Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	B. Tech.
Class, Semester	First Year (Robotics and Automations), Semester I
Course Code	2BS101
Course Name	Linear Algebra and Differential Equations
Desired Requisites:	Mathematics course at Higher Secondary Level

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100

Credits: 03

Course Objectives

1	To introduce fundamental concepts of matrix theory and linear algebraic equations.
2	To present foundational techniques of partial differentiation and improper integrals.
3	To outline analytical methods for solving first and higher-order differential equations.
4	To detail elementary numerical schemes for approximating ordinary differential equation solutions.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to

CO	**Course Outcome Statements**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	**Understand** the concepts of Linear Algebra to describe linear systems.	II	Understanding
CO2	**Understand** the mathematical properties of improper integrals and Beta-Gamma functions	II	Understanding
CO3	**Apply** analytical and numerical Methods to solve Ordinary Differential Equations	III	Applying
CO4	**Apply** partial differentiation approximations and system optimization points.	III	Applying

Module	**Module Contents**	**Hours**
I	**Linear Algebra** Matrices and Rank, system of Linear equations, Gauss elimination method, Eigen value and Eigen vector, Cayley Hamilton Theorem.	**5**
II	**Differential Calculus** Partial derivative, error and approximations, maxima and minima.	**4**
III	**Integral Calculus** Introduction, Improper integral, Gamma function and its properties, Beta function and its properties.	**5**
IV	**Differential Equations of First Order and First Degree** Introduction, Exact Differential equation, Non exact Differential equation, Linear Differential equation and Bernoulli's Differential equation.	**5**
V	**Numerical Solutions to Ordinary Differential Equations** Introduction, Euler's Method, Modified Euler's method, Runge Kutta 4th order method.	**4**

VI	**Linear Differential Equation of Higher Order** Introduction, Complimentary function, particular integral for exponential function, trigonometric function, polynomial and arbitrary function, Applications.	5

Text Books	
1	B. V. Ramana, Higher Engineering Mathematics, The McGraw Hill companies, 2006.
2	H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., 1st Edition, 2014.
3	Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition

References	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2015.
2	R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 5th Edition, 2016.
3	George B. Thomas, Maurice D. Weir, and Joel Hass, Thomas' Calculus, Pearson Education, 14th Edition, 2018.
4	S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 5th Edition, 2012.
5	Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 5th Edition, 2018.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc20_ma37/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma75/preview
3	https://onlinecourses.nptel.ac.in/noc19_ma28/preview

CO-PO Mapping

CO	Programme Outcomes (PO)											PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	3	2	—	—	—	—	—	—	—	—	—	—	—
CO2	3	3	—	—	—	—	—	—	—	—	—	—	—
CO3	3	3	—	—	—	—	—	—	—	—	—	—	—
CO4	3	3	—	—	—	—	—	—	—	—	—	—	—

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

Syllabus prepared by: Mr. M.N. Sutar, Mrs. R.S. Janagond, Ms. S.A. Jamadar

Syllabus checked by: R.S. Janagond HOD Dr. J.A. Shaikh

Walchand College of Engineering, Sangli
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AY 2026-27

Course Information

Programme	First Year B. Tech. Robotics and Automation Engineering
Class, Semester	First Year B. Tech., Sem. I/II
Course Code	2BS102
Course Name	Physical Sciences and Instrumentation
Desired Requisites:	Basic concepts of 10+2 level Physics.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ESE**	**Lab**	**Total**
Practical	2 Hrs/week	20	50	30	100
		Credits: 3			

Course Objectives

1	To provide fundamental scientific concepts for solving engineering and technical problems.
2	To develop analytical and critical thinking skills required for engineering studies.
3	To enhance the understanding of modern engineering and technological developments.
4	To develop experimental skills and the ability to analyze and interpret engineering data.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Exhibit memory of previously learned information by recalling facts, terms, and basic concepts in Physics.	I	Remember
CO2	Demonstrate understanding of facts and ideas by recalling, comparing, interpreting the terms in Physics.	II	Understand
CO3	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules for various concepts in Physics.	III	Apply
CO4	Analyze engineering systems for solving problems.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Modern Physics and Quantum Mechanics**: Introduction, Black Body Radiation, Planck's Quantum Theory, de-Broglie Hypothesis, Compton Effect, Heisenberg Uncertainty Principle, Wave Function and Physical Significance, Schrödinger Wave Equation, Eigen Value, Eigen Function.	5
II	**Wave Optics**: Introduction, Interference and Diffraction of Light, Newton's Rings, Fresnel Diffraction: Fresnel and Fraunhofer Diffraction, and its applications.	5
III	**Ultrasonic and Applications**: Introduction, Generation of Ultrasonic Waves by Magnetostriction and Piezoelectric Method, Detection of Ultrasonic Waves, Applications of Ultrasonic Waves in Engineering Fields.	3
IV	**Semiconductor Physics**: Introduction, Formation of Energy Bands, Number Levels in a Band, Density of States, Fermi–Dirac Statistics, Fermi Level, Variation of Fermi Level with Temperature, Electrical Conductivity of Metals and Semiconductors, Hall Effect.	5

V	**Nanoscience and Nanotechnology**: Introduction to Nanoscience and Nanotechnology, Properties of Nanomaterials, Top-Down and Bottom-Up Synthesis Methods, Carbon Nanotubes, Graphene, Applications of Nanomaterials.	4
VI	**Measurement and Instrumentation**: Introduction to measurement and instrumentation, measurement errors, static and dynamic characteristics of instruments, performance of measurement systems, digital instrumentation, Engineering applications of measurement and instrumentation.	4

	List of Experiments/ Lab Activities (Any 8-10)
1	Find the diameter of thin wire by diffraction of light.
2	Determination of wavelength of light by plane diffraction grating.
3	Determine the specific rotation of sugar solution.
4	Find the wavelength of He-Ne LASER using plane diffraction grating.
5	Verify the expression for the resolving power of a telescope.
6	Measure the wavelength of ultrasonic waves by Kundt's tube method.
7	Design and simulate Colpitt's Oscillator.
8	Determine the Planck's constant.
9	Study the I-V characteristic of P-N junction diode in forward and reverse bias conditions.
10	Determine the wavelength of Sodium Light by Newton's Ring.
11	Study of Rectifier circuits.
12	To study the Hall effect and determine the Hall coefficient and carrier concentration of a semiconductor material.
13	To study the I-V characteristics of a transistor and determine its current gain.
14	To study and verify the truth tables of logic gates.
15	To study and analyze electronic circuits and systems using MATLAB & SPICE simulation tools.

	Textbooks
1	M. N. Avadhanulu and P. G. Kshirsagar, "A Text book of Engineering Physics", S.Chand Pub.
2	Bhattacharya & Nag, Engineering Physics
3	Harnam Singh, *Advanced Practical Physics for Students*, S. Chand & Company Ltd., Revised Edition, 2011, Volumes I & II.
	References
1	Beiser, Arthur, Concepts of Modern Physics, McGraw-Hill Education, 7th Edition, 2015.
2	Ghatak, Ajoy, Optics, McGraw-Hill Education, 6th Edition, 2017.
3	Patranabis, D., Sensors and Transducers, Prentice Hall of India, 2nd Edition, 2003.
4	Streetman, Ben G. and Banerjee, Sanjay Kumar, Solid State Electronic Devices, Pearson Education, 7th Edition, 2015.
5	Thyagarajan, K. and Ghatak, A. K., Lasers: Fundamentals and Applications, Springer, 2nd Edition, 2010.
	Useful Links
1	https://onlinecourses.nptel.ac.in/e-learning
2	https://swayam.gov.in/nc_details/NPTEL
3	https://ocw.mit.edu/search/

CO-PO Mapping													
	Programme Outcomes (PO)											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1									1		
CO2	3	2			1						1		
CO3	3	3	2		2						1		
CO4	3	3	2		2						1		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment (Theory)

The assessment is based on MSE and ESE.
MSE shall be typically on modules 1 to 3.
ESE shall be on all modules with around 30% weightage on modules 1 to 3 and 70% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Assessment (Lab)

There is one component of lab assessment that is Lab ESE.
IMP: Lab ESE is a separate head of passing (min 40 %).

