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

AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1RA201
Course Name	Mechanics of Materials
Desired Requisites:	Basics of calculus and statistics

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

Course Objectives

1	To familiarize students with basics of stress-strain, behaviour of different engineering materials subject to different types of loading
2	To demonstrate calculation of principal stresses using analytical and graphical methods.
3	To calculate and plot shear force and bending moment diagrams for beams carrying different types of loads and support conditions
4	To determine deflection and slope of beams subject to different types of loads.
5	To evaluate the diameter of solid and hollow shafts subjected to torques

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 concepts of stress-strain, properties of materials, behaviour of material under different loading conditions	II	Understanding
CO2	Calculate Bending Moment (BM) and Shear Force (SF) diagrams, draw BM and SF diagrams for various types of beams carrying different types of loads	III	Applying
CO3	Analyse the principles of torque transmission to differentiate between solid and hollow shafts, and compute the required diameters based on strength and torsional rigidity criteria.	IV	Analysing
CO4	Calculate critical loads for different types of columns using Euler's and Rankine equation, limitations and applications of these equations	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Simple stress and strain** Definition/derivation of normal stress & shear stress, and normal strain & shear strain, Definitions of Elastic limit, yield point, ultimate strength, fracture point using Stress strain diagram for brittle and ductile materials, Poisson's ratio & volumetric strain, Elastic constants, Relationship between elastic constants and Poisson's ratio, Generalized Hooke's Law, Deformation of simple and compound bars, Concept of strain energy and resilience, Modulus of resilience, proof resilience, Types of loading (Gradual, Sudden, Impact, Shock), Deformation due to temperature changes.	5
II	**Bi-axial Stress system** Concept of plane stress system (2D stress state), stresses on inclined sections, principal stresses and maximum shear stresses, Concept of principal planes, principal stresses, and maximum shear stress, Graphical method for stress analysis using Mohr's Circle, Thick and Thin cylinders, Radial, Hoop stress and longitudinal stress,	5

	Volumetric strain and change in dimensions, Lame's equations for thick cylinders under Internal pressure and External pressure, real world applications.	
III	**Bending moment and Shear forces in beams** Definition of a beam and basic assumptions, Types of beams, Concept of shear force (SF) and bending moment (BM), S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure and its design implications.	4
IV	**Design of simple beam sections** Theory of Simple Bending, Concept of Neutral Axis and Neutral Surface, Shear Stress in Beams, section modulus of rectangular and circular sections (Solid and Hollow), Shear stress distribution in I, T and Channel sections, Bending Stress Distribution, Identification of critical shear locations, Practical significance in beam failure and design, real world applications.	4
V	**Torsion of circular shafts** Concept of torsion in circular shafts, Pure torsion, Derivation of Torsion Equation, Polar Moment of Inertia and Torsional Rigidity, Power Transmission in Shafts (solid and hollow circular), Selection of shaft dimensions based on allowable shear stress, Angle of twist limit, Weight, Cost and manufacturing implications, Real-life applications.	4
VI	**Columns** Definition of column and strut, long column and short column, Euler's Theory for Long Columns, Rankine's Formula and Comparison with Euler's Formula, Concept of buckling and stability, critical load, effective length of columns, Secant Formula and Buckling Load with Initial Imperfections, Design Examples and Practical Applications.	4

Text Books	
1	Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, Mechanics of materials, SI units, Tata McGraw-Hill publications, 8th edition, 2020.
2	M.N. Shesha Prakash and Suresh G. S., Mechanics of materials, PHI Learning, 2011
3	K.V. Rao, G.C. Raju, Mechanics of materials, Subhash Stores, 1st edition, 2007.
References	
1	Parviz Ghavami, Mechanics of Materials, Springer, 2015
2	Timoshenko S and Gere, Mechanics of Materials, CBS Publishers, 2014
3	RK Bansal, Strength of Materials, Lakshmi Publications, 2010.
4	SS Rattan, Strength of Materials, Tata McGraw-Hill, 2009
Useful Links	
1	https://nptel.ac.in/courses/105106172
2	https://ocw.mit.edu/courses/3-11-mechanics-of-materials-fall-1999/pages/modules/
3	https://www.engineer4free.com/mechanics-of-materials.html
4	https://static-archives.git-pages.mst.edu/mdsolids/
5	https://eng.libretexts.org/Bookshelves/Mechanical_Engineering/Mechanics_of_Materials_(Roylance)

