solutions of robots.	5
IV	Trajectory planning Trajectory planning, Geometric Jacobian / Analytical Jacobian, Singularities and redundancy, Inverse kinematics algorithms, Statics and manipulable, Kinematic solutions and trajectory planning.	5
V	Robot dynamics Forward Dynamics and Inverse Dynamics – Importance Spatial description and transformations – Different types of dynamic formulation schemes –Lagrangian formulation for equation of motion for robots and manipulators. Properties of the dynamic model, Dynamic model of simple manipulator structures, Dynamic parameters identification, Operational space dynamics model, Differential kinematics.	6
VI	Dynamic Modeling Modeling of motion of robots and manipulators using Newton – Euler equations – State space representation of equation of motion and system properties	5
Total Lecture Hours		30

Text Books

1. Ratan S.S, Theory of Machines, 3rd Edition, Tata McGraw Hill New Delhi.,2012.
2. Jorge J. Craig, Introduction to Robots (Mechanics and Control), 3rd Edition, Addison Wesley, 2003.
3. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education, 2014.

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4. Dilip Kumar Pratihari, Fundamentals of Robotics, Narosa Publishing House, 2019.
5. Grover M.P., Wiess M., Nagel R. N., Odrey N.G., Industrial Robotics Technology- Programming and Application, TATA McGraw Hills Education, 2013.

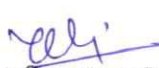
References:

1. Kelly R, Santibanez V and Loria A, —Control of Robot Manipulators in Joint Space, Springer, 2005.
2. Devendra K Chaturvedi, Modelling and Simulation of Systems using MATLAB and Simulink, CRC press, 2010.
3. Robert J. Schilling, Fundamentals of Robot Analysis and Control, PHI Learning, 2009.
4. Richard D. Klafter, Thomas A., Chri Elewski, Michael Negin, Robotics Engineering: An Integrated Approach, PHI Learning 2009.

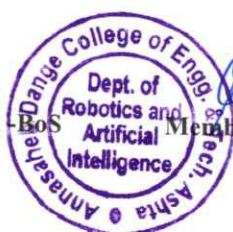
Online Learning Resources

1. NPTEL Course on *Robotics and Control: Theory and Practice* , by Prof. N. Sukhavanam, IIT Roorkee
<https://www.youtube.com/watch?v=lRm9GiGoZKg>
2. Digital document library, <https://www.scribd.com/document/996736569/theory-of-machines-syllabus>

Some experiments may be performed through virtual labs.


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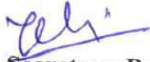

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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:								
Class, Semester		S. Y. B. Tech. Semester - III					Category	VS
Course Code, Course Title		0RAVS206-Python Programming					Type	L1
Prerequisites		0RAES111						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		01	00	02	01	02		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	-	-		50	50
Course Outcomes (COs):								
Upon successful completion of this course, the student will be able to:								
CO1	Apply Python programming fundamentals to develop programs using appropriate syntax, control structures, functions, and data types.							
CO2	Develop Python programs using built-in data structures and file handling techniques to solve computational problems effectively.							
CO3	Implement modular and robust Python applications using libraries, modules, and exception handling mechanisms.							
CO4	Analyze engineering and robotic data using Python tools and libraries to process, visualize, and interpret data effectively.							
Syllabus:								
Module	Contents							Lecture Hours
I	Introduction to Python Programming History and evolution of Python, Features and applications of Python, Installing Python and introduction to IDEs (IDLE, VS Code, etc.), Writing and executing first Python program, Understanding indentation and syntax, Basic input and output functions, Comments and documentation strings							2 Hrs
II	Control Statements Conditional statements: if, elif, else; Loops: for loop, while loop, nested loops; Control flow statements: break, continue.							2Hrs
III	Functions in Python Introduction to functions: Built-in vs. user-defined, Function definition and calling, return statement, Function arguments: default, keyword, variable-length arguments, Scope and lifetime of variables.							3 Hrs
IV	Strings, Lists, Tuples, and Dictionaries String operations and methods, String slicing and formatting, List operations, methods, and comprehensions, Tuple operations and immutability Dictionary operations and methods, Set operations							3 Hrs
V	File and Exception Handling File types (text, binary), Modes of file opening: read, write, append, read+write, Reading entire file, line by line, using read(), readline(), readlines(), Writing data to files using write(), writelines(), Introduction to exception handling, Using try, except, else, finally.							2 Hrs
VI	Python Standard Libraries and Modules Introduction to standard libraries in Python, Using math, random, datetime, os, sys, statistics, etc., module importing techniques, installation and use of external packages via pip. Introduction to NumPy, Pandas, Matplotlib, Basic robotics-oriented Python applications.							3 Hrs
Total Lecture Hours							15	
List of Experiments								
S. No	Title / Topic of the Experiment							
1	Introduction to lab and implement program using fundamental concepts like data types, operators.							CO1

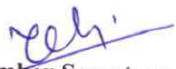

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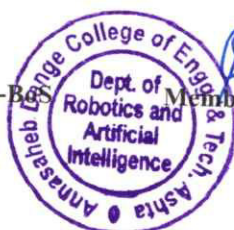

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2	Implement a program based on control statements and loops	CO1
3	Implement a programs to demonstrate the concept of user defined function.	CO1
4	Implement a programs to demonstrate built in list operations	CO2
5	Implement a programs to demonstrate tuple operations and immutability.	CO2
6	Implement a programs to demonstrate built in Set operations	CO2
7	Implement a programs to demonstrate built in dictionary operations	CO2
8	Implement a program to read and write text files using different file modes.	CO2, CO3
9	Implement a Program to handle exceptions using try, except, else, and finally blocks.	CO3
10	Implement a Program to demonstrate built-in modules math (Matrix and vector operations), random, date time and demonstrates their functionalities.	CO3
11	Implement a Program to demonstrate built-in modules os, sys, statistics and demonstrates their functionalities.	CO3
12	Program to process simulated sensor data using NumPy	CO3, CO4
13	Program to plot sensor readings	CO4
14	Sensor data processing	CO4
15	File-based logging of robotic sensor data	CO2, CO3, CO4
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1. Python Programming: Using Problem Solving Approach Reema Thareja Oxford University Press 3rd Edition, 2023		
2. Introduction to Programming Using Python Y. Daniel Liang Pearson Education 3rd Edition, 2023		
Reference Books		
1. Think Python Allen Downey O'Reilly 2nd Edition 2015		
2. Programming in Python 3 Mark Summerfield Addison-Wesley 2nd Edition 2023		
NPTEL and Online Resources		
1. https://www.learnpython.org/		
3. https://www.w3schools.com/python/default.asp		


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Course Information:								
Class, Semester	S. Y. B. Tech. Semester - III						Category	HS
Course Code, Course Title	0RAHS207 Foreign Language - German						Type	T2
Prerequisites	-							
Teaching Scheme (per week)	Lecture		Tutorial		Practical		Self Study	Credits
	02		-		0		02	02
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA		ESE
		00	50	00		00		00
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Introduce themselves and others in German during structured oral interactions using appropriate greetings and personal information.							
CO2	Communicate information related to family, hobbies, studies, and daily routines in simple German conversations and written exercises.							
CO3	Apply basic German grammar rules, vocabulary, and common phrases to construct simple sentences in speaking and writing activities.							
CO4	Read , interpret, and compose simple emails and short written texts in German using appropriate vocabulary and sentence structures.							
CO5	Formulate and respond to questions related to everyday situations in German through conversations and role-play activities.							
CO6	Demonstrate foundational German language skills in listening, speaking, reading, and writing required for progression to the A2 level.							
Syllabus:								
Unit	Contents							Lecture Hours
	PRE TERM SECTION							
1	Introduction to German Language • Introduction to German language and culture • German alphabets • Pronunciation and phonetics • Greetings and farewells • Classroom expressions • Basic vocabulary							10
2	Self-Introduction and Basic Communication • Personal pronouns • Verbs Haben and Sein • Verb conjugation • Introducing oneself and others • Numbers (0–1000) • Days of the week • Basic sentence structure • W-Fragen (Question Words)							10

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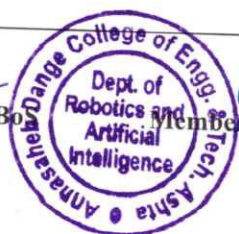
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3	Countries, Languages and Daily Communication • Countries and nationalities • Languages • Asking and answering simple questions • Yes/No questions • Articles (Definite and Indefinite) • Simple conversations	10
IN TERM SECTION		
4	Friends, Family and Hobbies • Talking about friends and colleagues • Family members • Hobbies and interests • Daily routine • Possessive articles • Describing people	10
5	Time, Dates and Appointments • Days, months and seasons • Telling time • Dates and birthdays • Making appointments • Invitations • Apologizing • Modal verbs	10
6	Work and Workplace Communication • Occupations and professions • Workplace vocabulary • Talking about studies and work • Telephone conversations • Job advertisements • Expressing opinions about jobs	10
7	City, Transport and Directions • Places in a city • Means of transport • Asking for and giving directions • Enquiring information • Imperative forms • Negation • Definite and indefinite articles	10
Self Study Section		
8	Food, Shopping and Restaurants • Food and beverages • Shopping conversations • Ordering food • Paying bills • Akkusativ case • Verbs with Akkusativ • Restaurant communication	10
9	Home, Communication and Writing Skills • Describing home and surroundings • Understanding advertisements • Likes and dislikes • Letters and emails • Understanding texts	10

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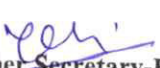
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	• Dativ case • Dativ prepositions • Wechselpräpositionen	
10	Social Life, Past Events and Fashion • Planning activities with friends • Event information and radio announcements • Separable verbs • Personal pronouns • Präteritum of Haben and Sein • Perfekt tense and Partizip II • Conjunctions (und, oder, aber) • Clothes and fashion • Demonstrative and interrogative articles • Verbs with Dativ	10
Total Lecture Hours		100
Text Books:		
1. Netzwerk neu A1 Kursbuch Goyal publishers & Distributors Pvt. Ltd. First Indian reprint 2020 Reprinted 2023		
2. Netzwerk neu A1 Übungsbuch Goyal publishers & Distributors Pvt. Ltd. First Indian reprint 2020 Reprinted 2023		
References:		
3. Fit fürs Goethe -Zertifikat A1 Start Deutsch 1 Hübner		


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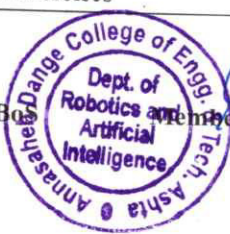