Assessment	Based on	Conducted by	Typical Schedule	Marks
Lab ESE	Lab Activities/ Journal/ Performance/ Presentations / Oral/ Mini Project	Lab Course Faculty and External Examiner as applicable	During Week 1 to Week 13. Marks Submission at the end of Week 13.	30

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Syllabus Prepared By	Dr. A. A. Mohite, Dr. B. N. Jamadar and Dr. K. V. Madhale
Syllabus Checked By	Head, Department of Robotics and Automation

Walchand College of Engineering, Sangli

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Course Information

Programme	B.Tech. Robotics and Automation
Class, Semester	First Year B.Tech., Sem. I
Course Code	2ES101
Course Name	Engineering Mechanics (for Robotics and Automation)
Desired Requisites:	Physics, Mathematics

Teaching Scheme		Examination Scheme (Marks)			
Lecture	2 Hrs/week	**MSE**	**ESE**	**LA**	**Total**
Tutorials	--	20	50	30	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. To impart the fundamentals of engineering mechanics related to force systems, equilibrium, mass properties, motion and energy of particles and rigid bodies.
2. To develop the ability to apply principles of statics, kinematics and kinetics to analyse simple engineering and robotic mechanical systems.
3. To provide hands-on experience in experimental verification, measurement and interpretation of fundamental mechanics principles.
4. To illustrate the relevance of engineering mechanics to robotic links, joints, actuators, grippers and mobile robotic platforms.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Explain the fundamental principles of force systems, equilibrium, mass properties, kinematics and kinetics of particles and rigid bodies.	II	Understanding
CO2	Apply principles of statics and kinematics to determine forces, moments, reactions, position, velocity and acceleration in simple engineering and robotic mechanical systems.	III	Applying
CO3	Analyze particle and fixed-axis rigid-body motion using force-acceleration, work-energy and impulse-momentum principles to determine force, torque, energy and power requirements.	IV	Analyzing
CO4	Analyze experimental data from engineering mechanics activities to verify principles and compare observed behaviour with theoretical predictions for simple mechanical and robotic systems.	IV	Analyzing

Module	Module Contents	Hours
I	**Force Systems and Free-Body Diagrams:** Concept of particle and rigid body; scalars and vectors; force representation and Cartesian components; composition and resolution of concurrent and non-concurrent coplanar force systems; resultants; moments and couples; equivalent force-couple system; Varignon's theorem; free-body diagrams, supports, contacts and mechanical joint forces. Introductory three-dimensional force vector and moment interpretation using M = r x F.	**5**
II	**Equilibrium, Friction and Simple Engineering Structures:** Equilibrium of two-dimensional rigid bodies; two-force and three-force bodies; simple connected bodies; roller, pin and fixed supports; beam loads and support reactions. Dry friction, static and kinetic friction, limiting friction, coefficient and angle of friction; impending motion; applications to blocks, inclined planes, simple wedges and belts. Introductory analysis of simple statically determinate plane trusses by method of joints and method of sections.	**5**

III	**Centroid, Centre of Mass, Moment of Inertia and Virtual Work:** Centroid of lines and simple/composite plane areas; centre of mass and centre of gravity. Area moment of inertia of simple and composite sections; parallel-axis theorem and radius of gyration. Mass moment of inertia of common rigid bodies; parallel-axis theorem and effect of mass distribution. Principle of virtual work and equilibrium of simple mechanical systems.	**4**
IV	**Kinematics of Particles and Rigid Bodies:** Position, displacement, velocity and acceleration; rectilinear and curvilinear motion; graphical interpretation of motion; normal-tangential components; elementary projectile motion; relative motion of particles in translating frames. Rigid-body translation and fixed-axis rotation; angular displacement, velocity and acceleration; relations $v = r\omega$, $a_t = r\alpha$ and $a_n = r\omega^2$.	**5**
V	**Kinetics of Particles and Rigid Bodies:** Newton's laws of motion; equations of motion using $F = ma$ in Cartesian and normal-tangential forms; motion on smooth and rough surfaces; simple connected bodies; introductory D'Alembert's principle. Translation and fixed-axis rotation of rigid bodies; torque-angular acceleration relation $\Sigma M = I\alpha$; simple applications involving payloads, rotating links and actuators.	**5**
VI	**Work-Energy, Impulse-Momentum and Engineering Applications:** Work of forces and couples; kinetic energy of particles and rigid bodies in translation and fixed-axis rotation; gravitational and elastic potential energy; work-energy principle and conservation of mechanical energy. Power and efficiency; $P = Fv$ and $P = \tau\omega$. Linear impulse-momentum and conservation of momentum; introductory angular impulse-momentum; direct central impact and coefficient of restitution. Applications to simple robotic and mechanical systems.	**4**
Total Theory Contact Hours: 28		

List of Experiments / Lab Activities

1)	Verification of equilibrium of concurrent coplanar force systems using free-body diagrams, analytical resolution and experimental force measurements.
2)	Verification of the principle of moments and determination of support reactions for a simply supported member.
3)	Determination of coefficient of friction on horizontal and inclined planes and application to impending motion, gripping or wheel traction.
4)	Experimental determination of centroid / centre of mass of a simple composite or irregular body and comparison with analytical prediction.
5)	Experimental determination of mass moment of inertia of a rigid body and study of the effect of mass distribution.
6)	Verification of the principle of virtual work using a simple lever, pulley or mechanical linkage system.
7)	Experimental study of particle kinematics: determination of displacement, velocity and acceleration from measured motion data.
8)	Experimental study of fixed-axis rotational kinematics: determination of angular displacement, angular velocity and angular acceleration; verification of $v = r\omega$.
9)	Verification of Newton's second law for translational motion and the force-acceleration relationship $F = ma$.
10)	Experimental study of fixed-axis rotational kinetics and the torque-angular acceleration relationship $\Sigma M = I\alpha$.
11)	Verification of the work-energy principle and estimation of mechanical power in a simple translating, lifting or rotating system.
12)	Experimental study of impact / collision and determination of coefficient of restitution using a suitable apparatus.
13)	Integrative R&A mechanics activity using measured parameters to analyse a simple gripper, wheel-drive, payload-lifting or single-link rotational system.
14)	Equivalent experiment / mini activity aligned with the course outcomes may be included based on available equipment and laboratory facilities.

Textbooks

1	Beer, F. P., Johnston, E. R., Mazurek, D. F. et al., Vector Mechanics for Engineers: Statics and Dynamics, McGraw-Hill Education.
2	Hibbeler, R. C., Engineering Mechanics: Statics and Dynamics, Pearson.
3	Bhavikatti, S. S. and Rajashekarappa, K. G., Engineering Mechanics, New Age International Publishers.

References

1	Meriam, J. L. and Kraige, L. G., Engineering Mechanics: Statics and Dynamics, Wiley.
2	Ramamrutham, S., Textbook of Applied Mechanics, Dhanpat Rai Publishing Company.
3	Bansal, R. K., Engineering Mechanics, Laxmi Publications.
4	Laboratory manuals / virtual laboratory resources relevant to the prescribed experiments and measurement activities.

Useful Links	
1	https://nptel.ac.in/courses/112106286
2	http://vlabs.iitb.ac.in/vlab/labsme.html

CO-PO Mapping

	Programme Outcomes (PO)											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	**3**												
CO2		**3**											
CO3		**3**											
CO4				**3**									

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High. Each CO of the course must map to at least one PO.

Assessment

LA	Continuous Learning Assessment based upon performance in the laboratory sessions, lab reports, data analysis and viva.	**30 Marks**
MSE	Written / Online Test based upon approximately 50% of the theory course content.	**20 Marks**
ESE	Written Examination based upon 100% of the theory course content, giving approximately 70% weightage to the post-mid-semester portion.	**50 Marks**

Walchand College of Engineering, Sangli

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Course Information

Programme	B.Tech. Robotics and Automation Engineering
Class, Semester	First Year B. Tech., Sem I
Course Code	2ES102
Course Name	Python Programming
Desired Requisites:	Computer Knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**LA1**	**MSE**	**ESE**	**Total**
Tutorials	--	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. To understand problem solving and problem solving aspects.
2. To learn basics, features and future of Python programming.
3. To acquaint with data types, input output statements, decision making, looping, functions, array, string, pointer, structure and union in Python

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Inculcate the various skills in Problem Solving.	II	Understand
CO2	Demonstrate significant experience with the Python Programming.	III	Apply
CO3	Apply functions and file-handling techniques in Python to develop modular programs and process data stored in files.	III	Apply
CO4	To test and execute the Python programs and correct syntax and logical errors.	IV	Analyse

Module	Module Contents	Hours
I	**Basics of Problem Solving**: General Problem Solving Concepts, Types of Problems, Problem Solving Strategies. Program Design Tools: Algorithms, Flowcharts and Pseudo-Codes.	4
II	**Python Programming:** Writing and Executing Python Program, Variables, Keywords, Identifiers, Constants, Operators & Expressions, Operators, Data Types.	4
III	**Decision Control Statements:** Conditional Statements: If, If-else, Nested If, If-else if Statements. Iterative Statements: While Loop, For Loop, Do While Loop, Break, Continue, Pass.	4
IV	**Functions:** Need, Definition, Call, Variable Scope, Return Statement, Lambda or Anonymous Function. Modules: Definition, Introduction to packages in Python, Introduction to standard library modules.	5
V	**Strings and Operations:** Concatenation, Appending, Multiplication and Slicing. Strings are Immutable, Strings Formatting Operator.	4
VI	**File Handling:** Introduction, File path, Types of files, Opening and Closing files, Reading and Writing files.	5

List of Experiments/ Lab Activities / Mini project activities….

1)	Program to simulate simple calculator that performs basic tasks such as addition, subtraction, multiplication and division.
2)	Program to demonstrate different operators and their order precedence
3)	Program to accept the number and Compute a) Square root of number, b) Square of number, c) Cube of number d) Check for prime, d) factorial of number,
4)	Program to accept a number from user and print digits of number in a reverse order
5)	Program to accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these two numbers.