CO-PO Mapping

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2025-26						
Course Information						
Programme	B. Tech. Robotics & Automation					
Class, Semester	Second Year B. Tech., Sem. III					
Course Code	1RA202					
Course Name	Advanced Materials and Metallurgy					
Desired Requisites:	Basics of physics and chemistry					
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**	
Tutorial	-	30	20	50	100	
	-	**Credits: 3**				

Course Objectives	
1	To gain knowledge of different types of material crystal structures, arrangement of atoms and mechanical properties
2	To know different types of fractures and their importance
3	To draw TTT curves and iron-carbon diagrams
4	To select various non-ferrous metals and alloys based on composition and properties for given application
5	To describe various types of composite materials, explain various manufacturing methods of composites and identify the engineering applications

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 different types of material crystal structures and arrangement of atoms	II	Remembering
CO2	Describe various mechanical properties of materials, types of fractures and their importance in engineering applications	II	Understanding
CO3	Explain concept of equilibrium diagram, plot cooling curves and phase diagram for pure metals and alloys	III	Applying
CO4	Explain various heat treatment processes and their importance in engineering field, identify and select different ferrous and non-ferrous metals for different applications.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Structure of Metals and Alloys** Unit Cell, Types of Crystal structures, Common Crystal Structures - BCC, FCC and HCP Structures, coordination number and atomic packing factors, Mechanism of crystallization, nuclei formation and crystal growth, dendritic structures, crystal imperfections –point, line and surface imperfections, structures of alloys, solid solution-types, Hume-Rothery's rule, Atomic Diffusion: Phenomenon, Flick's laws of diffusion, factors affecting diffusion.	7
II	**Mechanical Behaviour and Fracture** Stress-strain diagram for ductile and brittle materials, linear and non-linear elastic behaviour and properties, mechanical properties in plastic range, yield strength, ductility, ultimate tensile strength, and toughness. Creep: Description of the phenomenon with examples, three stages of creep. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.	6
III	**Solidification, Solid Solutions and Phase Diagram**	7

	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)	
IV	**Heat Treatment of Metals** TTT curves, annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening. Ferrous Materials: Properties, Composition and uses of grey cast iron, malleable iron, S.G iron and steel Non-Ferrous Metals: Copper alloys-brasses and bronzes. Aluminium alloys-Al-Cu, Al-Si, Al-Zn alloys.	6
V	**Composite Materials** Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP' and MMC's advantages, limitations and application of composites. Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.	7
VI	**Smart Materials** Other Materials: Brief description of other materials such as optical and thermal materials Smart materials – fibre optic materials, piezo-electrics, shape memory alloys Shape Memory Alloys – Nitinol, super elasticity, Magnetostrictive Materials. Biological applications of smart materials - materials used as implants in human Body, Selection of Materials, Performance of materials in service Residual life assessment – use of non-destructive testing.	6

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.
References	
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
Useful Links	
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

CO-PO Mapping

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2025-26						
Course Information						
Programme	B. Tech. Robotics & Automation					
Class, Semester	Second Year B. Tech., Sem. III					
Course Code	1RA203					
Course Name	Manufacturing Technology					
Desired Requisites:	Basic manufacturing processes					
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**	
Tutorial	-	30	20	50	100	
	-	**Credits: 3**				

Course Objectives	
1	To develop a problem oriented in depth knowledge of Manufacturing Technology
2	To address the underlying concepts, methods and application of casting, welding, forming.
3	To understand the different conventional and unconventional manufacturing methods employed for making different products
4	Introduce the basic principles that govern the principles of metal cutting and machining
5	To develop a comprehensive understanding and effectively interpret the scope and complexity of manufacturing processes.