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Course Information:							
Class, Semester	S. Y. B. Tech. Semester - III		Category	HS			
Course Code, Course Title	ORAHS208 Foreign Language - Japanese		Type	T2			
Prerequisites	-						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits		
	02	00	00				
Examination Scheme (Marks)	Theory	MS E	TA	ESE	Practical	CIA	ESE
		00	50	00		00	00
Course Outcomes (COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Communicate in basic scenarios using familiar everyday expressions to make greetings, introduce themselves and others, and ask or answer questions about personal details.						
CO2	Navigate daily life situations by ordering food, asking for simple directions, using public transportation, and making basic purchases at stores.						
CO3	Discuss routines and interests by talking simply about daily schedules, hobbies, past weekend activities, and future desires such as travel plans.						
CO4	Read and write basic Japanese by recognizing and reading Hiragana, Katakana, and a few high-frequency Kanji used in daily life.						
CO5	Demonstrate understanding of Japanese cultural context by applying basic Japanese social etiquette in workplaces, public spaces, and casual settings.						
Syllabus:							
UNIT	Contents						Lecture Hours
MODULE 1 - PRE-TERM							
I	Introduction to Japanese Language and Culture - Overview of Japanese language and culture - Japanese writing systems: Hiragana, Katakana, Kanji - Basic pronunciation and phonetics - Greetings according to time of day - Classroom and workplace expressions - Asking for repetition and clarification - Basic etiquette and manners						10
II	Self-Introduction and Personal Information - Introducing oneself and others - Name, nationality, occupation, and residence - Family members - Languages spoken - Basic sentence patterns - Introduction to Hiragana writing practice						10
III	Hiragana and Katakana Mastery - Complete Hiragana characters - Complete Katakana characters - Reading and writing practice - Simple words and phrases - Listening and pronunciation exercises						10

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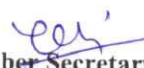
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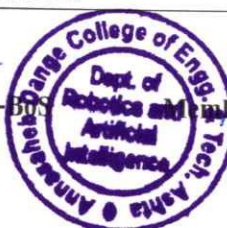


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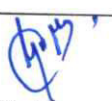
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	Everyday vocabulary development	
MODULE 2 - IN-TERM		
IV	Food and Dining - Food and beverage vocabulary - Expressing likes and dislikes - Reading simple menus - Ordering food and drinks - Restaurant conversations - Japanese dining etiquette	10
V	Home, Family and Surroundings - Describing houses and rooms - Household objects and furniture - Family relationships - Location expressions - Counting objects and people - Describing surroundings	10
VI	Daily Life and Time Expressions - Telling time - Days, dates, and months - Daily routines - Operating hours and schedules - Borrowing and lending items - Making simple appointments	10
VII	Hobbies, Interests and Social Interaction - Hobbies and leisure activities - Sports, movies, music, manga, and anime - Inviting friends - Accepting and declining invitations - Expressing preferences and interests - Social conversations	10
MODULE 3 - SELF STUDY		
VIII	Transportation and Navigation - Public transportation vocabulary - Trains, buses, stations, and landmarks - Asking for directions - Giving simple directions - Understanding signs and notices - Travel-related conversations	10
IX	Shopping and Everyday Transactions - Shopping vocabulary - Asking for products and prices - Quantities and measurements - Locating items in stores - Purchasing goods - Customer-service interactions	10
X	Holidays, Experiences and Future Plans - Talking about past weekend activities - Introduction to simple past tense - Expressing wishes and desires - Travel plans and future intentions	10

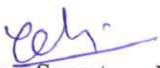

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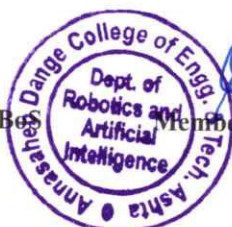
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	• Introduction to frequently used Kanji • Course review and consolidation • Speaking role-plays and presentations • Reading and writing assessment	
Total Lecture Hours		100
Text Books		
1. Irodori: Japanese for life in Japan (A1), The Japan Foundation, 2020		
Reference Books		
1. Marugoto Starter (A1) Katsudoo + Rikai (2 Books set) https://amzn.in/d/07fApBbW		
2. Genki: An Integrated Course in Elementary Japanese Vol. 1 [3rd Edition] https://amzn.in/d/0gXGM2Ef		
3. Minna no Nihongo 1-1&1-2 Main Textbook elementary +Translation & Grammatical with downloadable CDs. https://amzn.in/d/0dyQ9ips		
NPTEL and Online Resources		
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 Established: 1983	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics & Artificial Intelligence							
Course Information:								
Class, Semester		S. Y. B. Tech. Semester – III / IV				Category	HS	
Course Code, Course Title		0RAHS209 Psychology				Type	T2	
Prerequisites								
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		01	00	00	01	01		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	50	-		-	-
Course Outcomes (COs):								
Upon successful completion of this course, the student will be able to:								
CO1	Identify the basic concepts of decision making, emotional intelligence, and procrastination from given real-life situations with appropriate accuracy.							
CO2	Differentiate between effective and ineffective thinking patterns, emotional responses, and time-management behaviors in structured scenarios with logical reasoning.							
CO3	Apply suitable psychological strategies for decision making, emotional regulation, and task management in case-based scenarios.							
CO4	Analyze the influence of cognitive biases, emotions, distractions, and mindset on personal and academic performance.							
CO5	Select appropriate behavioral and self-management techniques from given practical situations to effectively improve focus, interpersonal understanding, and productivity							
Syllabus:								
Module	Contents						Lecture Hours	
I	Smart Thinking & Decision Making - What is decision making - Importance in engineering/management - Common mistakes (3 biases only) - Fast vs Slow thinking - Good enough vs perfect decision - Six Thinking Hats (application) - Individual vs group decision making - Growth Mindset vs Fixed Mindset Decision making in real-life situations						5	
II	Understanding Emotional Intelligence - Understanding emotions and importance - EI vs IQ 5 Domains of EI - Emotional Intelligence and Personality						3	
III	Emotional Regulation & Interpersonal Skills - Impulse control (self-regulation) - Handling criticism (self-management) - Empathy and altruism (social awareness) - Assertiveness (relationship management)						3	
III	Procrastination - Introduction and definition of procrastination - Why do we procrastinate						4	

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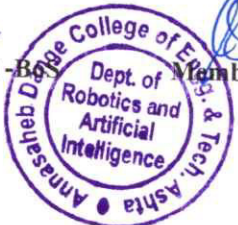
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	• Time management myths • Distractions and attention • Techniques to beat procrastination	
Total Lecture Hours		15
Reference Books		
1.	“Thinking, Fast and Slow”, Daniel Kahneman, Penguin Books, 2011	
2.	Emotional Intelligence: Why It Can Matter More Than IQ”, Daniel Goleman, Bantam Books, 1995	
3.	“Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones”, James Clear, Avery, 2018	
4.	“Deep Work: Rules for Focused Success in a Distracted World”, Cal Newport, Grand Central Publishing, 2016	
5.	“The Power of Habit: Why We Do What We Do in Life and Business”, Charles Duhigg, Random House, 2012	
6.	“Nudge: Improving Decisions About Health, Wealth, and Happiness”, Richard H. Thaler & Cass R. Sunstein, Penguin Books, 2008	
7.	“The 7 Habits of Highly Effective People”, Stephen R. Covey, Free Press, 1989	
NPTEL and Online Resources		
	Youtube Channel:	
1)	https://www.youtube.com/watch?v=O2y1QGCIzMw	
2)	https://www.youtube.com/watch?v=33d61cpRfog	
3)	https://www.youtube.com/watch?v=b6FpfGiENPo	
4)	https://www.youtube.com/watch?v=YLhGgef7SvA	
5)	https://www.youtube.com/watch?v=TOFjyi0tg5w	


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Course Information:											
Class, Semester		S.Y.B. Tech, Semester - III					Category	HS			
Course Code, Course Title		0RAHS210 Environmental Studies					Type	T2			
Prerequisites		-----									
Teaching Scheme (per week)		Lecture		Tutorial		Practical		Self-Study	Credits		
		2		--		-		2	2		
Examination Scheme (Marks)		Theory	MSE		TA		ESE		Practical	CIA	ESE
			-		50		-			-	-
Course Outcomes (COs):											
Upon successful completion of this course, the student will be able to:											
CO1		Explain environmental systems, population dynamics, natural resources, and sustainability concepts.									
CO2		Explain the Sustainable Development Goals (SDGs) and their significance in engineering for sustainable development.									
CO3		Apply pollution concepts to identify sources, impacts, and suitable control measures for air, water, soil, and noise pollution.									
CO4		Apply principles of climate change mitigation and adaptation, renewable energy, waste management, and environmental governance to recommend sustainable engineering practices.									
Syllabus:											
Module		Contents								Lecture Hrs.	
I		Environmental Systems, Population, and Resource Use: Components of environment and earth systems, Population growth, urbanization, and industrial development, Natural resources: water, energy, land, minerals, Resource depletion, carrying capacity, and environmental stress, Human-environment interactions and sustainability challenges								5	
II		Sustainable Development Goals (SDGs) and Engineering Responsibility: Evolution of sustainable development concept, Overview of 17 Sustainable Development Goals and key targets, Interlinkages among SDGs (water-energy-food-climate nexus), SDGs relevant to engineering disciplines, Role of engineers in achieving SDGs								5	
III		Pollution Science and Environmental Quality: Air pollution: sources, types, impacts, and control overview, Water pollution: indicators, standards, reuse and recycling, Soil pollution: contamination sources and remediation concepts, Noise pollution: sources, measurement, impacts, and mitigation.								5	
IV		Climate Change – Science, Mitigation, and Adaptation: Greenhouse effect and climate change science, Evidence of climate change and observed impacts, Mitigation strategies: technology, energy transition, efficiency, Adaptation strategies: climate-resilient infrastructure and planning, Role of engineers in climate action.								5	
V		Renewable Energy and Sustainable Technologies: Overview of renewable energy technologies, Solar energy (PV and thermal systems), Wind energy systems, Hydropower, geothermal, ocean energy, Bioenergy and waste-to-energy, Comparative assessment of renewable technologies.								5	
VI		Waste Management, and Environmental Governance: Solid waste management and E-waste management, Life Cycle Assessment (LCA): concept and applications, Environmental policies and legislation (India and global overview), Environmental Impact Assessment (EIA), Ethics and professional responsibility of engineers								5	
		Total Lecture Hours								30	