6)	Program to find whether the number is positive / negative / zero using conditional statement.
7)	Programs to show different types of iteration / loop.
8)	Program to accept N numbers from user and compute and display maximum in list, minimum in list, sum and average of numbers.
9)	Program to print the Fibonacci Series (with & without recursion).
10)	Program to swap two number using function.
11)	Program to accepts a string from user and perform following string operations, a) Calculate length of string, b) String reversal, c) Check palindrome,
12)	Program to demonstrate different file handling functions.
13)	Program to copy contents of one file to other.
Textbooks	
1	Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, ISBN 13: 978-0-19-948017-6.
2	R. Nageswara Rao, "Core Python Programming", Dreamtech Press; Second edition ISBN10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL.
References	
1	Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition, ISBN 10: 9780132492645, ISBN-13: 978-0132492645.
2	Romano Fabrizio, "Learning Python", Packt Publishing Limited, ISBN: 9781783551712, 1783551712.
3	Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education, ISBN-10: 9789387572942, ISBN-13: 978-9387572942, ASIN: 9387572943.
4	Jeeva Jose, P. Sojan Lal, "Introduction to Computing & Problem Solving with Python", Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810
Useful Links	
1	https://www.w3schools.com/python
2	https://www.geeksforgeeks.org/python-programming-language

CO-PO Mapping (Theory)

	Programme Outcomes (PO)											**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	1		2		2								
CO3		2	1	2									
CO4		2	1	2									

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

LA	Continuous Learning Assessment based upon performance in the Laboratory sessions, Lab reports and Viva	30 Marks
MSE	Written / Online Test based upon approximately 50% of the theory course content	20 Marks
ESE	Written Examination based upon 100% of the theory course content giving 70% weightage on post midsem portion	50 Marks

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Course Information

Programme	B.Tech. (Robotics and Automation)
Class, Semester	First Year B.Tech., Sem - I
Course Code	2RA101
Course Name	Elements of Robotics and Automation
Desired Requisites:	Physics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**ISE/LA1**	**MSE/LA2**	**ESE**	**Total**
Tutorial	--	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1	To provide a strong foundation in the principles, components, and applications of robotics and automation systems.
2	To develop an understanding of robot subsystems, including joints, sensors, end effectors, material handling equipment, and automated assembly systems.
3	To analyse and select appropriate robotic and automation components, such as grippers, sensors, actuators, and automation strategies, for industrial applications.
4	To gain practical knowledge and experience in the design, operation, and implementation of automated manufacturing and robotic systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Identify and explain the fundamental components of robotics, automation systems, robot joints, sensors, actuators, and end effectors.	II	Understanding
CO2	Describe and analyse various robot grippers, material handling systems, automated assembly systems, and elements of automation.	IV	Analyzing
CO3	Demonstrate basic robot operations, simple robot programming, and determine suitable grippers and gripper forces for specific industrial tasks.	III	Applying
CO4	Select appropriate robotic and automation components, including sensors, joints, end effectors, material handling equipment, and automated assembly systems for industrial applications.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	Robot-Definition, Basic concepts, Need, Law, History, Robot Anatomy, Robot configurations- Cartesian, cylinder, polar and articulate. Work Volume, Precision of Movement.	4
II	Robot End Effectors Types of End Effectors, Mechanical Grippers, Other Types of Grippers, Tools as End Effectors, Considerations in Gripper Selection and Design, Gripper force when gravity is directed parallel to the contacting surfaces.	4
III	Robot Sensors and kinematics Introduction to Sensors in robot - Touch sensors, Proximity and range sensors, Force sensors. Robot joints and links-Types, Introduction to Robot kinematics – direct and inverse kinematics.	5
IV	Automation Definition, reasons for automating. Types of production and types of automation, levels of automation, Basic elements of automated systems- power, program and control.	5

V	Material Handling Systems Material handling introduction, Unit Load, Palletizing, Material Transport Equipments- automated guided vehicles (AGV), Rail-Guided Vehicles (RGV), Conveyors- Types of Conveyors, Pick and Place Robots.	5
VI	Automated Assembly Systems Types of automated assembly systems- in-line, dial-type, carousel, single station; Parts delivery at workstations, Product design considerations for automated assembly.	5

List of Experiments / Lab Activities/Topics
Demonstrations of following Elements of Robotics and Automation 1. Robot axes and joints 2. Pick and place robot 3. Object sorting by robot. 4. Robot grippers 5. Robot programming by teach method. 6. One experiment using Virtual Lab 7. Sensors (proximity, force) for Robots. 8. Coin counting. 9. Case study on Robotics 10. Case study on Automation

Textbooks	
1	Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics Technology, Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008.
2	Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2001

References	
1	Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.
2	Klafter.R.D, Chmielewski.T.A, and Noggin’s., “Robot Engineering: An Integrated Approach”’, Prentice Hall of India Pvt. Ltd., 1994
3	Fu.K.S, Gonzalez.R.C&Lee.C.S.G, “Robotics control, sensing, vision and intelligence”, Tata-McGraw Hill Pub. Co., 2008
4	Akande, Olushola. “Industrial Automation from Scratch: A Hands-on Guide to Using Sensors, Actuators, PLCs, HMIs, and SCADA to Automate Industrial Processes”, United Kingdom, Packt Publishing, 2023.

Useful Links	
1	Mechanisms & Robotics Lab http://vlabs.iitkgp.ernet.in/mr/
2	Robotics Application Lab https://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525
3	Bio Inspired Robotics Virtual Lab https://vlab.amrita.edu/?sub=3&brch=257

CO-PO Mapping		
	Programme Outcomes (PO)	**PSO**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	3												2		
CO2	2												1		
CO3			1										1		
CO4				1									1		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

Assessment
The assessment is based on MSE, ISE, LA1, LA2 and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27

Course Information

Programme	B. Tech. Robotics and Automation
Class, Semester	First Year B. Tech. Sem I
Course Code	2VS151
Course Name	Robotics Workshop Practices
Desired Requisites:	Physics, Mathematics

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To develop safe and correct practices in the use of basic workshop tools, fasteners and fabrication processes for preparing and assembling simple engineering components.
2	To provide introductory exposure to conventional and modern manufacturing processes used for fabrication of engineering components, including conventional machining, CNC machining, laser cutting, welding and sheet-metal working.
3	To develop basic skills in dimensional measurement and inspection of manufactured engineering components using commonly used measuring and inspection instruments.
4	To develop practical skills in low-voltage electrical and electronic wiring, circuit assembly, measurement, soldering, crimping, connection and testing practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Perform basic workshop, fabrication and mechanical assembly operations using appropriate tools, equipment and safety practices.	III	Applying
CO2	Explain the basic work, capabilities and applications of conventional and modern manufacturing processes used for producing engineering components.	II	Understanding
CO3	Measure and inspect engineering components using appropriate dimensional measuring instruments and record the measured dimensions and deviations.	III	Applying
CO4	Assemble and test basic low-voltage electrical and electronic circuits and interconnections using appropriate components, instruments and connection practices.	III	Applying

List of Experiments / Lab Activities/Topics

1. Workshop Safety, Hand Tools, Fasteners and Basic Assembly Practices

2. Basic Cutting, Fitting, Drilling and Finishing Operations

3. Study and Demonstration of Conventional Machine Tools and Cutting Machines

4. Sheet-Metal Fabrication, Bending and Mechanical Joining

5. Study and Demonstration of CNC Machining and Laser Cutting

6. Basic Fabrication by Arc Welding, Grinding and Finishing

7. Dimensional Measurement and Inspection of Manufactured Components

8. Electrical Safety, Basic Wiring and Measurement Using Electrical Instruments

9. Basic Electronic Components, Breadboarding and Circuit Testing

10. Soldering, Desoldering, Wire Preparation, Crimping and Connector Practices

1. Workshop Safety, Hand Tools, Fasteners and Basic Assembly Practices

Details / Scope: Workshop rules and safe working practices; PPE; safe handling and correct use of spanners, Allen keys, screwdrivers, pliers, hammers, files, hacksaws, punches and similar hand tools; types and applications of bolts, nuts, washers, machine screws, socket-head screws and grub screws; clearance and threaded holes; correct tightening, assembly and dismantling practices.

Expected Hands-on Activity: Identify common tools and fasteners, select the appropriate tool for a given operation, and perform assembly/disassembly of a simple mechanical unit using safe practices.

2. Basic Cutting, Fitting, Drilling and Finishing Operations

Details / Scope: Marking and layout using steel rule, scriber, try-square, divider and center punch; hacksaw cutting; basic filing techniques and types of files; drilling-machine safety; drill selection; drilling and countersinking; introduction to tapping where facilities permit; deburring and surface finishing.

Expected Hands-on Activity: Demonstration only.

3. Study and Demonstration of Conventional Machine Tools and Cutting Machines

Details / Scope: Construction, basic working principle, applications and safety of lathe, drilling machine, bench grinder, power hacksaw/band saw/circular saw or available stock-cutting equipment; work holding and cutting tools; demonstration of facing, simple straight turning, drilling and stock-cutting operations; qualitative introduction to cutting speed and feed.

Expected Hands-on Activity: Observe guided demonstrations, identify major machine components, and record the sequence from workpiece holding and tool setting to machining/cutting and the finished component. Independent advanced machine operation is not expected.

4. Sheet-Metal Fabrication, Bending and Mechanical Joining

Details / Scope: Identification of commonly used sheet materials and thicknesses; safe handling of sheet metal and sharp edges; marking and layout; cutting using hand shears/snips or suitable available equipment; drilling/punching; basic bending and forming; introductory bend radius/bend allowance; riveting and other mechanical joining methods; detachable joints using screws/fasteners; deburring and finishing.

Expected Hands-on Activity: Demonstration only.

5. Study and Demonstration of CNC Machining and Laser Cutting

Details / Scope: Introduction to digital manufacturing; conventional versus CNC machining; basic CNC axes and coordinate system; CAD-CAM-toolpath-simulation-machining workflow; work holding, cutting-tool selection and introductory feed, speed and depth of cut. Laser-cutting principle; suitable materials; 2D CAD/vector/DXF profiles; cutting and engraving; kerf; nesting; basic process parameters and safety.

Expected Hands-on Activity: Observe CNC machining of a simple component/profile and laser cutting of a simple plate/bracket/profile, including preparation, machine setup and processing; compare the capabilities and typical applications of the two processes.