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	Discuss the working principles, tools, and applications of different manufacturing methods like casting, forging, machining, and welding.	II	Understanding
CO2	Exercise the selection of suitable welding processes for given engineering components based on material and design requirements.	III	Applying
CO3	Examine the influence of process parameters on metal forming processes, and productivity in manufacturing operations.	IV	Analysing
CO4	Evaluate the performance, advantages, and limitations of various nonconventional machining processes	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Conventional Manufacturing processes** Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.	7
II	**Metal cutting** Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.	6
III	**Metal Joining (Welding)** Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG	6

	processes and their parameters. Resistance welding - spot, seam projection etc.	
IV	**Other Joining Process** Welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Adhesive bonding. Ultrasonic Welding, Laser Joining Techniques, Weld decay in HAZ. Parameters involved & Mechanism. Different Types of Soldering & Brazing Methods.	7
V	**Unconventional Machining Processes** Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.	7
VI	**Modern Manufacturing Processes** Additive Manufacturing: Introduction to additive manufacturing (AM), AM process chain, benefits and comparison with conventional manufacturing, classification of AM processes, AM technologies: vat polymerization, powder bed fusion, material extrusion, material jetting binder jetting, sheet lamination, direct energy deposition, direct write technologies.	6

Text Books	
1	Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2	Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
3	Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
4	P.N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I Tata McGraw Hill, 4th edition, 2013, ISBN: 9781259062575.
5	Jagadeesha T, "Unconventional Machining Processes", Dreamtech Press, Edition 2020, ISBN No:978-93-89976-05-2
References	
1	Manufacturing Technology Vol-II, By P.N. Rao, Tata McGraw Hill.
2	Production technology, by R.K. Jain, Khanna publishers
3	Welding Processes and Technology by R.S.Parmar, Khanna.
4	Technology of Metal forming Processes by Surendra, PHI
5	Jagadeesha T, "Non-traditional Machining Processes", Dreamtech Press, Edition 2020, ISBN No:978-93-85920-72-9
Useful Links	
1	https://youtu.be/Qx-Kx4GapgI
2	https://youtu.be/ljveGnQw2G0?list=PLSGws_74K018JY-1RyIj0cm4yppa1h54r
3	https://youtu.be/ZLlwfXSXEVc?list=PLSGws_74K01_zyzpQkNtm-6ickGhCwi-4
4	https://youtu.be/TlhGTSDfQxc
5	https://www.youtube.com/watch?v=cxU1zUOpGLk&t=3016s
6	https://www.youtube.com/watch?v=Hc6mfNWT8oQ&t=7s
7	https://www.youtube.com/playlist?list=PLzCSUZGIUJkaSyCzPiQMWynGyxmC8hrpl
8	https://www.youtube.com/watch?v=ICjQ0UzE2Ao
9	https://www.youtube.com/watch?v=WJtF1wEOeAw
10	https://www.youtube.com/watch?v=sPhTjrvpGyE&t=1838s
11	https://www.youtube.com/watch?v=mmKy5PbndQI&list=PLyqSpQzTE6M-KwjFQByBvRx464XpCgOEC

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

CO1	3		2									2	
CO2	3			2								2	
CO3	2		3	2								2	1
CO4	2		2	3								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)

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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1RA204
Course Name	Analog and Digital Electronics
Desired Requisites:	Basics of electronics

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

Course Objectives

1	To give exposure to students for the selection of analog integrated circuits for different applications in the field of robotics
2	To understand the concepts of combinational logic circuits and sequential circuits for design of 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	Define semiconductor device and different operating condition and their performance parameter.	II	Remembering
CO2	Analyze various circuits to generate signals for different applications using op-amp	IV	Analyzing
CO3	Analyze the design procedure for synchronous and asynchronous combinational and sequential circuits	IV	Analyzing
CO4	Apply the concept of digital logic families with circuit implementation	III	Applying

Module	**Module Contents**	**Hours**
I	**Transistor Amplifier** Review of Transistor and its configuration, Small Signal BJT amplifiers: frequency response of basic & compound configuration Feedback & Oscillator Circuits: Effect of positive and negative feedbacks, basic feedback topologies & their properties, Analysis of feedbacks, basic feedback topologies & their properties, Analysis of practical feedback amplifiers, Sinusodial Oscillators (RC, LC and Crystal), Multivibrators Field Effect Transistors: Junction Field Effect Transistors, MOSFETs, Differences between JFETs and MOSFETs, Biasing MOSFETs, FET Applications, CMOS Devices.	7
II	**Operational Amplifier Applications** Review of Operational Amplifier, Ideal v/s practical Op-amp, Performance Parameters, Wave-Shaping Circuits, Multivibrators, Peak Detector Circuit, Comparator, Active Filters, Non Linear Amplifier, Relaxation Oscillator, Current-To-Voltage Converter, Voltage-To Current Converter	6
III	**Combinational Logic** Review of Digital logic gates and circuits, Code converter, Quine: Mc cluskey method for logic minimization, Designs using MUX and Demux, Priority Encoder, Priority decoder, Parity Generator and Checker, Carry look ahead adder, ALU , tristate buffers, Hazards, Hazard removal	6