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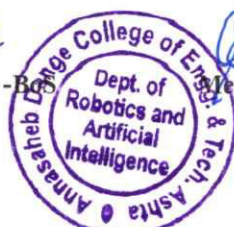
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Text Books:
1. Singh, J. S., Singh, S. P., Gupta, S. R., and Singh, R. Ecology, Environmental Science and Conservation. 2nd Edition. S. Chand Publishing, 2025.
2. Bharucha, E. Environmental Studies for Undergraduate Courses. 4th Edition. Universities Press (India) Pvt. Ltd. 2025.
3. Cunningham, W.P., & Cunningham, M.A., Environmental Science: A Global Concern, 15th Edition, McGraw-Hill Education, New Delhi, 2020.
4. Rathoure, V.C., Fundamentals of Environmental Studies, 2nd Edition, Tata McGraw-Hill Education, New Delhi, 2019
5. Singh, J.S., & Singh, S.P., Environmental Science: An Integrated Approach, 5th Edition, Jones & Bartlett Learning, 2019
6. Kaushik, A., & Kaushik, C.P., Perspectives in Environmental Studies, 5th Edition, New Age International Publishers, New Delhi, 2018.
References:
1. Trivedi, R.K., & Goel, P.K., An Introduction to Environmental Biology, 1st Edition, University Book House, Jaipur, 2018.
2. Odum, E.P., Fundamentals of Ecology, 5th Edition, Cengage Learning, 2017.
3. Dash, M.C., Fundamentals of Ecology, 4th Edition, McGraw-Hill Education, New Delhi, 2016.
Online Learning Resources
1. https://www.youtube.com/watch?v=MtpxOdtS9KU&list=PL3qvHcrYGy1u2egw2tipHWODV6elVC2Gg
2. https://niti.gov.in/divisions/division/sustainable-development-goal
3. https://sdgs.un.org/goals
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_de04


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Course Information:			
Class, Semester	S. Y. B. Tech. Semester – III		Category
Course Code, Course Title	0RACC211– Aptitude and Reasoning Part - I		MA
Prerequisites	-		Type
Teaching Scheme (per week)	Lecture	Tutorial	Credits
	02	00	00
Examination Scheme (Marks)	Theory	MSE	ESE
		-	-
Course Outcomes (COs) :			
Upon successful completion of this course, the student will be able to:			
CO1	Apply quantitative aptitude concepts such as HCF & LCM, Vedic Mathematics, Ages, Percentage, Profit & Loss to solve numerical and real-time problem-solving tasks efficiently.		
CO2	Analyze and solve logical reasoning problems based on Number Series, Alphabet Series, Coding-Decoding, Cubes & Dice by applying systematic analytical approaches.		
CO3	Develop professional and career readiness skills through SWOT Analysis, understanding of Engineering Ecosystem, effective email writing, and essay writing techniques.		
CO4	Demonstrate logical thinking, decision-making ability, and personality development skills to enhance employability and professional effectiveness.		
Syllabus:			
Module	Contents		Lecture Hours
I	HCF & LCM Vedic Math		5
II	Number Series, Alphabet Series (Quant) Percentage		5
III	Profit & Loss Coding-Decoding		5
IV	Cubes & Dice SWOT Analysis		5
V	Introduction to Engineering Ecosystem Ages		5
VI	Email writing, Essay writing Logical Thinking Basics		5
Total Lecture Hours			30
Text Books			
1. Quantitative Aptitude, R.S. Agarwal, S Chand Publications, 2019 Edition.			
2. Verbal & Non-Verbal Reasoning, R.S. Agarwal, S Chand Publications, 2010 Edition.			
3. Wren & Martin (Verbal, Grammar), P.C. Wren, S Chand Publications, 2017 Edition			
References:			
1. APTIPEDIA (Quantitative, Logical, Verbal Aptitude), FACE, Wiley Publications, 2017 Edition.			
2. Wiley Quantitative Aptitude, P.A. Anand, Maestro Publications, 2015 Edition			
3. Verbal Ability, Meenakshi Upadhyay (Arun Sharma Series), McGraw Hill Publications, 2020 Edition.			


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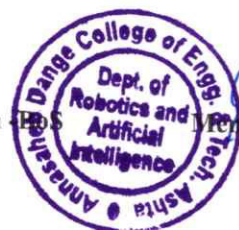

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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:								
Class, Semester		SY. B. Tech, Semester - III					Category	ES
Course Code, Course Title		0RABS212, Mathematics					Type	T1
Prerequisites		-						
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self-study	Credits	
		3	-		-	3	3	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	-	100		-	-
Course Outcomes (COs) : Upon successful completion of this course, the student will be able to:								
CO1		Apply linear algebra concepts using appropriate mathematical techniques to solve matrix and vector-related problems accurately.						
CO2		Analyze multivariable functions and differential equations using standard analytical methods to obtain correct mathematical solutions.						
CO3		Apply probability and statistical concepts using appropriate computational methods to analyze data and uncertainty accurately.						
CO4		Apply numerical interpolation techniques using finite difference methods to estimate unknown values with acceptable accuracy.						
Syllabus:								
Module	Contents							Lecture Hours
I	Matrices and System of Linear Equations: Definition and types of matrices, system of linear equations and their classification, rank of matrix using echelon and normal form, Rouché–Capelli theorem, solution of homogeneous and non-homogeneous systems							7
II	Eigen Values and Eigen Vectors: Definition of vectors in R^n , Linear Dependence and Independence of Vectors, Characteristic Equation of Matrix, Cayley-Hamilton theorem (statement only), Applications of Cayley-Hamilton theorem, Eigen Values and Properties, Eigen Vectors and Properties.							8
III	Partial Differentiation and its applications: Functions of several variables, partial derivatives of first and higher order, Euler’s theorem on homogeneous functions, Jacobians and their properties, maxima and minima of functions of two variables							8
IV	Ordinary Differential Equations: First-order first degree differential equations, linear differential equation, reducible to linear differential equation, exact differential equation, and reducible to exact differential equation.							8
V	Probability and Statistics: Basic probability concepts, conditional probability and Bayes’ theorem, discrete random variables, mathematical expectation, measures of central tendency such as mean, median, mode, and measures of dispersion such as variance and standard deviation.							7
VI	Finite Differentiation and Interpolation: Finite differences, Newton’s forward and backward interpolation, Stirling formula, Lagrange interpolation formula, and Newton’s divided difference formula.							7
Total Lecture Hours							45	

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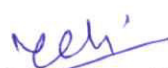
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Text Books

1. N.P. Bali and Manish Goyal , A text book of Engineering Mathematics , 8th Edition, Laxmi Publications ,2011.
2. H. K. Das , Advanced Engineering Mathematics , 22th Edition, S. Chand ,2018.
3. B. V. Ramana, Higher Engineering Mathematics, 6th Edition, Tata McGraw Hill Publ., 2010
4. Erwin Kreyszig , Advanced Engineering Mathematics , 9th Edition, John Wiley & Sons,Inc ., 2007

References:

1. Dr. B. S. Grewal , Higher Engineering Mathematics , 44th Edition, Khanna Publishers ,2018.
2. N. P. Bali, Manish Goyal , Advanced Engineering Mathematics , 7th Edition, Infinity science press ,2010.
3. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Vol-I, 9th Edition Pune Vidyarthi Griha Prakashan,1984
4. James L. Johnson, Probability and Statistics for Computer Science, 1 Edition, Wiley Publication, 2008.
5. Dr. J. Ravichandran, Probability and Statistics for Engineers, 1 Edition, Wiley Publication, 2012.


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 Established:		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist.: Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence								
Course Information:										
Class, Semester		SY. B.Tech, Semester - IV					Category	PC		
Course Code, Course Title		0RAPC213, Hydraulic and Pneumatic Drives for Robots					Type	LIT1		
Prerequisites		0RAES102								
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self Study		Credits		
		2	-		2	2		3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE		
			40	20	40		50	50		
Course Outcomes (COs) :										
Upon successful completion of this course, the student will be able to:										
CO1		Apply hydraulic and pneumatic principles to fluid power systems using appropriate components, circuits, and control elements.								
CO2		Design hydraulic and pneumatic control circuits for automation applications using suitable actuators, valves, and circuit design methods.								
CO3		Develop PLC programs for industrial automation problems using standard instructions, ladder logic, and control strategies.								
CO4		Analyze DCS and integrated automation systems for industrial applications based on their architecture, communication, and control functions.								
Syllabus:										
Module		Contents							Lecture Hours	
I		Hydraulic Systems in Automation: Hydraulics: Fluid properties, Pascal's Law and applications, Fluid power symbols, Hydraulic pumps, Sizing of Pumps, Pump Performance, Characteristics and Selection, Control valves: Direction control valves, Pressure control valves, Flow control valves, Hydraulic Proportional Valves, Servo valves. Accumulator- types, application circuits. Design and analysis of typical Industrial hydraulic circuits. Accessories used in fluid power system, Filtration systems and maintenance of system.							5	
II		Pneumatics Systems in Automation: Gas laws, Preparation of air, Fluid-conditioning elements, Actuators, Sizing of Actuators, Control valves: Direction control valves, Pressure control valves, Flow control valves. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling, Pneumatic circuit design: Cascade method, step – counter method. Fluid logic devices. Circuits using Fluid logic devices and applications							5	
III		Fluid Power Circuits & Control: Control of Single and Double Acting Hydraulic Cylinders, Control of Single and Double Acting Pneumatic Cylinders, Electrical Controls for Fluid Power Circuits, Electro-hydraulic and Electro Pneumatic Circuits, Examples of Fluid Power Circuits in Robotics.							5	
IV		Programmable Logic Controllers Introduction Parts of PLC Principles of operation PLC sizes PLC hardware components I/O section Analog I/O modules Digital I/O modules CPU processor memory module PLC programming simple instructions Output control devices Latching relays PLC ladder diagram.							6	
V		Instructions Timer instructions ON Delay, OFF Delay and Retentive Timers UP Counter, DOWN Counter and UP/DOWN Counters Program control instructions – Data manipulating instructions Math instructions. APPLICATION OF PLC Traffic light control 24-hour clock design Automatic stacking process Temperature control							6	
VI		Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS. APPLICATIONS OF DCS Pulp and paper environment Power plant Petroleum refining environment Wireless control system in challenging environments like welding shops Introduction to Soft PLC.							3	
Total Lecture Hours								30		

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List of Experiments with CO Mapping		
S. No	Title / Topic of the Experiment	CO Mapped
1	Study of hydraulic trainer kit components	CO1
2	Operation of Single Acting Hydraulic cylinder	CO1
3	Operation of Double Acting Hydraulic cylinder	CO1
4	Pressure relief valve characteristics	CO1
5	Flow control valve characteristics	CO1
6	Operation of solenoid operated 4/2 direction control valve	CO1
7	Review	
8	Operation of solenoid operated 4/3 direction control valve	CO3
9	PLC control of Hydraulic cylinder	CO3, CO4
10	Demonstrate and Hands on the Application of hydraulics using PLC	CO3, CO4
11	Operation of Single-Acting Pneumatic Cylinder using 3/2 Valve and Double-Acting Pneumatic Cylinder using 5/2 Valve	CO2
12	Operation of Pneumatic Rotary Actuator	CO2
13	PLC Control of Cylinder and Rotary Actuator Sequence	CO2, CO4
14	Review	
15	Final Submission	
Total Practical Hours		30
Text Books		
1. Fluid Power, Anthony Esposito, Prentice Hall Publications. 2. Industrial Hydraulics and Pneumatics, Stewart 3. Industrial Hydraulics and Pneumatics, H.P. Garg. 4. Oil Hydraulic Systems: Principles and Maintenance by S. R. Mujumdar 5. Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 6. Lucas, M.P., Distributed Control System, Van Nostrand Reinhold Co. NY.		
References:		
1. Industrial Hydraulics, Vickers Handbook. 2. Hydraulics-Basic level TP501 handbook by FESTO. 3. Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi. 4. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA Publication. Bolton, "Programmable Logic Controllers" Newnes.		
Online Learning Resources		
1. NPTEL Course on Industrial Hydraulics and Automation https://onlinecourses.nptel.ac.in/noc24_me69/preview 2. NPTEL Course on Oil Hydraulics and Pneumatics https://onlinecourses.nptel.ac.in/noc24_me55/preview 3. NPTEL Course on Industrial Automation and Control https://onlinecourses.nptel.ac.in/noc21_me67/preview		