6. Basic Fabrication by Arc Welding, Grinding and Finishing

Details / Scope: Welding safety and PPE; basic principle of arc welding; welding machine, electrode, electrode holder and earth connection; workpiece preparation and positioning; simple lap or butt joint; introductory identification of common visible weld defects; grinding-machine safety, deburring, grinding and finishing; typical applications in frames, supports and fixtures.

Expected Hands-on Activity: Under supervision, Demonstration only.

7. Dimensional Measurement and Inspection of Manufactured Components

Details / Scope: Importance of measurement and inspection; least count and selection of a suitable instrument; use of Vernier caliper, outside micrometer, depth-measuring facility/gauge, feeler gauge, thread pitch gauge and radius gauge.

Expected Hands-on Activity: Measure suitable features of engineering components (simple geometries to cover diameter, length, width, height, etc.) and prepare an inspection sheet showing specified/nominal dimension, measuring instrument, measured dimension.

8. Electrical Safety, Basic Wiring and Measurement Using Electrical Instruments

Details / Scope: Electrical laboratory safety; introductory distinction between AC and DC; polarity, voltage, current and resistance in practical measurements; digital multimeter functions, terminal/range selection and continuity testing; regulated DC power supply; switches, fuses/protection devices and terminal blocks; basic series and parallel connections and safe low-voltage wiring.

Expected Hands-on Activity: Measure voltage and resistance; perform continuity checks; identify polarity; verify wiring using a digital multimeter and DC power supply; identify simple connection faults.

9. Basic Electronic Components, Breadboarding and Circuit Testing

Details / Scope: Identification and basic function of resistor, capacitor, diode, LED, transistor, pushbutton/switch, potentiometer, buzzer and relay; resistor color code; polarized and non-polarized components; breadboard internal connections; simple LED and switching circuits; introductory transistor/relay switching concept; circuit testing using a multimeter. Detailed semiconductor theory is outside the scope.

Expected Hands-on Activity: Identify basic electronic components and assemble simple breadboard circuits such as LED indication, pushbutton-controlled LED/buzzer, transistor switching or relay-based output; test and verify circuit operation.

10. Soldering, Desoldering, Wire Preparation, Crimping and Connector Practices

Details / Scope: Soldering-iron safety; selection and preparation of wire; stripping and conductor preparation; tinning; correct soldering technique and identification of satisfactory/poor solder joints; basic desoldering; crimp terminals and crimping tools; common connectors and terminal blocks; heat-shrink tubing; cable routing and basic cable-management practices; continuity testing.

Expected Hands-on Activity: Hands-on practice with soldering and desoldering activity

Textbooks

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy, *Elements of Workshop Technology – Vol. I*, Media Promoters & Publishers Pvt. Ltd., 14th Edition, 2010.
2	Electronics Projects For Dummies, by by Earl Boysen and Nancy Muir, Published by Wiley Publishing, Inc., 2006
3	D.C. Kulshreshtha, "Basic Electrical Engineering", 1 st revised editionMcGraw Hill, 2012.
4	D.P Kothari and I.J Nagrath, "Basic Electrical Engineering",Tata McGraw Hill, 2010.

References

1	Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 1989
2	E-learning material through Intranet/Internet
3	V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering", 2 nd edition, Tata McGraw Hill.
4	Bolton W., *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education, 7th Edition, 2019.

Useful Links

1	https://youtube.com/@workshop.supdtjmdabir5653?si=mj1q6TnmIxjp4mmY
2	https://youtube.com/@jamildabir9820?si=-njCut9Q8ty-ilGo

CO-PO Mapping

	Programme Outcomes (PO) Robotics and Automation											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	**1**				**2**								
CO2					**1**								
CO3	**1**			**1**	**2**								

CO4	**1**				**2**								

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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AY 2026-27 onwards

Course Information

Programme	B. Tech. Engineering
Class, Semester	F.Y. B.Tech. Sem: I/II
Course Code	8IK151
Course Name	Indian Knowledge System
Desired Requisites:	Basic knowledge of Indian Civilization

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**ISE/LA1**	**MSE/LA2**	**ESE**	**Total**
Interaction	2 Hrs/week	30	30	40	100
Tutorial	-				
Practical	-	**Credits: 2**			

Course Objectives

To introduce undergraduate students to the ancient Indian technologies that exemplify the ingenuity and achievements of India's glorious civilization.

To emphasize the nature-centric aspects of ancient Indian technologies and explore their relevance and adoption in the modern era.

To expose students to the scientific principles and technological advancements of ancient India and explore their potential applications in modern technological development.

Course Outcomes

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

CO	**Description**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Enumerate the main characteristics of education system in Vedic and post Vedic period to enrich the intellectual imagination	I	Remember
CO2	Review the ancient discovery and research in Indian number system and ancient Indian mathematics	II	Understand
CO3	Review the contribution from Ancient Indian system to astronomy and metallurgy	III	Understand
CO4	Trace the significant developments in Indian engineering and technology in Irrigation, painting, surgical techniques and shipbuilding	IV	Apply

Course Assessment Plan (*for total 26 learning hours)*					
Assessment	**Formative Assessment type**	**Brief Description**	**Marks**	**Notional Learning hours**	**week**
ISE/LA1	Suggested Creative Activity (any one)	1. Article Reflection 2. Book Design (preferably flip-book) on a given topic 3. Any other suggested by teacher	**10**	**8**	**3**
	Suggested creative activity - 2 (any one)	1. Exploration Visit Report 2. Short Film Making 3. Any other suggested by teacher	**20**	**5**	**5**
MSE/ LA2	Creative Activity-3:	Quiz: 30 Marks	**30**	**8**	**1-8**
ESE	Creative Activity-3	1. App Making/ Game Design/Website Design 2. Physical Prototype 3. Design of Experiment 4. Any other suggested by teacher	**40**	**5**	**1-8**
		Total	**100**		**26 hrs**

Text Books	
1	B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R. N., "*Introduction to Indian Knowledge System: Concepts and Applications*" PHI, 2022
2	Kapil Kapoor, Avadhesh K. Singh, "*Indian Knowledge Systems, Volume 1*", Indian Institute of Advanced Study, 2005
3	R. P. Kulkarni, "*Glimpses of India Engineering and Technology: Ancient and Medieval Period*," Munshiram Manoharlal Publishers Pvt. Ltd., 2018

Useful Links	
1	https://iksindia.org/
2	https://egyankosh.ac.in/
3	https://www.ugc.ac.in/
4	https://ncert.nic.in/textbook.php

A-A-Powar

S.S.Rathod

Walchand College of Engineering, Sangli
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AY 2026-27 onwards

Course Information

Programme	B. Tech.
Class, Semester	First Year (Robotics and Automations), Semester II
Course Code	2BS103
Course Name	Vector Calculus and Statistical Methods
Desired Requisites:	Mathematics course at Higher Secondary Level

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100

Credits: 03

Course Objectives

1	To introduce multi-variable calculus through double and triple integration techniques.
2	To present foundational principles of vector differential and integral calculus theorems.
3	To cover essential concepts of engineering statistics, regression, and probability distributions.
4	To detail introductory methods of complex variable differentiation and integration.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to

CO	**Course Outcome Statements**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	**Understand** the properties of analytical functions and the fundamental results of Complex Analysis.	II	Understand
CO2	**Apply** statistical and probability concepts to analyse the data and solve Engineering problems.	III	Apply
CO3	**Apply** vector differential operators to calculate derivatives, velocities and accelerations.	III	Apply
CO4	**Apply** multiple and vector integration techniques to evaluate integrals arising in Engineering application.	III	Apply

Module	**Module Contents**	**Hours**
I	**Multiple Integral** Double integral, triple integral, Change the order of integration, integration over the area.	**5**
II	**Vector Differentiation** Velocity and acceleration, directional derivative, gradient, divergence, Curl of vector function.	**4**
III	**Vector Integration** Work done, Line integral, surface integral, Green's theorem, Stoke's theorem, Gauss divergence Theorem.	**5**
IV	**Statistics and Regression** Mean, Variance and Covariance, Correlation, Linear Regression.	**3**

V	**Probability** Conditional Probability, Theorems of Total Probability and Bayes, Continuous and discrete random variable, Probability Mass Function, Probability Density Function, Binomial distribution, Poisson distribution, Gaussian Distribution, Exponential distribution.	7
VI	**Complex Analysis** Analytic function, Cauchy Riemann equation, complex integration, Cauchy integral theorem, Cauchy's integral formula.	4

Textbooks	
1	B. V. Ramana, Higher Engineering Mathematics, The McGraw Hill companies, 2006.
2	H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., 1st Edition, 2014.
3	Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition

References	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2015.
2	R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 5th Edition, 2016.
3	George B. Thomas, Maurice D. Weir, and Joel Hass, Thomas' Calculus, Pearson Education, 14th Edition, 2018.
4	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, 6th Edition, 2020.
5	Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 5th Edition, 2018.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ma75/preview
2	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
3	https://onlinecourses.nptel.ac.in/noc23_mg51/preview

CO-PO Mapping

CO	Programme Outcomes (PO)											PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	3	2	—	—	—	—	—	—	—	—	—	—	—
CO2	3	3	—	—	—	—	—	—	—	—	—	—	—
CO3	3	2	—	—	—	—	—	—	—	—	—	—	—
CO4	3	2	—	—	—	—	—	—	—	—	—	—	—

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing).