IV	**Sequential logic and it's Applications** Storage elements: latches and flip flops, characteristic equations of flip flops, flip-flop conversion, Shift registers, Ripple Counters, Synchronous counters, Johnson & Ring Counter.	5
V	**Synchronous and Asynchronous Sequential Circuits** Analysis of clocked sequential circuits with state machine designing, State reduction and assignment, design procedure, Analysis of asynchronous sequential circuits, circuit with latches, Reduction of state and flow table, Race free state assignment, hazards	7
VI	**Memory and Programmable Logic Devices** Digital logic families:DTL, DCTL, TTL, ECL & CMOS, Fan-in, fan-out, noise margin, RAM, ROM, PLA, PAL, Circuits of Logic families, Interfacing of digital logic families, Circuit implementation using ROM, PLA and PAL.	5

Text Books	
1	Anil K. Maini, Varsha Agarwal, Electronic Devices and Circuits, Wiley, 2012
2	Donald P Leach, Albert Paul Malvino and Goutam Saha, Digital Principles and Applications, 8th edition, Tata McGrawhill, 2015.
3	Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGrawHill.
4	M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003
References	
1	Electronic Devices and Circuits,K.Lal Kishore B.S Publications
2	Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi, 2006.
3	John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
4	John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
Useful Links	
1	https://nptel.ac.in/courses/108102112
2	https://nptel.ac.in/courses/108105132

CO-PO Mapping

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

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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1RA251
Course Name	Metallurgy and Manufacturing Technology Lab
Desired Requisites:	Basics of mechanical engineering, chemistry

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

Course Objectives

1	To expose the students to a variety of manufacturing processes including their typical use and capabilities
2	To demonstrate and explore examples of casting, moulding, machining and joining processes.
3	

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Level	Descriptor
CO1	Study the Metallographic examination of different engineering materials	II	Understanding
CO2	Understand castings processes, working principles and applications and list various defects in metal casting	III	Applying
CO3	Understand the various metal forming processes, working principles and applications	IV	Analysing
CO4	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.	V	Evaluating

List of Experiments / Lab Activities

List of Experiments:

Part A (Metallurgy)

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, gray CI, SG iron, Brass and Bronze.
2. Non-destructive test experiments like,
   a. Ultrasonic flaw detection
   b. Magnetic crack detection
   c. Dye penetration testing. To study the defects of Cast and Welded specimens
3. Brinell and Rockwell Hardness test.
4. Tensile, Shear and Compression tests of metallic and non-metallic specimens using Universal Testing Machine
5. Bending Test on metallic and non-metallic specimens.

PART B (Manufacturing Technology)

6. Testing of Moulding Sand and Core Sand: Preparation of sand specimens and conduction of the following tests:
   a. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
   b. Permeability test
   c. Core hardness & Mould hardness tests.
   d. Sieve Analysis to find Grain Finest number of Base Sand
7. Welding process for the application of joining materials

8. Demonstrate components of a forging machine and its safety considerations 9. Study of Sheet metal operations

Text Books	
1	Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2	Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
3	Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
References	
1	Manufacturing Technology Vol-II, By P.N. Rao, Tata McGraw Hill.
2	Production technology, by R.K. Jain, Khanna publishers
3	Welding Processes and Technology by R.S.Parmar, Khanna.
4	Technology of Metal forming Processes by Surendra, PHI
Useful Links	
1	https://msvs-dei.vlabs.ac.in/

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	3		2										2	
CO2	3			2									2	
CO3	2		3	2									2	1
CO4	2		2	3									3	2
The strength of mapping: 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. Lab ESE is treated as End Semester Exam and is based on all experiments/lab activities.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab Performance and documentation	Lab Course faculty	During Week 13 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The actual schedule shall be as per the academic calendar. Lab activities/Lab performance shall include performing experiments, mini-projects, 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.				