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 Established:	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:								
Class, Semester		S. Y. B. Tech. Semester - IV					Category	PC
Course Code, Course Title		0RAPC214 – Data Structures and Algorithms					Type	LIT2
Prerequisites		0RAES111						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		02	00	02	02	03		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		50	-
Course Outcomes (COs):								
Upon successful completion of this course, the student will be able to:								
CO1	Apply algorithmic concepts and complexity analysis to computational problems using appropriate data abstraction and recursion techniques.							
CO2	Implement linear data structures for data organization and processing using suitable operations and representations.							
CO3	Analyze searching, sorting, and hashing techniques for data management based on efficiency and problem requirements.							
CO4	Apply tree and graph data structures to solve computational problems using appropriate traversal and representation methods.							
Syllabus:								
Module	Contents							Lecture Hours
I	Basics of Data Structures: Algorithm, ADT, Space and Time Complexity, Recursion							2
II	Lists Definition, representation, operations, implementation and applications of singly, doubly and circular linked lists							7
III	Stack and Queue Stacks as ADT, operations, representation using static and dynamic structures, applications of stack Queue as ADT, operations, representation using static and dynamic structures, circular queue, priority queue, double ended queue							6
IV	Searching and Sorting Techniques Linear search, binary search, bubble sort, selection sort, insertion sort, merge sort, quick sort, radix sort. Hashing – Definition, hash functions, overflow, collision, Collision resolution techniques, Open addressing, Chaining							6
V	Trees Basic terminology, representation, binary tree, traversal methods, binary search tree, AVL search tree, Heaps- Operations and their applications							5
VI	Graphs Basic concept of graph theory, storage representation: adjacency matrix, adjacency list, adjacency multi-lists, graph traversal techniques- BFS and DFS							4
Total Lecture Hours							30	
Note- For DSA use Python Programming Language								
List of Experiments								
S. No	Title / Topic of the Experiment							
1	Introduction to lab and Function and Recursion							CO1
2	Singly Linked List							CO2
3	Doubly Linked List							CO2
4	Circular Linked List							CO2
5	Stack							CO2
6	Queue							CO2

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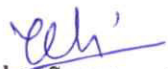
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7	Review	
8	Sorting Techniques – Bubble, Selection, Insertion, Merge and Quick Sort	CO3
9	Searching Techniques- Linear, Binary Search	CO3
10	Binary Search Trees and traversal	CO4
11	AVL tree & HEAP operation	CO4
12	Graph traversal technique- BFS & DFS	CO4
13	Graph using adjacency list	CO4
14	Review	
15	Final Submission	
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1.	Data Structures- A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzon, Cengage Learning, 2nd Edition, 2004.	
2.	Data Structures with C Schaum's Outlines Series, S. Lipschutz, Tata McGraw-Hill, 2017.	
3.	Data Structure using C, Reema Thareja, Oxford, 2nd Edition, 2014.	
Reference Books		
1.	Data Structure using C, A. M. Tanenbaum, Y. Langsam, M. J. Augenstein, Prentice-Hall Of India Pvt. Limited, 2003.	
2.	Understanding Pointers in C, Yashavant Kanetkar, BPB Publication, 2009.	
3.	C and Data Structures, N. B. Venkateshwarlu, E. V. Prasad, S. Chand and Company, 2010.	
4.	Let Us C, Yashavant Kanetkar, BPB Publication, 2016.	
Online Courses:		
https://nptel.ac.in/courses/106102064 - Introduction to Data Structures and Algorithms		


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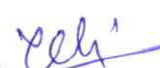

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 Established: 1999		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:								
Class, Semester		SY. B. Tech, Semester - IV					Category	PC
Course Code, Course Title		0RAPC215, Microcontroller Based System Design					Type	LIT1
Prerequisites		0RAPC203						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		2	-	2	2	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		50	50
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain microcontroller architectures, embedded systems, and memory organization using appropriate hardware and architectural concepts.							
CO2	Develop microcontroller programs for embedded applications using suitable instructions, programming techniques, and development tools.							
CO3	Apply interfacing and communication techniques in embedded systems using appropriate peripheral devices and communication protocols.							
CO4	Implement IoT-enabled embedded applications using modern development platforms employing suitable hardware, software, and cloud integration techniques.							
Syllabus:								
Module	Contents							Lecture Hours
I	Microcontroller Fundamentals and Architecture: Overview of microcontrollers: 8-bit, 16-bit, and 32-bit microcontrollers; comparison and industry relevance; Definition and characteristics of embedded systems; role of microcontrollers in embedded systems; Overview of the 8051 microcontroller family and introduction to ARM7, Intel Core series (i3/i5/i7), 8051 Internal Architecture: CPU, ALU, working registers, Stack & Stack Pointer, Program Counter, SFRs, I/O ports; Memory organization: RAM, ROM, Program/Data Memory, Clock & Reset circuits, Timing diagrams, Machine cycles							5
II	Programming and Instruction Set : Addressing modes: Immediate, Register, Direct, Indirect, Relative, Indexed, Bit-inherent, Bit-direct; 8051 Instruction Set: Data transfer, Arithmetic, Logical, Branch, Subroutine, Bit manipulation; Programming approaches: Assembly language programming, C programming for 8051; Use of assemblers, compilers, programming, and debugging tools; Interrupts: Types, programming, and handling.							5
III	I/O, Communication Interfaces, and Applications : Interfacing peripheral devices: General Purpose I/O, timers, counters, memory devices; Serial communication: Synchronous & Asynchronous, RS232, SPI, I2C; Introduction to wireless interfaces: Bluetooth, Wi-Fi; interfacing basics, Applications in Robotics & AI: LED, LCD, keyboard interfacing, Stepper motors, sensors, ADC/DAC, and signal conditioning							5
IV	Arduino & ESP32 : Introduction to Embedded Systems, Arduino & ESP32 platforms, IDEs, pinout, GPIO basics, Digital & Analog I/O: ADC, PWM, controlling LEDs, buzzers, motors, Communication Protocols: UART, I2C, SPI, wireless (Bluetooth/Wi-Fi), IoT & Cloud Integration: ESP32 with ThingSpeak/MQTT, remote monitoring,							5
V	Raspberry Pi: Introduction to Raspberry Pi, embedded Linux, GPIO, and industrial applications, Digital & Analog Interfacing (via ADC modules), PWM, sensors, and actuators, Communication Protocols: UART, I2C, SPI, and wireless connectivity, IoT & Cloud Integration: MQTT, HTTP, ThingSpeak, Node-RED,							5
VI	STM32: Introduction to STM32, ARM Cortex-M architecture, development tools (STM32CubeIDE, HAL, CubeMX), industrial applications; Digital & Analog I/O, PWM, timers, and interrupts; Communication Protocols: UART, I2C, SPI, RS-485, CAN, USB; IoT & Wireless Integration: Wi-Fi (via ESP modules), BLE, MQTT, HTTP;							5
Total Lecture Hours							30	


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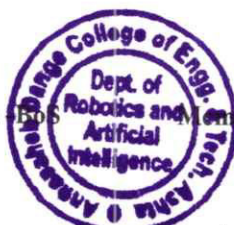

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List of Experiments with CO Mapping			
Sr. No	Title / Topic of the Experiment	CO Mapped	
1	Introduction to lab and LED Blinking and Switch Input (8051/ARM7) – Demonstrate basic GPIO output and digital input using LEDs and switches.	CO1, CO2	
2	Arithmetic and Logic Operations (8051/ARM7) – Perform arithmetic and logic operations using microcontroller instructions.	CO2	
3	Timer and Interrupt-Based LED Control (8051/ARM7) – Implement timers and interrupts to control LEDs.	CO1, CO2	
4	7-Segment / LCD Display Interface (8051/ARM7) – Display numeric/character data using 7-segment or LCD.	CO2, CO3	
5	Stepper / DC Motor Control (8051/ARM7) – Control motors using GPIO and PWM signals.	CO2, CO3	
6	Digital & Analog I/O with Sensors (Arduino/ESP32) – Read and process digital and analog sensor data.	CO3, CO4	
7	Review		
8	PWM Control of LEDs and Motors (Arduino/ESP32) – Control LED brightness and motor speed using PWM.	CO3, CO4	
9	UART / I2C / SPI Communication (Arduino/ESP32) – Interface multiple devices using serial communication protocols.	CO3	
10	ESP32 IoT & Cloud Data Logging (Arduino/ESP32) – Send sensor data to cloud platforms like ThingSpeak/MQTT.	CO3, CO4	
11	Mini Project: Smart Home / Automation (Arduino/ESP32) – Build an IoT-enabled automation prototype.	CO3, CO4	
12	IoT Data Acquisition & Cloud Integration (Raspberry Pi) – Acquire sensor data and upload to cloud dashboards.	CO3, CO4	
13	STM32 Mini Project: Multi-Sensor & Wireless Prototype – Integrate sensors, actuators, and wireless communication for IoT applications.	CO3, CO4	
14	Review		
15	Final Submission		
Total Practical Sessions		15	Total Practical Hours
			30
Note: Expt. 1- 5:- Perform using ALP & C language programming, compare the results & comment on the same.			
Expt. 6-12 :- Implement with hardware components			
Text Books			
1. Krishna Kant , Microprocessors and Microcontrollers: Architecture, Programming and System Design, 2nd Edition, PHI / Eastern Economy Edition, 2012			
2. R.S. Gaonkar , Microprocessor Architecture, Programming, and Applications with the 8085, 6th Edition, Penram International, 2013			
3. Dogan Ibrahim , Advanced PIC Microcontroller Projects in C, 2nd Edition, Elsevier / Newnes, 2018			
4. Stephen F. Barrett, Daniel J. Pack , Embedded Systems Design with the Atmel AVR Microcontroller, 2nd Edition, Elsevier, 2012			
References:			
1. Andrew N. Sloss, Dominic Symes, Chris Wright , ARM System Developer's Guide: Designing and Optimizing System Software, 2nd Edition, Morgan Kaufmann, 2004			
2. Michael McRoberts , Programming Embedded Systems in C and C++, 2nd Edition, O'Reilly Media, 2006			
3. Dogukan Koksall, Mehmet Ali Aydin , Hands-On Microcontroller and Embedded Systems Projects with Arduino, ESP32, and STM32, Packt Publishing, 2022			
4. Dogukan Koksall, Mehmet Ali Aydin , Hands-On Microcontroller and Embedded Systems Projects with Arduino, ESP32, and STM32, Packt Publishing, 2022			
Online Learning Resources			
1. Embedded System Design with ARM by Prof. Prof. Indranil Sengupta , https://onlinecourses.nptel.ac.in/noc25_cs29			
2. Embedded Systems by Dr. Umashanker Sahu https://www.classcentral.com/course/swayam-embedded-systems-503678?			