Syllabus prepared by: Mrs. R. S. Janagond, Mr. N. N. Sutar, Ms. S. A. Jamadar

checked by: HoD Dr. J. A. Shaikh -

Walchand College of Engineering, Sangli
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AY 2026-27

Course Information

Programme	First Year B. Tech. Robotics and Automation
Class, Semester	First Year B. Tech., Sem. I/II
Course Code	2BS104
Course Name	**Analytical Chemistry and Material Science**
Desired Requisites:	Students are expected to know the basic concept in Chemistry.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ESE**	**Lab**	**Total**
Practical	2 Hrs/week	20	50	30	100
		Credits: 3			

Desired Knowledge

Basic knowledge of chemistry concepts studied at higher secondary level (10+2), Fundamental understanding of physics and mathematics concepts, elementary laboratory skills and scientific understanding.

Course Objectives

1	To introduce students to the engineering principles and applications of various materials used in robotics and automation.
2	To provide basic knowledge of chemical analysis and material characterization techniques for engineering applications.
3	To develop an understanding of material evaluation methods and the relationship between material composition and properties.
4	To familiarize students with metals, polymers, ceramics, composites, and nanomaterials used in robotic systems and automated devices.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the principles of chemical analysis, material characterization techniques, and structure–property relationships of engineering materials.	II	Understand
CO2	Explain the working and applications of batteries, fuel cells, and supercapacitors used in robotics and automation systems.	II	Understand
CO3	Apply the concepts of corrosion science, Gibbs phase diagrams for material selection and processing of engineering materials.	III	Apply
CO4	Demonstrate chemical analysis and material testing experiments, interpret experimental data, and prepare technical laboratory reports. (Lab)	III	Apply

Module	**Module Contents**	**Hours**

I	**Chemical analysis and Characterization of Materials:** Introduction to chemical analysis, Qualitative vs Quantitative methods, Gravimetric analysis-principles & examples, Volumetric (titrimetric) analysis, Spectroscopic techniques (UV-Vis, IR, HRMS/Mass)-basic concepts, Introduction microscopic techniques to SEM & TEM for material characterization, Application examples: alloy composition, quality evaluation.	8
II	**Structure and Properties of Engineering Materials:** Atomic structure and bonding in materials, Crystalline vs amorphous solids, Defects in solids (point, line, planar), Mechanical properties: strength, ductility, hardness.	3
III	**Polymers, Composites and Ceramics:** Classification of polymers, Polymerization processes, Rubber, Vulcanization, Engineering composites-types & applications, Ceramics-properties & industrial uses.	3
IV	**Corrosion Science:** Fundamentals of corrosion, Electrochemical corrosion mechanisms, Factors affecting corrosion, Types of corrosion (uniform, pitting, crevice, galvanic), Corrosion monitoring & control, Corrosion prevention methods (coatings: metallic, cathodic, Anodic protection).	5
V	**Phase Rule:** Gibbs phase rule, Explanation of the terms Phase, Component, Degree of freedom, Phase reactions, types of equilibrium, equilibrium conditions. One component system- Water system, Sulphur system, Application of Eutectic system, Merit and Demerits of Phase rule.	4
VI	**Electrochemical Energy Storage and Conversion:** Batteries-basic principles, Primary vs secondary cells, Fuel cells-working & types, Supercapacitors & applications in mechanical & robotics automation.	3

	List of Experiments/ Lab Activities (Any 10)
1	Estimation of hardness of water by EDTA method (Complexometric titration).
2	Estimation of alkalinity of water (Neutralization titration).
3	Estimation of dissolved oxygen in water (Iodometric titration).
4	Estimation of chloride content in water (Argentometry).
5	Demonstration of pH meter and pH metric titration.
6	Determination of strength of acid/base conductometrically.
7	Colorimetric estimation of copper.
8	Estimation of copper from bronze (Iodometric titration).
9	Estimation of Zn from brass (Displacement titration).
10	Determination of purity of iron (Redox titration).
11	Determination of viscosity using Ostwald viscometer.
12	Determination of corrosion rate by weight loss method.
13	Gravimetric estimation of Ba from $BaSO_4$ as BaO.
14	Preparation of resin.

	Textbooks
1	P. C. Jain and M. Jain, *Engineering Chemistry*. New Delhi, India: Dhanpat Rai Publishing Company (P) Ltd., 2015.
2	S. K. Kulkarni, *Nanotechnology: Principles and Practices*, 3rd ed. Cham, Switzerland: Springer, 2015.
3	G. R. Chatwal and S. K. Anand, *Instrumental Methods of Chemical Analysis*, 5th ed. Mumbai, India: Himalaya Publishing House, 2007.

4	S. Chawla, *A Textbook of Engineering Chemistry*, 4th ed. New Delhi, India: Dhanpat Rai & Co. (P) Ltd., 2016.
5	S. K. Bhasin and S. Rani, *Laboratory Manual on Engineering Chemistry*, 3rd ed. New Delhi, India: Dhanpat Rai Publishing Company (P) Ltd., 2008.

References

1	A. I. Vogel, *A Textbook of Quantitative Chemical Analysis*, 5th ed. London, U.K.: Longman Scientific & Technical, 1989.
2	B. K. Sharma, *Engineering Chemistry*. Meerut, India: Krishna Prakashan Media Pvt. Ltd., 2014.
3	H. H. Willard, L. L. Merritt Jr., J. A. Dean, and F. A. Settle Jr., *Instrumental Methods of Analysis*, 7th ed. New Delhi, India: CBS Publishers & Distributors, 1986.
4	Graphene Nanoelectronics, H. Raza, Ed. Berlin, Germany: Springer, 2012.
5	S. Sahay, *Quantitative Chemical Analysis*. New Delhi, India: Oxford Book Company, 2012.

Useful Links

1	https://www.youtube.com/watch?v=Vl3BYsoif-c&pp=ygU3bnB0ZWwgZW5naW5lZXJpbmcgY2hlbWlzdHJ5IHNwZWN0cm9zY29weSB1diB2aXMgaXIgbWFzcw%3D%3D
2	https://www.youtube.com/@nptelhrd/search?query=vulcanization+rubber+nptel
3	https://nptel.ac.in/?utm_source

CO-PO Mapping (Theory)

	Programme Outcomes (PO)											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	1	-	-	-	-	-	-	-	-		
CO2	3	3	3	-	-	-	-	-	-	-	-		
CO3	3	2	2	-	-	-	-	-	-	-	-		
CO4	3	3	-	3	3	-	-	2	3	3	1		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High

Each CO of the course must map to at least one PO.

Assessment (Theory)

The assessment is based on MSE and ESE.

MSE shall be typically on modules 1 to 3.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Assessment (Lab)

The lab assessment will be conducted as mentioned below.

IMP: Lab ESE is a separate head of passing (min 40 %).

Assessment	Based on	Conducted by	Typical Schedule	Marks
Lab ESE	Lab Activities/ Journal/ Performance/ Presentations/ Oral/ Mini Project	Lab Course Faculty and External Examiner as applicable	During Week 1 to Week 13. Marks Submission at the end of Week 13.	30

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Syllabus Prepared By	A. A. Powar Dr. J. K. Shaaikh Dr. R. P. Gajbhar
Syllabus Checked By	HoD. Dr. J. K. Shaaikh Dr. N. K. Rokade

Walchand College of Engineering, Sangli

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AY 2026-27

Course Information	
Programme	B. Tech. (Robotics and Automation)
Class, Semester	First Year B. Tech. Sem. II
Course Code	2ES103
Course Name	Electrical & Electronics Engineering
Desired Requisites:	12th Physics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	This course intends to summarize and solve electrical and magnetic circuits.
2	It imparts skill to identifying principles, construction and working of electrical machines.
3	To introduce students to the fundamentals of digital electronics and analog electronics
4	To understand working of diode circuits, transistorized and op-amp based amplifiers.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**know** principles, construction and workings of electrical machines, and apply electrical safety and wiring practices.	II	Understanding
CO2	**Solve** the electrical and magnetic circuits problems using fundamental circuit laws.	III	Applying
CO3	know fundamentals of digital electronics.	I	Understanding
CO4	Solve the examples on digital circuits, diodes and transistors and Op-amp based circuits	III	Applying

Module	**Module Contents**	**Hours**
I	**Module 1: Electrical Circuit Fundamentals** Electrical quantities and circuit elements (R,L,C), Ohm's law, KCL & KVL, Series and Parallel circuits, AC fundamentals, RMS value, Real, Reactive and Apparent power, Power factor and its significance in industrial electrical systems.	5
II	**Module 2: Electrical Machines** Magnetic circuits: magnetic flux, MMF and Faraday's law of electromagnetic induction, **DC Motor:** Construction, working principle, applications and torque- speed characteristics, **Three Phase Induction Motor:** Construction, working principle, types and applications, torque- speed characteristics, **Single Phase Transformer:** Construction, working principle, types and applications.	5
III	**Module 3: Electrical Safety, Wiring and Protection** Electrical hazards and safety precautions, Earthing and grounding, Protective devices (Fuse, MCB and RCCB), Electrical wiring, Electrical energy conservation.	4

IV	**Module IV: Fundamentals of Digital Electronics** Number systems and binary arithmetic, Logic gates and truth tables, Boolean algebra and K-map simplification, Introduction to combinational and Sequential Circuits.	4
V	**Module V: Diodes and Transistors** P-N junction diode, diode characteristics, half-wave and full-wave rectifier, clippers and clampers; Zener diode, LED, Photodiode and Solar Cell. Transistor structure and types.	5
VI	**Module VI: Operational Amplifier** Basic op-amp configuration, op-amp powering, feedback in op-amp circuits, ideal op-amp circuits analysis, inverting, non-inverting amplifier, summing amplifier, difference amplifier, unity gain buffer; IC555 timer.	5

Textbooks

1	D.C. Kulshreshtha, "Basic Electrical Engineering", 1st revised edition McGraw Hill, 2012.
2	D.P Kothari and I.J Nagrath, "*Basic Electrical Engineering",* Tata McGraw Hill, 2010.
3	B.L Theraja "A Textbook of Electrical Technology", S Chand Publication, 2013.
4	R. P. Jain, "Modern Digital Electronics", 4th edition, Tata McGraw Hill, 2009.
5	Robert Boylestad, Louis Nashelsky, 11th edition, "Electronic Devices and Circuits, Pearson, 2015.
6	Ramakant Gaikwad, "Op-amp and Linear Integrated Circuits", 4th edition, Pearson, 2015.

References

1	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
2	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3	V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering", 2nd edition, Tata McGraw Hill.
4	Morris Mano, "Digital Design", Pearson, 4th edition, 2011
5	Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd edition, Tata McGraw Hill, 2011
6	Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th edition, PHI, 2009

Useful Links

1	Basic Electrical Technology, IISc Bangalore, by Prof. L. Umanand, "https://nptel.ac.in/courses/108108076"
2	Basic Electrical Technology, IIT Kharagpur, by Prof. N.K. De, Prof. G.D. Roy, Prof. T.K. Bhattacharya, "https://nptel.ac.in/courses/108105053"
3	Fundamentals of Electrical Engineering, IIT Kharagpur,by Prof. Debapriya Das , "https://nptel.ac.in/courses/108105112"
4	https://nptel.ac.in/courses/108101091
5	https://nptel.ac.in/courses/108105113

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	3	2												
CO2	3	3				2								
CO3	3	2			2									
CO4	3	3			3									
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on Three modules. (One and half modules from Electrical syllabus and one and half modules from Electronics syllabus) ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules up to MSE and 60% weightage on modules after MSE. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	B. Tech. All
Class, Semester	First Year
Course Code	8ES151
Course Name	Engineering Exploration
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hr /week	**Credits: 4**			

Course Objectives

1. To instil an understanding of the engineering profession
2. To impart a structured engineering design methodology
3. To build foundational skills in system modelling and analysis
4. To introduce physical computing and platform-based development
5. To foster professional ethics and sustainable engineering practices

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Discuss the scope of Engineering and its study.	Understand	II
CO2	Solve real world challenges using multidisciplinary engineering skills	Apply	III
CO3	Demonstrate effective teamwork and communication skill during engineering project execution.	Apply	III
CO4	Analyse alternative design concepts using engineering criteria such as functionality, sustainability.	Analyse	IV
CO5	Develop engineering solutions using the engineering design process while considering sustainability and ethical constraints.	Create	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	1	-	-	-	-	1	-	-	-	-	-
CO2	2	2	-	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	2	-
CO4	-	2	2	-	-	-	3	-	-	-	-
CO5	-	-	3	-	-	-	1	3	-	-	-

Module	Module Contents	Hours
I	**Module 1: Introduction to Engineering and Engineering Study** Requirements and expectations of Engineering, disciplines of engineering, Expectation of modern engineer and Graduate Attributes Significance of teamwork, Significance of Agile practices, Significance of documentation	03 + 04
II	**Module 2: Sustainability and Ethics in Engineering** Introduction to sustainability, Sustainability leadership matrix, Life cycle assessment, carbon footprint, embodied energy calculation, alternative material selection and justification Identifying Engineering as a Profession, Significance of Professional Ethics, Code of Conduct for Engineers, Identifying Ethical Dilemmas in different tasks of engineering, Applying Moral Theories and codes of conduct for resolution of Ethical Dilemmas.	03 + 04

III	**Module 3: Engineering Design** Engineering Design Process, Problem definition formulation process, Concept generation- Function tree, Morphological chart, and Concept selection- Pugh Chart, Material selection based on density, carbon foot-print and embodied energy, Product Architecture.	06 + 12
IV	**Module 4: Virtual Implementation** Virtual Implementation, Introduction to Engineering Drawing, Introduction to 3D modelling software, Part modelling & assembly. Circuit Diagram, Flowchart	06 + 14
V	**Module 5: Mechanisms, Motor Sizing and Battery Sizing (MSBS)** Types of mechanisms, degree of freedom, linkages, four bar linkage mechanism, actuators & its types, torque, governing equations, FOS, motor sizing, motor selection, mass identification using software, power adapters, types of adapters, power calculations & adapter selection	06 + 12
VI	**Module 6: Platform Based Development** Introduction to various platform-based development (Arduino) programming and its essentials, Introduction to sensors, transducers and actuators and its interfacing with Arduino	06 + 14
		Total Hrs: 30+60

Course Project

Physical Implementation: Prototyping planning/Prototyping Sprint Reviews 18 Hrs

Each faculty will provide a need statement to students and mentor the group of students. Each group will come up with their own solution to the need statement. Number of need statements should be equal to number faculty teaching this course.

Sample need statements

1. To automate floor cleaning and reduce human effort.
2. To automate a selected industrial processing operation.
3. To automate Waste Segregation and Recycling.
4. To digitally capture the shape and dimensions of physical objects.
5. To reduce time and effort required for fruit peeling.
6. To automate corn shelling and improve agricultural productivity.
7. To detect driver fatigue and help prevent road accidents.
8. To automate the stacking of objects for improved productivity and safety.

Expected Deliverables

1) Problem Statement
2) Objectives
3) Literature Review
4) Methodology
5) Sustainability Analysis
6) Ethical Considerations
7) Prototype/Model/Survey/Simulation
8) Results and Discussion
9) Conclusion and Future Scope
10) Presentation and Final Report

Course Assessment Plan (*for total 90 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	**1**	Engineering Exploration Quiz & Reflection (individual)	Quiz or Individual reflection report on engineering disciplines, graduate attributes, ethics, sustainability and teamwork, Agile practices.	**10**	5 (1)	1–3
	2	Sustainability & Ethics Studio Activity (individual or team)	Life Cycle Assessment and carbon footprint & embodied energy calculation exercise or ethical dilemma case study analysis	**10**	5 (1)	4–7
	3	Concept Generation & Design Review (team submission)	Problem definition & formulation, concept generation (function tree, morphological chart), concept selection (Pugh chart), material selection justification	**10**	6 (1)	8-15

LA2	**4**	Virtual Implementation (individual or team)	CAD part modelling & assembly, engineering drawing.	**10**	12 (2)	1–3
	5	Motor and Battery Sizing (individual or team)	circuit diagram/flowchart, mechanism selection, motor & battery sizing calculations	**10**	10 (2)	4–7
	6	Platform-Based Development (individual or team)	Arduino programming fundamentals, sensor/transducer/actuator interfacing	**10**	10 (2)	8-15
ESE	**7**	Prototyping Sprint Review 1	Problem Statement, Objectives, Literature Review, Methodology (Project deliverables 1–4)	**15**	4 (7)	1–3
	8	Prototyping Sprint Review 2	Sustainability Analysis, Ethical Considerations, working Prototype/Model/Survey/Simulation (Project deliverables 5–7)	**15**	4 (7)	4–7
	9	Final Presentation & Report	Results and Discussion, Conclusion and Future Scope, final report + presentation (Project deliverables 8–10)	**10**	4 (7)	8-15
Total				**100**	**60** (Contact hrs) + **30** (Self Learning) **=90 hrs**	

Note: The Course Faculty will finalize the assessment plan (including the distribution of internal evaluations, practical rubrics, and continuous assessments) at the start of the semester in accordance with institute regulations. Any modifications will be communicated to the students in advance.

Text Books

1	Introduction to Engineering, Paul H. Wright, Carl T. F. Ross, Wiley India, 2008
2	Engineering Design: A Project-Based Introduction. 4th ed., by Clive L. Dym and Patrick Little, John Wiley & Sons, 2013.

References

1	Systems Engineering Principles and Practice, Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Steven M. Biemer, Wiley, 2020
2	Engineering Ethics: Concepts and Cases, Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2018
3	Norman, D. A., The Design of Everyday Things, Revised and Expanded Edition, Basic Books, 2013.
4	Ulrich, K. T., & Eppinger, S. D., Product Design and Development, 7th Edition, McGraw-Hill, 2024.
5	Ashby, M. F., Materials Selection in Mechanical Design, 5th Edition, Elsevier, 2016.
6	Budynas, R. G., & Nisbett, J. K., Shigley's Mechanical Engineering Design, 11th Edition, McGraw-Hill, 2019.
7	White, E., Making Embedded Systems, 2nd Edition, O'Reilly Media, 2024.