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:								
Class, Semester		SY. B. Tech, Semester - II				Category	PE	
Course Code, Course Title		0RAPE216, Mobile and Micro Robotics				Type	T1	
Prerequisites		0RAPC202						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		3	-	-	3	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain mobile robot configurations, locomotion mechanisms, sensors, and operating environments using appropriate robotic principles and classifications.							
CO2	Analyze kinematics, dynamics, localization, and motion control of mobile robots using suitable mathematical models and sensing techniques.							
CO3	Apply micro-robotic design, fabrication, and actuation concepts using appropriate microfabrication and micro-assembly techniques.							
CO4	Evaluate intelligent navigation and autonomous robotic systems using AI techniques, localization methods, and decision-making approaches.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Introduction to Mobile Robots - Tasks of mobile robots, robots manufacturers, type of obstacles and challenges, tele-robotics, philosophy of robotics, service robotics, types of environment representation. Ground Robots: Wheeled and Legged Robots, Aerial Robots, Underwater Robots and Surface Robots.						6	
II	Kinematics and Dynamics of Wheeled Mobile Robots (two, three, four - wheeled robots, omni-directional and macanum wheeled robots). Sensors for localization: magnetic and optic position sensor, gyroscope, accelerometer, magnetic compass, inclinometer, GNSS and Sensors for navigation: tactile and proximity sensors, ultrasound rangefinder, laser scanner, infrared rangefinder, visual system.						9	
III	Motion Control of Mobile Robots (Model and Motion based Controllers): Lyapunov-based Motion Control Designs and Case Studies. Understand the current application and limitations of Mobile Robots. Introduction to Mobile Manipulators and Cooperative Mobile Robots.						7	
IV	Micro-robotics: Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro-robots - Mobility and Functional-based definition of micro- robots - Applications for MEMS based micro-robots. Implementation of Micro-robots: Arrayed actuator principles for micro-robotic applications – Micro-robotic actuators.						7	
V	Micro-Robotics Design, Fabrication and Assembly: Design of locomotive micro-robot devices based on arrayed actuators. Micro-robotics devices: Micro- grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots – Multi- robot system: Micro-robot powering, Micro-robot communication. Microfabrication and Micro-assembly: Micro-fabrication principles - Design selection criteria for micromachining - Packaging and Integration aspects – Micro-assembly platforms and manipulators.						9	
VI	Intelligent Mobile Robotics and Autonomous Navigation: Localization and Mapping in mobile robotics. Artificial Intelligence and Autonomous Navigation in Mobile Robots Introduction to AI in Robotics, Robot Decision Making and Path Planning, Obstacle Avoidance and Machine Learning Basics, Smart Robotics Systems and Applications.						7	
Total Lecture Hours						45		
Text Books								
1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Sacramuzza, Introduction to Autonomous Mobile Robots, MIT press, 2nd edition, 2011.								

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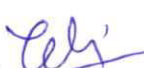
2. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, —Principles of Robot Motion-Theory, Algorithms, and Implementation, MIT Press, Cambridge, 2005.

References:

1. Atnaik, Srikanta, "Robot Cognition and Navigation: An Experiment with Mobile Robots", Springer-Verlag Berlin and Heidelberg, 2007.
2. Spyros G. Tzafestas, "Introduction to Mobile Robot Control", Elsevier, 2021.
3. Margaret E. Jefferies and Wai-Kiang Yeap, "Robotics and Cognitive Approaches to Spatial Mapping", Springer-Verlag Berlin Heidelberg, 2008.

Online Learning Resources

1. <https://nptel.ac.in/courses/112106298> Wheeled Mobile Robots, By Prof. Asokan T, Prof. Santhakumar Mohan | IIT Madras, IIT Palakkad
2. <https://nptel.ac.in/courses/112105236> Mechanism and Robot Kinematics, IIT Kharagpur, Prof. Anirvan Dasgupta


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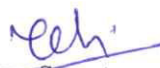

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 Established: 1999		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:								
Class, Semester		SY. B. Tech, Semester - IV					Category	PE
Course Code, Course Title		0RAPE217, Intelligent Decision Systems					Type	T1
Prerequisites		0RAPE201, 0RAVS206						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		3	-	-	3	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain decision-making concepts and intelligent decision systems using appropriate decision models and principles.							
CO2	Analyze uncertainty, risk, and decision-making problems using probabilistic and decision-theoretic approaches.							
CO3	Apply search, planning, optimization, and intelligent decision models to solve engineering and robotic applications.							
CO4	Evaluate autonomous and AI-driven decision systems considering intelligent agents, explainability, ethics, and emerging trends.							
Syllabus:								
Module	Contents							Lecture Hours
I	Foundations of Decision Making Data, Information and Knowledge, Human Decision Making, Decision Making in Intelligent Systems, Rationality and Bounded Rationality, Decision Support Systems, Decision Intelligence Overview. Applications: Manufacturing, Healthcare, Autonomous Vehicles, Smart Cities.							6
II	Decision Making Under Uncertainty Sources of Uncertainty, Risk and Uncertainty, Probability Concepts, Conditional Probability, Bayesian Thinking (Conceptual), Decision Trees, Utility Theory. AI Applications: Medical Diagnosis, Predictive Maintenance, Fault Detection.							8
III	Search, Planning and Optimization Problem Formulation, State Space Representation, Search Concepts, Heuristic Search, Planning in Intelligent Systems, Optimization Concepts. Applications: Robot Navigation, Route Planning, Scheduling Systems.							8
IV	Intelligent Decision Models Rule-Based Systems, Knowledge-Based Systems, Expert Systems, Fuzzy Logic Concepts, Multi-Criteria Decision Making, Hybrid Intelligent Systems. Applications: Industrial Automation, Medical Decision Support, Robotics.							8
V	Autonomous and Agent-Based Decision Systems Intelligent Agents, Agent Architectures, Reactive Systems, Goal-Based Systems, Learning Agents, Multi-Agent Systems, Agentic AI Concepts. Applications: Autonomous Robots, AI Assistants, Intelligent Transportation Systems.							8
VI	Modern Intelligent Decision Systems AI-driven Decision Making, Recommendation Systems (Conceptual), Reinforcement Learning Overview, Explainable AI, Responsible AI, Human-in-the-Loop AI, Future Trends in Intelligent Systems.							7
Total Lecture Hours							45	
Text Books								
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach , Pearson Education, 4th Edition, 2021.								
2. Lorien Pratt, Link: How Decision Intelligence Connects Data, Actions, and Outcomes for a Better World , Wiley, 2023.								


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3. Mykel J. Kochenderfer, Tim A. Wheeler and Kyle H. Wray, **Algorithms for Decision Making**, MIT Press, 2022.

4. Wolfgang Ertel, **Introduction to Artificial Intelligence**, Springer, 3rd Edition, 2024.

References:

1. Daniel Kahneman, **Thinking, Fast and Slow**, Farrar, Straus and Giroux, 2013.

2. David L. Poole and Alan K. Mackworth, **Artificial Intelligence: Foundations of Computational Agents**, Cambridge University Press, 3rd Edition, 2023.

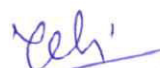
3. Jack R. Benjamin and C. Allin Cornell, **Probability, Statistics and Decision for Civil Engineers**, Dover Publications, 2014.

4. George F. Luger, **Artificial Intelligence: Structures and Strategies for Complex Problem Solving**, Pearson, 6th Edition, 2019.

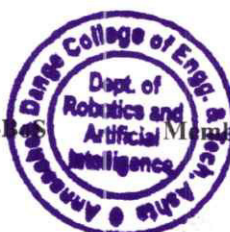
Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs67 **Artificial Intelligence: Search Methods for Problem Solving** (Prof. Deepak Khemani, IIT Madras)

2. <https://nptel.ac.in/courses/106105079> **Introduction to Artificial Intelligence** (Prof. P. Dasgupta, IIT Kharagpur)


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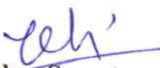

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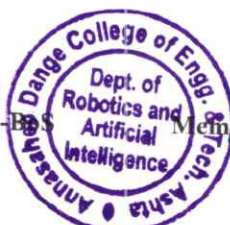



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 Established: 1999		Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:									
Class, Semester		SY. B. Tech, Semester - IV					Category	PE	
Course Code, Course Title		0RAPE218, Intelligent Manufacturing					Type	T1	
Prerequisites		0RAPC202							
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits			
		3	-	-	3	3			
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE	
			40	20	40		-	-	
Course Outcomes (COs) :									
Upon successful completion of this course, the student will be able to:									
CO1	Analyze computer integrated manufacturing and Industry 4.0 architectures using appropriate manufacturing technologies and communication systems.								
CO2	Apply manufacturing information systems and industrial communication techniques for integration of manufacturing operations.								
CO3	Develop intelligent manufacturing solutions using knowledge-based systems, AI techniques, and decision-support approaches.								
CO4	Evaluate smart manufacturing and group technology systems for improving productivity, flexibility, and digital transformation.								
Syllabus:									
Module	Contents							Lecture Hours	
I	Computer Integrated Manufacturing and Industry 4.0 Foundations: Structure and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM, Evolution from CIM to Industry 4.0, Smart Factory Architecture: Shopfloor Level, MES Layer, ERP Layer (SAP/Oracle), Cyber-Physical Systems (CPS), Industrial Internet of Things (IIoT), Cloud Manufacturing, Digital Thread and Digital Twin Concepts.							7	
II	Manufacturing Communication Systems and MES: Manufacturing Automation Protocol (MAP/TOP), OSI Reference Model, Data Redundancy, Top-Down and Bottom-Up Approaches, Manufacturing Information Flow, Manufacturing Execution Systems (MES): Production Tracking, Quality Data Collection, Product Traceability Downtime Monitoring. MES Integration with ERP Systems, Automotive and Discrete Manufacturing Case Studies, Industrial Communication Systems: Industrial Ethernet, Profinet EtherNet/IP, OPC-UA Fundamentals, Introduction to Edge Computing for Manufacturing Data Acquisition							8	
III	Knowledge-Based Systems, AI and Process Planning: Knowledge Representation Techniques, Comparison of Knowledge Representation Schemes Inference Engine, Knowledge Acquisition, Automated Process Planning: Variant Approach, Generative Approach. Expert Systems for Process Planning, Feature Recognition, Phases of Process Planning, AI in Manufacturing: Rule-Based Systems vs Data-Driven AI, Introduction to Machine Learning, AI-Assisted Process Planning, Intelligent Decision Support Systems							8	
IV	Intelligent Manufacturing Decision Systems: Manufacturing System Design, Equipment Selection Problems, Modeling Manufacturing Equipment Selection, Problem Solving Approaches in KBSES, Structure of KBSES AI-Based Manufacturing Applications: Predictive Maintenance, Vision-Based Defect Detection, Process Optimization, Intelligent Resource Allocation. Introduction to Manufacturing Analytics and Data-Driven Decision Making							7	
V	Group Technology and Cellular Manufacturing: Fundamentals of Group Technology (GT): Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation, Similarity Coefficient Method, Sorting-Based Algorithms, Bond Energy Algorithm, Cost-Based Method, Cluster Identification Method, Extended CI Method GT Applications in: Forging Industries, Machining Industries Cellular Manufacturing Layout Design, Industrial Case Study: Reduction in Setup Time, Reduction in Work-In-Process (WIP), Productivity Improvement through GT							8	