Useful Links

1	https://youtube.com/playlist?list=PL2935W76vRNEE_NNWlpUar20iUdkFQ1z2&si=-MaDgeRnw2uTllTw
2	https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg54
3	https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg63
4	https://www.youtube.com/playlist?list=PLGxa5y5etMwAY238yKu1orXTnzD9h5nL_
5	https://docs.arduino.cc/

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-2027

Course Information

Programme	First Year B. Tech.
Class, Semester	Sem I and Sem II
Course Code	8AE151
Course Name	Professional Communication
Desired Requisites:	10+2 level English

Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	---	**LA1**	**LA2**	**ISE**	**ESE**	**Total**
Tutorial	1Hr/week	30	30	--	40	100
Practical	---					
Interaction	1Hr/week	**Credits: 2**				

Course Objectives

1	Enable clear, confident, and context-aware communication (verbal, non-verbal, written, digital)..
2	Prepare students to understand and apply effective listening, feedback and professional writing skills required for academic and career contexts.
3	Develop oral communication skills including public speaking, group discussion, debate and persuasion skills
4	Inculcate understanding of teamwork, collaboration, and digital communication, and equip students with personal branding and career communication skills.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	Communicate clearly, confidently, and competently in diverse real-world scenarios	Apply
CO2	Demonstrate adequate proficiency in language.	Apply
CO3	Demonstrate communication skills (LSRW) in personal and professional settings.	Apply
CO4	Work effectively in teams and apply communication and interpersonal skills for career readiness.	Apply

Module	**Module Contents**	**Hours**
	Foundations of Communication	
1	Communication -Nature, Types, and Principles. Barriers to Effective Communication and overcoming them. Developing Effective Listening Skills: Types, listening and note-making.	2
	Language Skills & Communicative Grammar	
2	Vocabulary precision, clarity. Modal verbs, passives, phrasal verbs. Common errors & editing Communicative Grammar: modal verbs, question tags, misplaced modifiers, passives Reading comprehension	2
	Non-Verbal Communication & Vocalics	

3	Understanding Non-Verbal Communication — Scope and Significance, Codes of non-verbal communication. Vocalics —Understanding Pronunciation, Intonation, and Voice modulation, eliminating fillers Developing Non-verbal skills for professional settings	3
	Formal Oral Communication Skills	
4	Presentation Skills — Structure, Delivery and Confidence. Techniques for public speaking. Group Discussion: Types, Dynamics, and Techniques Introduction to Debate: Structured Arguments and Rebuttal Techniques	2
	Professional Writing & Business Communication	
5	Introduction to academic writing. Principles of Professional Writing: Brevity, Clarity and Pragmatic writing, Cover letter writing. Résumé Writing: Formats, ATS Compatibility	2
	Interpersonal, Teamwork & Career Communication Skills	
6	Interpersonal skills- Significance, Emotional Intelligence (EQ) —Cores of Emotional Intelligence Team Building: Definition, Hierarchy and Team Dynamics Personal Branding in the Digital Age — LinkedIn and Social Media Strategy Interview Skills: Types, STAR Method, Mock Interview Preparation	3

	Textbooks
1	Adler, R.B. & Rodman, G. — Understanding Human Communication, Oxford University Press
2	Sanjay Kumar & Pushpalata — Communication Skills, Oxford University Press, First Edition, 2012
3	Cialdini, R. — Influence: The Psychology of Persuasion, Harper Business
	References
1	Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hills publishing Company 2006
2	William Sanborn Pfeiffer, T.V.S. Padmaja, Technical Communication: A Practical Approach, Pearson, Sixth Edition 2012
3	Reynolds, G. — Presentation Zen: Simple Ideas on Presentation Design and Delivery, New Riders
4	Exercises in Spoken English, Parts I and II, CIEFL, Hyderabad, Oxford University Press
	Useful Links
1	www.ted.com/talks — TED Talks on Communication

Course Assessment Plan — Notional Learning Hours

Professional Communication | First Year B Tech | Sem I & II | Credits: 2 | Total NLH: 60

Sl. No.	Assessment Type	Brief Description	Marks	Notional Learning Hours (NLH)	A T*	CO Mapped	Bloom's Taxonomy Level
1	Tutorial Exercise	Structured exercises based on Module I & II topics	20	8	LA1	CO2	Apply (L3)
2	Listening + Note-Making Task	Audio-visual listening exercise with note-making and summary writing from Module I	10	8	LA1	CO1, CO2	Apply (L3)
3	Oral Presentation	Individual 10-minute structured presentation evaluated via rubric (Module IV)	10	10	LA2	CO1, CO3	Apply (L3)
4	Group Discussion / Debate	Mock GD / Debate on current affairs or case-based topics (Module IV)	10	10	LA2	CO3, CO4	Apply (L3)
5	Professional Writing Task	Email makeover + Résumé peer review using ATS simulation (Module V)	10	8	LA2	CO1, CO4	Apply (L3)
6	End-Semester Examination	Oral exam covering all 6 modules (30–40% weightage on Modules 1–3; 60–70% on Modules 4–6)	40	16	ESE	CO1–CO4	Apply (L3)
		Total	**100**	**60**		—	

Notes: | **AT**= Assessment Type. NLH = **Notional Learning Hours** includes lecture contact hours, tutorial hours, self-study, and assessment preparation. | Total NLH = 60 (as per 2-credit course norm: 1 credit = 30 NLH).

Notional Learning Hours breakup as per component.

Component	Hours	Basis
Lecture contact hours (1 hr/week × 14 teaching weeks)	14	Teaching scheme

Notional Learning Hours breakup as per component.

Component	Hours	Basis
Lecture contact hours (1 hr/week × 14 teaching weeks)	14	Teaching scheme
Tutorial / Lab contact hours (1 hr/week × 14 teaching weeks)	14	Teaching scheme
Self-study, reading & comprehension practice	12	Home preparation
Assessment preparation (LA1 + LA2 + ESE)	12	Assessment plan
Co-curricular / Activity-based learning tasks	8	Activity sessions
Total Notional Learning Hours	**60**	1 Credit = 30 NLH × 2 Credits

CO-PO Mapping

	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1									3		2			
CO2									3		2			
CO3							2		2		2			
CO4								3	2		2			

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High

Each CO of the course must map to at least one PO.

Syllabus Prepared By	Mr. M H Kalawate
Syllabus Checked By	HOD, Robotics & Automation-

Walchand College of Engineering, Sangli
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Course Information

Programme	B.Tech. Robotics
Class, Semester	First Year B. Tech. Sem II
Course Code	2ES104
Course Name	Engineering Graphics
Desired Requisites:	Basic Knowledge of Different Types of Curves

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**MSE**	**ISE/LA**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Lab	2 Hrs/week	**Credits: 3**			

Course Objectives

1	Introduce students to the conventions, concepts and basic principles of Engineering Drawing.
2	Draw projections of geometrical objects and real life components.
3	Demonstrate graphics skill for communication of concepts, ideas and design of engineering products

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrating Principles of Engineering, Computer Graphics through drafting software	I	Demonstrating
CO2	Understanding Principles of Engineering Graphics	II	Understanding
CO3	Outline projection of engineering objects	III	Applying
CO4	Correlating the knowledge of engineering graphics in real life applications.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction to Engineering Drawing / Curves** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;	4
II	**Projection of Lines** Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes, Skew Lines, Parallel Lines, Perpendicular Lines using auxiliary methods;	5
III	**Projection of Planes** Principles of Orthographic Projections-Conventions - Projections of planes inclined Planes - Auxiliary Planes;	4
IV	**Projections of Regular Solids Sections and Sectional Views of Right Angular Solids** Inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;	5
V	**Orthographic Projections** Principles of Orthographic Projections-Conventions - Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	4
VI	**Isometric Projections** Principles of Isometric projection – Isometric Scale, Isometric Views,	4

	Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	

List of Experiments / Lab Activities

Exp. No.	Title of Experiment	Content / Scope
1	Introduction to CAD Environment	Introduction to CAD software, user interface, coordinate systems, drawing limits, units, layers, object snaps, file management, and plotting.
2	Basic Drawing Commands	Creation of 2D geometries using Line, Polyline, Rectangle, Circle, Arc, Polygon, Ellipse, and Spline commands.
3	Editing Commands in CAD	Application of Move, Copy, Rotate, Mirror, Scale, Offset, Trim, Extend, Fillet, Chamfer, and Array commands for modifying drawings.
4	Construction of Engineering Curves	Preparation of Cycloid, Epicycloid, Involute of Circle, and Archimedean Spiral using CAD tools and construction methods.
5	Orthographic Projection of Points and Lines	Drawing projections of points and straight lines in different positions with determination of true length and true inclinations.
6	Orthographic Projection of Plane Surfaces	Projection of plane figures such as square, rectangle, pentagon, and hexagon inclined to HP and VP; determination of true shape.
7	Projection of Solids	Drawing projections of prisms, pyramids, cylinders, and cones in simple and inclined positions using CAD.
8	Sectional Views of Solids	Generation of sectional views of prisms, pyramids, cylinders, and cones; application of hatching and section conventions.
9	Development of Surfaces of Solids	Preparation of developments of prisms, pyramids, cylinders, and cones with applications in sheet metal design.
10	Isometric Drawing and Visualization	Construction of isometric views and isometric projections of engineering objects from orthographic views.
11	Dimensioning and Annotation	Application of linear, angular, radial, and diameter dimensions; text, leaders, hatching, symbols, tolerances, and plotting standards.
12	Drawing of Standard Machine Components	Preparation of CAD drawings of nuts, bolts, screws, keys, cotters, riveted joints, welded joints, and other standard machine elements.
13	Assembly Drawing and Working Drawing Project	Preparation of detailed part drawings and assembly drawings of simple mechanical systems such as flange coupling, knuckle joint, plummer block, or footstep bearing including dimensions and bill of materials.

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

The student will learn :

- Introduction to engineering drawing and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics projection of standard solid primitives
- Exposure to visualization of 3-D solid modeling
- Exposure to computer-aided geometric drafting
- Exposure to creating working drawings

Text Books

1	Bhatt N.D., Panchal V.M. and Ingle P.R., Engineering Drawing, Charotar Publishing House, 2014.
2	Shah, M.B. and Rana B.C., Engineering Drawing and Computer Graphics, Pearson Education, 2008.
3	Agrawal B. and Agrawal C. M., Engineering Graphics, TMH Publication, 2012.