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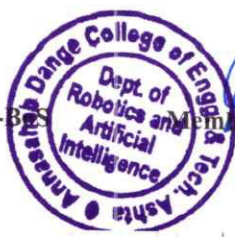
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VI	Knowledge Based Group Technology & Smart Manufacturing Applications: Group Technology in Automated Manufacturing Systems, Knowledge-Based Systems for GT Database Design, Knowledge Base Design, Clustering Algorithms, Digital Twin Applications in Production Systems, Intelligent Warehouse and ASRS Integration, and Smart Factory Implementation Framework Emerging Trends: AI-Enabled Manufacturing, Industry 5.0 Concepts, Human-Robot Collaboration in Manufacturing	7
Total Lecture Hours		45
Text Books		
1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., 2008.		
2. Computer Integrated Manufacturing & Computer Aided Manufacturing, Walnut Publication, 2021.		
3. John R. Rehg and Henry W. Kraebber, Computer-Integrated Manufacturing, 3rd Edition, Pearson, 2024.		
4. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.		
References:		
1. Andrew Kusiak, Intelligent Manufacturing Systems, Prentice Hall, 1990.		
2. Taylan Altan, Smart Manufacturing: The Lean Six Sigma and Industry 4.0 Connection, CRC Press, 2021.		
3. August-Wilhelm Scheer, CIM: Computer Integrated Manufacturing – Towards the Factory of the Future, Springer, 1991.		
4. Charles Møller and Niels H. Jørgensen, Manufacturing Execution Systems (MES): Optimal Design, Planning and Deployment, McGraw-Hill Education, 2005.		
Online Learning Resources		
1. Computer Integrated Manufacturing Course (IIT Kanpur), Prof. J. Ramkumar, Prof. Amandeep Singh Oberoi https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me48		


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Course Information:								
Class, Semester		SY. B. Tech, Semester - IV				Category	PE	
Course Code, Course Title		0RAPE219, Signals and Systems				Type	T1	
Prerequisites		0RABS101, 0RABS108, 0RABS201						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		3	-	-	3	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Analyze continuous-time and discrete-time signals and systems using appropriate signal characteristics and system properties.							
CO2	Apply time-domain analysis techniques to LTI systems using convolution, differential equations, difference equations, and state-space methods.							
CO3	Analyze signals and systems in the transform domain using Fourier, Laplace, and z-transform techniques.							
CO4	Evaluate sampled data systems and signal processing applications considering sampling, reconstruction, stability, and frequency-domain characteristics.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. Classification of systems - Static and dynamic, Linear and nonlinear, Time-variant and time-invariant, Causal and non-causal, Stable and unstable, Impulse response and step response of systems. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.						8	
II	Module 2: Behavior of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.						7	
III	Module 3: System Analysis of Fourier Transforms: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. Continuous-time Fourier transform (CTFT), The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem, Inverse Fourier Transform.						8	
IV	Module 4: System Analysis of Laplace Transform: Relation between Laplace and Fourier transforms, Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, Inverse Laplace transform, solution to differential equations and system behavior.						7	
V	Module 5: System Analysis of z-Transforms: The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis, s-plane to z-plane mapping, Inverse z-transform, Solution to difference equations using z-transform, Region of convergence, Stability analysis.						8	

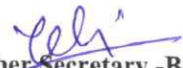

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VI	Module 6: Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	7
Total Lecture Hours		45
Text Books		
1. Michael J. Robert, "Introduction to Signals and Systems", TMH, Second edition, 2003.		
2. Tarun Kumar Rawat "Signals and Systems", Oxford University Press, First edition, 2010.		
3. Alan V Oppenheim, Alan S Willsky, "Signals and systems" PHI, Second edition, 2009.		
4. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.		
References:		
5. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.		
6. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.		
7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.		
8. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.		
Online Learning Resources		
1. https://onlinecourses.nptel.ac.in/noc26_ee37/preview?utm_source=chatgpt.com		


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:							
Class, Semester		SY. B.Tech, Semester - I				Category	MM
Course Code, Course Title		0RAMM220, Introduction to Robotics				Type	LIT2
Prerequisites		0RAPC202					
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits		
	3	-	-	3	4		
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		40	20	40		50	-
Course Outcomes (COs) :							
Upon successful completion of this course, the student will be able to:							
CO1	Explain robot structures, components, sensors, actuators, and end effectors using appropriate robotic principles and specifications.						
CO2	Apply robot kinematics, motion concepts, and programming fundamentals to analyze robot operation and industrial applications.						
CO3	Analyze mobile robots and intelligent robotic systems using localization, navigation, and AI-based approaches.						
CO4	Evaluate emerging robotic technologies and multidisciplinary applications considering safety, ethics, human-robot interaction, and societal requirements.						
Syllabus:							
Module	Contents					Lecture Hours	
I	Introduction to Robotics: Definition and History of Robotics, Components of a Robot System, Basic Robot Anatomy and Degrees of Freedom (DOF), Classification of Robots based on Structure and Application, Cartesian Robot, Cylindrical Robot, Spherical Robot, Articulated Robot, SCARA Robot, Industrial Robot Specifications, Workspace, Payload, Speed, Accuracy,					6	
II	Robot Architecture and Subsystems Motion System, Recognition System, Control System, Power Supply System, Introduction to End Effectors, Sensors and its selection, Mechanical Grippers, Vacuum Grippers, Magnetic Grippers, Selection of Grippers, Applications of Grippers,					9	
III	Basics of Robot Kinematics and Applications: Introduction to Robot Manipulators, Coordinate Systems and Reference, Robot Motion and Path Planning (Introduction), Robot Programming Concepts, Industrial Applications of Robots, Material Handling, Pick and Place Operations, Welding, Painting, Assembly, Inspection, Emerging Applications, Medical Robots, Agricultural Robots, Service Robots					7	
IV	Mobile Robotics and Autonomous Systems: Introduction to mobile robots, types of mobile robots (wheeled, legged, aerial and underwater robots), applications in various domains. Basic locomotion concepts. Introduction to sensors used in mobile robots for localization and navigation (proximity sensors, ultrasonic sensors, infrared sensors, vision systems). Concept of robot localization and mapping (basic idea). Applications such as delivery robots, drones, and autonomous vehicles.					9	
V	Artificial Intelligence and Applications in Robotics: Introduction to artificial intelligence in robotics, automated vs autonomous systems. Basic decision-making in robots, rule-based and behavior-based approaches. Concept of path planning and obstacle avoidance (intuitive understanding). Introduction to machine learning concepts (supervised and reinforcement learning) and their applications in robotics. Case studies of AI-based robots in industries such as healthcare, agriculture, manufacturing, and smart cities.					7	
VI	Emerging Trends and Multidisciplinary Applications of Robotics: Introduction to collaborative robots (cobots) and human-robot interaction. Applications of robotics in various engineering domains: manufacturing, construction, healthcare, agriculture, logistics, and space. Basics of Internet of Things (IoT) in robotics and smart systems. Introduction to swarm robotics and multi-robot systems (conceptual). Industrial					7	

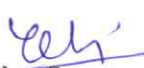
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	robot safety, collaborative robot safety, basic risk assessment concepts, safety standards and regulations for robotic systems, Ethical, safety, and societal issues in robotics. Future trends and challenges in robotics.		
Total Lecture Hours			45
Sr. No.	Title / Topic of the Experiment		CO Mapped
1	Introduction to lab		-
2	Development and Control of an Automated 2D Path Tracing System		CO2
3	Implementation of Robotic Pick-and-Place Operations for Palletization		CO2
4	Design of a Vision-Guided, Color-Based Conveyor Pick-and-Place System		CO1, CO2
5	Vision-Based Surface Defect Detection and Automated Quality Sorting Material		CO1, CO3
6	Classification Using Inductive and Capacitive Proximity Sensors Design and		CO1
	Review		
7	Calibration of a Weight-Based Material Sorting System		CO1
8	Integration of Color Vision-Guided Pick-and-Place with Defect Detection Sorting		CO1, CO2, CO3
9	Multi-Criteria Sorting System: Integrating Color Vision, Defect Detection, and Inductive–Capacitive Material Sensing		CO1, CO2, CO3
10	Design of an Advanced Multi-Modal Industrial Sorting Line Combining Computer Vision, Material Sensing, and Weight Verification		CO1, CO2, CO3, CO4
11	Automated Package Sorting Using Optical Character Recognition (OCR)		CO2, CO3, CO4
	Review		
	Final Submission		
Total Practical Sessions		15	Total Practical Hours
			30
Text Books			
1. John J. Craig, Introduction to Robotics, Pearson Education Inc., Asia, 3rd Edition, 2005.			
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press, 2006.			
3. Dilip Kumar Pratihari, Fundamentals of Robotics, Narosa Publishing House, 2019.			
References:			
1. S. K. Saha, Introduction to Robotics, TATA McGraw Hills Education, 2014. S. B. Nikku,			
2. Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., 2020.			
3. Michael Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems (3rd Edition), 2011.			
4. Vinod Chandra S.S., Anand Hareendran S, "Artificial Intelligence and Machine Learning", 2014.			
Online Learning Resources			
1. https://nptel.ac.in/courses/112105236 Mechanism and Robot Kinematics, IIT Kharagpur Prof. Anirvan Dasgupta			
2. https://nptel.ac.in/courses/112108298 Robotics: Basics and Selected Advanced Concepts, IISc Bangalore, Prof. Ashitava Ghosal			


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Course Information:							
Class, Semester	SY. B. Tech, Semester –I				Category	HS	
Course Code, Course Title	0RAHS221 Indian Constitution				Type	T2	
Prerequisites	-						
Teaching Scheme (per week)	Lecture 1	Tutorial -	Practical -	Self-Study 1	Credits 1		
Examination Scheme (Marks)	Theory	MSE -	TA 50	ESE -	Practical	CIA -	ESE -
Course Outcomes (COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Describe the evolution and salient features of the Indian Constitution using the Government of India Acts of 1935 and 1947.						
CO2	Illustrate the philosophy of the Indian Constitution using the Preamble, Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy						
CO3	Explain the constitutional amendment process, principles of the Basic Structure, and emergency provisions under the Indian Constitution						
CO4	Summarize the structure and functioning of the Union and State Governments using the parliamentary and legislative systems.						
Syllabus:							
Module	Contents					Lecture Hours	
I	Constitution: Basic Structure & Making of Constitution Meaning of the constitution law and constitutionalism, Historical perspective of the constitution of India, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Meaning and importance of Constitution, Making of Indian Constitution – Sources, Salient features of Indian Constitution, Preamble.					04	
II	Fundamental Rights & Fundamental Duties Fundamental Rights – Features and characteristics, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles-Definition and Meaning, 42 nd Constitutional Amendment Act, List and Importance of Fundamental Duties.					06	
III	Amendments of Constitution and Emergency Provisions: Meaning and need of Constitutional Amendments, Procedure of Amendment under Article 368, Types of Amendments, Important Constitutional Amendments (42 nd , 44 th , 73 rd , 74 th , 86 th and 101 st Amendments), Basic Structure Doctrine. Emergency Provisions – Meaning and Objectives, National Emergency (Article 352), State Emergency/President's Rule (Article 356), Financial Emergency (Article 360), Effects of Emergency on Fundamental Rights and Centre-State Relations, Safeguards introduced by 44 th Constitutional Amendment.					03	
IV	Government of The Union and States: President of India – Election and Powers, Prime Minister of India - Election and Powers, Lok Sabha - Structure, Rajyasabha – Structure, Governor of State, Chief Minister and Council of Ministers in a state.					02	
Total Lecture Hours					15		
Text Books							
1. M. Laxmikanth, Indian Polity, 7th Edition, McGraw Hill Publications Delhi, 2023.							
2. P. M. Bakshi, The Constitution of India, 19th Edition, Lexis Nexis, 2023.							


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| 3. Durga Das Basu, Introduction to the Constitution of India, 26th Edition, Lexis Nexis, 2022. |
| 4. M. Laxmikanth, Governance in India, 3rd Edition, McGraw Hill Publications Delhi, 2021. |
| 5. J. N. Pandey, The Constitutional Law of India, 59th Edition, Allahabad: Central Law Agency, 2022. |

References:

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| 1. V. N. Shukla, Constitution of India, 14th Edition, EBC, 2022. |
| 2. V. N. Tripathi, Constitution of India, 9th Edition, Premier Publishing Company, 2021. |
| 3. M. V. Pylee, India's Constitution, 18th Edition, S. Chand Publications, New Delhi, 2020. |

Online Learning Resources

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| 1. https://legislative.gov.in/constitution-of-india/ |
| 2. nptel.ac.in/courses/129106003?utm |


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:								
Class, Semester		SY. B. Tech, Semester - IV					Category	HS
Course Code, Course Title		0RAHS222, Universal Human Values					Type	T2
Prerequisites								
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self Study	Credits	
		2	-		-	-	2	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	50	-		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain the evolution, need, and significance of Universal Human Values in the context of global developments, societal challenges, and professional life.							
CO2	Apply the understanding of self, harmony, and human relationships to improve personal behavior and interpersonal interactions.							
CO3	Demonstrate the principles of social and environmental responsibility by relating human actions to sustainable and ethical living.							
CO4	Analyze ethical issues in engineering and emerging technologies such as Artificial Intelligence and Robotics using appropriate ethical frameworks.							
CO5	Evaluate value-based decisions and approaches for personal growth and professional practice through reflection and case analysis.							
Syllabus:								
Unit	Contents							Lecture Hours
I	Evolution and Need of Universal Human Values: Meaning and concept of Universal Human Values, Historical evolution of value systems, Impact of Industrial Revolution on society and lifestyle, Consequences of World War II and global conflicts, Emergence of global value frameworks, Role of United Nations and UNESCO, Introduction of UHV in Indian education system by AICTE, Present-day challenges: stress, lack of purpose, environmental issues							05
II	Understanding the Human Being: Human being as a combination of self and body, Distinction between self (consciousness) and body (physical entity),Needs of self vs needs of body, Happiness vs physical pleasure, Harmony in the self (thoughts, feelings, actions),Self-exploration and self-awareness							05
III	Harmony in Relationships: Meaning and importance of relationships, Values in relationships (Trust, Respect, Affection, Care, Guidance, Reverence, Love), Mutual fulfillment in relationships, Role of family in value development, Interpersonal conflicts and resolution, Relationship in professional environment							05
IV	Harmony in Society and Nature: Individual → Family → Society → Nation → World, Concept of undivided society, social harmony and responsibility, Coexistence in nature, Human-nature relationship, Environmental degradation and its causes, Sustainable living and resource utilization, Local and global environmental issues							05

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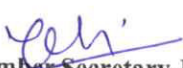
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V	Universal Human Values in Engineering and Technology: Professional ethics in engineering, Role of engineers in society, Guidelines by IEEE, Ethical issues in modern technology, Role of institutions like OpenAI, Core Framework to Assess Values: Self-Reflection Model, Value-Action Gap Model, Emotional Intelligence (EQ) Framework.	05
VI	Application of UHV in Personal and Professional Life: Self-reflection and personal development, Value-based decision making, Goal setting with values, Application of UHV in career and workplace, Development of holistic and responsible lifestyle, Core Framework to Assess Values: Emotional Intelligence (EQ) Framework, Ikigai Model.	05
Total Lecture Hours		30
Text Books		
1. Human Values and Professional Ethics: R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books, New Delhi, 2010		
2. Engineering Ethics: Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2013		
3. Understanding Human Being, Nature and Existence Comprehensively: UHV Team, UHV, 2022.		
4. Life 3.0, Max Tegmark, Knopf, 2017		
References:		
1. AICTE Universal Human Values Course Material, 2017 onwards		
2. IEEE Code of Ethics		
3. Engineering Ethics: Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2013		
Online Learning Resources		
1. TED Talks on ethics, happiness, human behaviour		
2. NPTEL Courses on UHV and Engineering Ethics		
3. MIT: AI Ethics lectures (OpenCourseWare)		


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence						
Course Information:							
Class, Semester	S. Y. B. Tech. Semester - IV				Category	RM	
Course Code, Course Title	0RARM223 Research Methodology				Type	L2	
Prerequisites	--						
Teaching Scheme (per week)	Lecture		Tutorial		Practical	Self-Study	Credits
	00		00		02	00	01
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		00	00	00		50	00
Course Outcomes (COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Utilize fundamental concepts of research, research problems, literature sources, and research methodologies for engineering applications under given research scenarios.						
CO2	Apply appropriate research design, sampling techniques, and data collection methods to conduct systematic research studies under given problem statements.						
CO3	Analyze research data using qualitative, quantitative, statistical, and hypothesis testing techniques under given research scenarios.						
CO4	Develop a technical research article with ethical publication practices, appropriate referencing standards, and quality research guidelines.						
Syllabus:							
Module	Contents					Lecture Hours	
I	Research Fundamentals Meaning and objectives of research, Significance of research, Types of research, Research process, Criteria of Good Research, Importance of Research in Engineering					4	
II	Research Problem & Literature Review Meaning of Research Problem, Identification & Formulation of research Problem, Techniques for defining Research Problem, Literature Sources: Journals, Conferences, Patents, Use of Digital Libraries, Literature Review techniques and gap identification.					5	
III	Research Design & Methodology Need & Features of Good Research Design, Types of Research Design: Exploratory, Descriptive, Experimental, Sampling Techniques. Data Collection: Types of Data: Primary, Secondary, Methods of Data Collection: Survey, Questionnaire, Interview, Observation, Experimentation					6	
IV	Data Analysis & Testing of Hypothesis Types of data: Qualitative and Quantitative, Basic statistical tools: Mean, Median, Standard Deviation, Data representation: Tables, Graphs, Charts, Introduction to analysis tools, Interpretation of results, Hypothesis, Basic concepts concerning testing of hypothesis, Procedure for hypothesis testing, Flow diagram of hypothesis testing, Test of hypothesis, Hypothesis testing of Means, Hypothesis testing for differences between Means.					5	
V	Report Writing Introduction Technical Report Writing and tools (Latex), Significance of report writing, Steps in writing report, Types of reports, Layout and structure of reports, Documentation and Referencing Styles, Presentation Tools & Techniques: Zotero & Mendeley.					4	
VI	Research Journals and Publication Ethics Research Journals, Types of Journals, Research Publication Process, Journal Indexing: Meaning and Importance of Journal Indexing, Benefits of Indexed Journals, Major Indexing Databases, (Scopus, Web of Science, Google Scholar, SCI, ESCI, and PubMed), Journal Metrics and Quality Indicators: Impact Factor, h-index, i10-index, CiteScore, SNIP and SJR, Types of Publications, Ethics in Research Publication: Plagiarism and Similarity Index (Turnitin Software), Copyright and Authorship, Duplicate Publication, Clone, Predatory, and Fake Journals, Researcher Profiles and Identifier (ORCID, Researcher ID)					6	
Total Lecture Hours					30		

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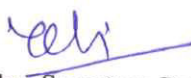
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Text Books
1. Research Methodology–Methods and Techniques by C. R. Kothari, Second Edition, New Age International Publishers
2. Dr. Santosh M Nejakar, Dr. Harish Bendigeri “Research Methodology and Intellectual Property Rights”, ISBN 978-93-5987-928-4, Edition: 2023-24
Reference Books
1. Research Methodology Concept and cases By Deepak Chawala and Neena Sondhi
2. Research Methodology: Step by step guide for beginners, Ranjeet Kumar, 5 th Edition, SAGE Publications
3. How to Write and Publish a Scientific Paper, Robert A. Day, Barbara Gastel, 8 th Edition: 8th Edition, Cambridge University Press
NPTEL and Online Resources
1. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed28
2. https://onlinecourses.swayam2.ac.in/e-learning/course/nou26_ge46

Note: For the smooth and effective execution of this course, the department shall allocate 02 lecture hours in the respective timetables in place of practical hours as per the resolution passed in STT meeting.

ISE Activities

1. Conduct a literature review in the selected domain, identify the research gap, and submit a Literature Review Report.
2. Prepare and submit a Technical Article on the chosen topic based on the literature review.