References

1	Narayana, K.L. and P Kannaiah, Text book on Engineering Drawing, Scitech Publishers, 2008.
2	Warren J. Luzzader, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2010
3	Fredderock E. Giesecke, Alva Mitchell others, Principles of Engineering Graphics, Maxwell McMillan Publishing, 2010

Useful Links

1	https://nptel.ac.in/courses/112/103/112103019/

2	https://nptel.ac.in/courses/105/104/105104148/
3	https://www.youtube.com/watch?v=xXdpkQXDuMw&list=PL9RcWoqXmzaJT-fliqTSwUjWU4zCX_H2A

CO-PO Mapping For Robotics and Automation															
	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	3				2					1		1	2		
CO2			2										1		
CO3					3					1			2		
CO4												3	1		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

Assessment

The assessment is based on MSE, ISE/LA and ESE.
MSE shall be typically on modules 1 to 3.
ISE/LA shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be lab work, assignment, orals etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE/LA+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
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AY 2026-27

Course Information

Programme	B. Tech. Robotics and Automation
Class, Semester	First Year B. Tech., Sem. II
Course Code	2RA102
Course Name	Materials and Manufacturing Processes
Desired Requisites:	12th Physics and Chemistry, Physical Sciences

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs / Wk	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr / Wk	30	20	50	100
	-	**Credits: 3**			

Course Objectives

1	To introduce the fundamental concepts of metal solidification, phase identification, and the Iron-Carbon system
2	To familiarize students with basic heat treatment processes (such as annealing, quenching, and tempering) and the core properties of ferrous and non-ferrous alloys
3	To impart an elementary understanding of the working principles, tool parameters, and material mechanics behind casting, forming, cutting, and joining operations
4	To align students' thinking towards the role of automation on the modern shop floor—including foundry automation, automated forming lines, and robotic welding cells

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	State the rules governing solid solution formation and identify basic phase diagram configurations, including eutectic, peritectic, and eutectoid transformations.	I	State Identify
CO2	Explain the mechanics of orthogonal metal cutting, chip formation, and the factors influencing tool wear and surface finish during machining.	II	Explain
CO3	Apply the lever rule to compute phase fractions on the Iron-Carbon equilibrium diagram and calculate material removal rates in machining processes.	III	Apply Compute
CO4	Select appropriate material and manufacturing process for given application	IV	Select

Module	**Module Contents**	**Hours**
I	**Solidification, Solid Solutions and Phase Diagram** Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures, solid solutions- types and rules governing the formation of solid solutions. **Phase Diagram**: Basic terms, phase rule, lever rule, cooling curves, construction and interpretation of different phase diagrams (eutectic, eutectoid, peritectic and peritectoid) **Iron-Carbon Phase Equilibrium Diagram**.	5
II	**Ferrous & Non-Ferrous Materials and Heat Treatments** Transformations and Heat Treatments: TTT curves, continuous cooling curves, annealing and its types. normalizing, hardening, tempering, age hardening of aluminium-copper alloys. Ferrous Materials: Properties, Classification, Composition and uses of steels and cast irons. Non-Ferrous Materials: Properties, Classification, Composition and uses of copper alloys, aluminium alloys, nickel alloys.	5
III	**Metal Casting & Foundry Automation** Introduction, Basic Process & Materials, Types of Casting, Gating & Solidification, Casting Defects, Foundry Automation	4
IV	**Metal Forming**	4

	Introduction, Classification, Science of Metal Forming, Important Processes, Forming Defects, Forming Automation	
V	**Metal Cutting** Introduction, Mechanism of Cutting, Cutting Parameters & Tool Materials, Types of machining Processes, Tool wear and Finish	5
VI	**Metal Joining** Introduction, Welding: Principles and Types, Science Behind Metal Joining, Brazing and Soldering, Defects in Joining, Automation in Metal joining **Processing of Plastics and Composites** Introduction, Processing of Plastics, Processing of Composites, Applications, Defects.	5

Note:
As these modules need numerical treatment and process flow diagrams, these shall be taught and practiced during "**batchwise tutorial**" sessions.

Text Books	
1.	William F. Smith, Javad Hashemi, Francisco Presuel- Moreno, Foundations of Materials Science and Engineering, 6th Edition McGraw Hill, 2022
2.	M. K. Muralidhara, Materials Science and Metallurgy, SunStar Publisher, 4th edition, 2011.
3.	O.P. Khanna, Material Science and Metallurgy, Dhanpat Rai publication, 2010.
4.	Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
5.	Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
6.	Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
7.	P.N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I Tata McGraw Hill, 4th edition, 2013, ISBN: 9781259062575.
8.	
1.	V. Raghavan, Material science and engineering, PH Pub. 2015.
2.	R.K.Rajput, Engineering materials and metallurgy. S. Chand & Co. 2006.
3.	William and Collister, Materials Science and Engineering, Wiley pub. 2014.
4.	Sidney H. Avener, Introduction to Physical Metallurgy, TMH
5.	Manufacturing Technology Vol-II, By P.N. Rao, Tata McGraw Hill.
6.	Production technology, by R.K. Jain, Khanna publishers
7.	Welding Processes and Technology by R.S.Parmar, Khanna.
8.	Technology of Metal forming Processes by Surendra, PHI
9.	
1.	http://www.istl.org/02-spring/internet.html
2.	https://www.efunda.com/home.cfm
3.	https://library.up.ac.za/c.php?g=247504
4.	https://library.nitrkl.ac.in/libguide/subjects/guide.php?subject=MM
5.	https://youtu.be/Qx-Kx4GapgI
6.	https://youtu.be/ljveGnQw2G0?list=PLSGws_74K018JY-1RyIj0cm4yppa1h54r
7.	https://youtu.be/ZLlwfXSXEVc?list=PLSGws_74K01_zyzpQkNtm-6ickGhCwi-4
8.	https://youtu.be/TlhGTSDfQxc
9.	https://www.youtube.com/watch?v=cxU1zUOpGLk&t=3016s

CO-PO Mapping

	Programme Outcomes (PO)											**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1	-	-	-	-	-	-	-	-	-		
CO2	3	2	-	-	-	-	-	-	-	-	-		
CO3	3	3	2	-	-	-	-	-	-	-	-		
CO4	3	3	3	2	2	1	2	-	-	-	-		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. (during "**tutorial**" sessions) and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (**ESE shall be a separate head of passing**)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27

Course Information

Programme	First Year B. Tech Robotics and Automation
Class, Semester	First Year B. Tech., Sem I/II
Course Code	2VS152
Course Name	Electrical and Electronics Lab
Desired Requisites:	12th Physics

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	3 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 3			

Course Objectives

1	This course intends to demonstrate basic knowledge of Electrical engineering .
2	It intends to develop skills to recognize working principle, construction and types of electrical Machines.
3	This course intends to demonstrate basic knowledge of Electronics engineering.
4	To provide knowledge of electronic components and circuits to first year engineering students, so that they can understand, design and implement simple analog / digital electronic circuits.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Describe** basic concepts of electrical circuits and various theorems.	II	Understanding
CO2	**Demonstrate** the use of transformers and AC/DC machines	III	Applying
CO3	**Identify and explain** use of electronics components and instruments .	II	Understanding
CO4	**Construct** digital IC, diode, transistor and op-amp based circuits	III	Applying

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode): Electrical

1. To study AC and DC machines parts and their functions.
2. Study of AC/DC motor starters.
3. To study servo motor/ steeper motor with application.
4. Study of installation techniques using fuse, MCB and MCCB.
5. Measure voltage, current and power in single phase R-C series circuit.
6. Measure Voltage, current and power factor of 1-phase A.C R-L series circuit.

List of Lab Activities: Electrical

1. Electrical Safety Measures.
2. To study series-parallel RL, RC and RLC circuits
3. To verify KVL and KCL theorems.
4. To study speed control techniques of ac and dc machines.
5. To perform load test on transformer.
6. Find out equivalent resistance in series and parallel connection.

List of Lab Activities: Electronics

1. Identification of components and instruments required in lab to perform experiments in basic electronics engineering.
2. Realization of logic gates using basic building block (NAND/NOR).
3. Implementation of combinational and sequential logic circuit.
4. Study of half-wave and full-wave rectifier.
5. Study of diode-based clipper and clamper circuits
6. Study of transistor as a switch.
7. Study of inverting and non-inverting amplifier using op-amp.

Textbooks	
1	D.C. Kulshreshtha, "Basic Electrical Engineering", 1 st revised editionMcGraw Hill, 2012.
2	D.P Kothari and I.J Nagrath, "Basic Electrical Engineering",Tata McGraw Hill, 2010.
3.	R. P. Jain, "Modern Digital Electronics", 4th edition, Tata McGraw Hill, 2009.
4	Robert Boylestad, Louis Nashelsky, 11th edition, "Electronic Devices and Circuits, Pearson, 2015.
5.	Ramakant Gaikwad, "Op-amp and Linear Integrated Circuits", 4th edition, Pearson, 2015.

References	
1	V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering", 2 nd edition, Tata McGraw Hill.
2	Morris Mano, "Digital Design", Pearson, 4th edition, 2011
3	Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd edition, Tata McGraw Hill, 2011
4	Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th edition, PHI, 2009

Useful Links	
1	Virtual Labs ,An Initiative of Ministry of Education Under the National Mission on Education through ICT, 1. https://www.vlab.co.in/broad-area-electrical-engineering 2. http://vlabs.iitkgp.ac.in/asnm/#
2	Virtual Labs, An Initiative of Ministry of Education Under the National Mission on Education through ICT:Basic Electronics
3	https://nptel.ac.in/courses/122106025

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3								2					
CO3	3													
CO4	3								2					

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.