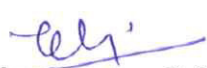

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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence													
Course Information:														
Class, Semester	S. Y. B. Tech. Semester - IV	<table border="1"> <tr> <td>Category</td> <td>EL</td> </tr> </table>	Category	EL										
Category	EL													
Course Code, Course Title	0RAEL224 Innovation and Product Development	<table border="1"> <tr> <td>Type</td> <td>L2</td> </tr> </table>	Type	L2										
Type	L2													
Prerequisites	--													
Teaching Scheme (per week)	<table border="1"> <tr> <td>Lecture</td> <td>Tutorial</td> <td>Practical</td> <td>Self-Study</td> <td>Credits</td> </tr> <tr> <td>00</td> <td>00</td> <td>02</td> <td>00</td> <td>01</td> </tr> </table>	Lecture	Tutorial	Practical	Self-Study	Credits	00	00	02	00	01			
Lecture	Tutorial	Practical	Self-Study	Credits										
00	00	02	00	01										
Examination Scheme (Marks)	<table border="1"> <tr> <td rowspan="2">Theory</td> <td>MSE</td> <td>TA</td> <td>ESE</td> <td rowspan="2">Practical</td> <td>CIA</td> <td>ESE</td> </tr> <tr> <td>00</td> <td>00</td> <td>00</td> <td>50</td> <td>00</td> </tr> </table>	Theory	MSE	TA	ESE	Practical	CIA	ESE	00	00	00	50	00	
Theory	MSE		TA	ESE	Practical		CIA	ESE						
	00	00	00	50		00								
Course Outcomes (COs):														
Upon successful completion of this course, the student will be able to:														
CO1	Identify innovative product ideas by observing real-world problems and user needs using creativity and design thinking tools.													
CO2	Apply design thinking techniques to generate and refine innovative solutions for identified engineering or societal problems based on user requirements.													
CO3	Construct functional prototypes and estimate preliminary production costs using appropriate materials, manufacturing methods, and engineering tools.													
CO4	Analyze prototype performance and production feasibility by interpreting testing results, cost data, and scalability requirements.													
CO5	Evaluate intellectual property opportunities, commercialization potential, and production planning based on technical feasibility, market requirements, and economic considerations.													
CO6	Develop a comprehensive entrepreneurial proposal integrating intellectual property protection, commercialization strategy, and production planning for an innovative product.													
Syllabus:														
The Innovation and Product Development course is designed to provide students with experiential learning in innovation, prototyping, product development, and commercialization. The course focuses on identifying real-world problems and transforming innovative ideas into functional prototypes/models/products through systematic design and development processes.														
Students will learn techniques for validating innovative concepts, assessing feasibility and utility, selecting suitable materials, along with a design-thinking approach and developing prototypes/models/products through iterative improvement and performance testing. The course also emphasizes expert reviews, prototype assessment, cost estimation, pricing strategies, and preliminary production planning for scalability.														
Further, students will gain exposure to Intellectual Property Rights (IPR), commercialization processes, and startup development, enabling them to prepare draft proposals for patenting, commercialization, or entrepreneurial ventures based on their innovative solutions.														


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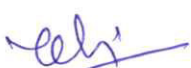



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INNOVATION AND PRODUCT DEVELOPMENT ACTIVITY PLAN

Sr. No	Innovation Prototype Course Activities	Planned Week
01	Introduction to Innovation and Prototyping	Week 1
02	Revising Design Thinking Approach	Week 2
03	Identifying Innovative Problems (Students & Faculty)	Week 3
04	Validating Innovation: Assessing Utility of a Proposed Concept	Week 4
05	Review No. 1 – by Guides - Innovativeness Assessment - (Final Idea Presentation)	Week 5
06	Planning and Designing the Prototype	Week 6
07	Choosing and Testing Materials for the Prototype	Week 7
08	Building the working Prototype / Model/ Product	Week 8
09	Improving working Prototype / Model/ Product	Week 9
10	Testing the Prototype / Model/ Product Performance	Week 10
11	Review No. 2 – by Expert Panel - Prototype/Model/Product Assessment along with poster	Week 11
12	Estimating Costs & Formulating a Pricing Strategy for Product	Week 12
13	Creating a Preliminary Production Plan for Scaling the Prototype	Week 13
14	Formulating IPR or Commercialization or Start up	Week 14
15	Review No. 3 – Submission of Draft Copy for IPR or Commercialization or Start up	Week 15

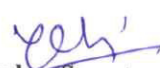

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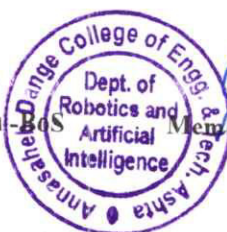

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 Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Robotics and Artificial Intelligence							
Course Information:							
Class, Semester	S. Y. B. Tech. Semester – IV		Category	MA			
Course Code, Course Title	0RACC225– Aptitude and Reasoning Part - II		Type	T2			
Prerequisites	-						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits		
	02	00	00	02	00		
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		-	50	-		-	-
Course Outcomes (COs) : Upon successful completion of this course, the student will be able to:							
CO1	Apply quantitative aptitude concepts such as Partnership, Average, and Syllogism to solve numerical and logical problems effectively.						
CO2	Analyze and solve reasoning-based problems involving Seating Arrangements, Puzzles, and Direction Sense using systematic problem-solving approaches.						
CO3	Demonstrate professional communication and employability skills through presentation skills, grooming, body language, group discussions, and interview techniques for effective participation in hiring processes.						
CO4	Develop career readiness skills by preparing professional resumes, optimizing LinkedIn profiles, and applying networking strategies such as cold calling for internship and job opportunities.						
Syllabus:							
Module	Contents						Lecture Hours
I	Partnership Average						5
II	Seating Arrangements Puzzles						5
III	Syllogism Direction						5
IV	Presentation Skills Grooming & Body Language						5
V	Resume Writing LinkedIn Cold Calling						5
VI	Group Discussion Interview						5
Total Lecture Hours						30	
Text Books							
1. Quantitative Aptitude, R.S. Agarwal, S Chand Publications, 2019 Edition.							
2. Verbal & Non-Verbal Reasoning, R.S. Agarwal, S Chand Publications, 2010 Edition.							
3. Wren & Martin (Verbal, Grammar), P.C. Wren, S Chand Publications, 2017 Edition							
References:							
1. APTIPEDIA (Quantitative, Logical, Verbal Aptitude), FACE, Wiley Publications, 2017 Edition.							
2. Wiley Quantitative Aptitude, P.A. Anand, Maestro Publications, 2015 Edition							
3. Verbal Ability, Meenakshi Upadhyay (Arun Sharma Series), McGraw Hill Publications, 2020 Edition.							


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Annasaheb Dange College of Engineering and Technology
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 (An Empowered Autonomous Institute)
 Department of Robotics and Artificial Intelligence

**Course Information:**

Class, Semester	S.Y. B. Tech – Semester I				Category	ES
Course Code, Course Title	0RAES226, Computer Programming				Type	L2
Prerequisites	-					
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits	
	1	-	2	2	2	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA
		-	-	-		50
						ESE
						-

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Prepare an algorithm and draw a flowchart to accurately solve various mathematical problems by using structured approach.
CO2	Apply the fundamental concepts like data types, operators to solve mathematical problems by using the C language.
CO3	Apply the decision and looping constructs to solve the problems related to decision, repetitive statements for real time problem statement using C
CO4	Develop a C program to demonstrate the modular approach by using the concept of function, structure and pointer
CO5	Compile and debug C program for various problem statements by using structured approach.

Syllabus:

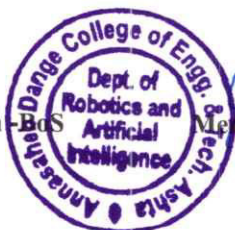
Module	Contents	Lecture Hours
I	Basics of Programming The meaning of algorithms, Flowcharts, Pseudo codes, Writing Algorithms and drawing flowcharts for simple exercises, C Program development environment.	2
II	C Fundamentals Importance of 'C' Language, History, Structure of 'C' Program, Sample 'C' Program, Constants, variables and data types, Enumeration. Operators and expressions, Managing input / output operations, Control statements-Decision making, Case control & Looping Constructs.	3
III	Arrays and Strings 1D and 2D Arrays: Declaration, Initialization, Input/Output; Multidimensional Arrays; String Handling: Basics and Standard Functions	2
IV	Functions User Defined Functions, Function Declaration, Definition, Calling, Return Types, Parameter Passing, Scope, Recursion, Library Functions	2
V	Structure & Pointers Structure Definition, Initialization, Accessing Variables, Arrays of Structures, Structures with Functions, Unions, Pointers: Basics, Arithmetic, Arrays, Strings, Functions, Dynamic Memory Allocation	4
VI	File Handling: File Operations: Open, Read, Write, Close; Error Handling, Random Access Files, Command Line Arguments, Preprocessor Directives	2
Total Lecture Hours		15

List of Experiments with CO Mapping

S. No	Title / Topic of the Experiment	CO Mapped
1.	Write an algorithm & draw flowchart for given problem statement	CO1
2.	Program using different data types and operators, demonstration of operator precedence	CO2
3.	Program using if and if else construct, if else ladder and nested if else	CO3
4.	Program using switch case, demonstrate looping constructs	CO3
5.	Program to demonstrate one dimensional & two-dimensional array	CO3
6.	Implement a program to demonstrate String handling functions & user defined functions	CO3
7.	Review	

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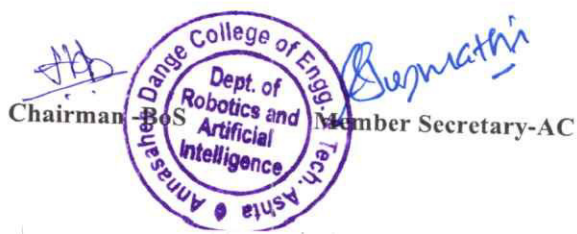
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8.	Program to demonstrate concept of recursion (factorial, Fibonacci)	CO4
9.	Program to demonstrate concept of structures in C	CO4
10.	Program to demonstrate concept of array of structures in C	CO4
11.	Program to demonstrate pointers arithmetic in C	CO4
12.	Implement a program to demonstrate file handling	CO5
13.	Program to demonstrate command line arguments	CO5
14.	Review	
15.	Final Submission	
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1. ISRD Group , Programming and Problem Solving Using C Language , McGraw-Hill Publications ,2012. 2. Yashwant Kanetkar , Let Us C , 3 rd Edition, BPB , 2011. 3. Harvey M. Deitel, Paul J. Deitel, Abbey Deitel , C How to Program ,2 nd Edition, Pearson ,2009. 4. E. Balaguruswamy , Programming in ANSI C , 4 th Edition, BPB Publications, 2008		
References:		
1. D. M. Ritchie, The 'C' Programming Language, 2 nd Edition, Pearson ,1998. 2. Sidnal, C Programming Laboratory: Handbook for Beginners, 1 st Edition, Wiley India Limited, 2012. 3. Yashwant Kanetkar, Understanding Pointers in C, 4 th Edition, BPB Publications,2001. 4. Yashwant Kanetkar, Test Your C Skills, 5 th Edition, BPB Publications, 2013		
Online Learning Resources		
1. NPTEL Course on Computer Programming By Dr. T. Sugirtha IIIT Tiruchirappalli https://nptel.ac.in/courses/111105035		
2. Learn C Programming https://www.programiz.com/c-programming		
3. C Programming Tutorials https://www.tutorialspoint.com/cprogramming/index.htm		
4. C Programming Language https://www.geeksforgeeks.org/c-programming-language/		

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