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Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1RA252
Course Name	Analog and Digital Electronics Lab
Desired Requisites:	

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

Course Objectives

1	To get practical experience in design, assembly and evaluation/testing of Analog components and circuits including Operational Amplifier, Timer, Combinational logic circuits, Flip - Flops and their operations, Counters, flip-flops, Synchronous and Asynchronous sequential circuits and A/D and D/A converters

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Level	Descriptor
CO1	Interpret circuits using linear ICs for wide range applications	II	Understanding
CO2	Practice Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.	III	Applying
CO3	Analyze the concepts of Flip Flops, counters to design the synchronous sequential circuits.	IV	Analyzing

List of Experiments / Lab Activities

List of Experiments:

Part A (Analog Electronic Circuits)

1. "Design a multivibrator circuit using NE 555 timer IC. Simulate the same for any one duty cycle."
2. Using UA 741 Opamp, design a Relaxation Oscillator with 50% duty cycle. And simulate the same.
3. Using UA 741 opamap, design a window comparate for any given UTP and LTP. And simulate the same.

PART B (Digital Electronic Circuits)

4. Design and implement Half adder, Full Adder, Half Subtractor, Full Subtractor using basic gates. And implement the same in HDL.
5. Design Simple logic gates, multiplexer and implement the same in HDL.
6. Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table. And implement the same in HDL.
7. Design and implement code converter- (I)Binary to Gray (II) Gray to Binary Code using basic gates.
8. Design and implement a mod-n synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.
9. Design and implement an asynchronous counter using decade counter IC to count up from 0 to n and demonstrate on 7-segment display (using IC-7447)

Text Books

1	Anil K. Maini, Varsha Agarwal, Electronic Devices and Circuits, Wiley, 2012

2	Donald P Leach, Albert Paul Malvino and Goutam Saha, Digital Principles and Applications, 8th edition, Tata McGrawhill, 2015.
3	Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGrawHill.
References	
1	Electronic Devices and Circuits, K.Lal Kishore B.S Publications
2	Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi, 2006.
3	John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
4	John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
Useful Links	
1	E-book versions are available at 'https://www.knimbus.com/' of the VTU consortium.
2	https://nptel.ac.in/courses/108102112
3	https://nptel.ac.in/courses/108105132

CO-PO Mapping

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

The strength of mapping: 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. Lab ESE is treated as End Semester Exam and is based on all experiments/lab activities.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab Performance and documentation	Lab Course faculty	During Week 13 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates the starting week of a semester. The actual schedule shall be as per the academic calendar. Lab activities/Lab performance shall include performing experiments, mini-projects, 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.

Walchand College of Engineering, Sangli
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Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1MA201
Course Name	Applied Mathematics for Robotics
Desired Requisites:	Engineering Mathematics I&II

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

Course Objectives

1	To impart Mathematical skills and enhance thinking power of students.
2	To introduce fundamental concepts of Mathematics and their applications in engineering fields.

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	Understand the solutions of nonlinear partial differential equations and the fundamental concepts and properties of the Fourier transform.	II	Understanding
CO2	Apply Fourier series using Euler's formulae, utilize Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients, and employ vector calculus concepts to address engineering-related problems	III	Applying

Module	**Module Contents**	**Hours**
I	**Fourier Series** Periodic functions, Dirichlet's conditions, Definition, determination of Fourier coefficients (Euler Formulae), Expansion of functions, Even and odd functions, change of interval and functions having arbitrary period, Half range Fourier sine and cosine series.	**7**
II	**Partial Differential Equations** Four Standard forms of partial differential equations, application to one dimensional heat equation.	**6**
III	**Laplace Transform and Its Applications** Definition, Transform of Standard functions, Properties, Transform of derivative and Integral, Inverse Laplace Transform, Convolution Theorem, Applications to solve linear differential equation with constant coefficient**.**	**8**
IV	**Fourier Transform** Definition, Fourier Sine and Cosine Integral, Fourier sine and Cosine transform, Inverse Fourier sine and Cosine transform, Properties, Parseval's Identity.	**6**
V	**Vector Differentiation** Concept of vector field, directional derivatives, gradient of vector field, tangent line to the curve, velocity, acceleration, divergent and curl of vector field.	**6**
VI	**Vector Integral** Line integrals, surface integral, Green's theorem in plane, Stoke's Theorem, Gauss Divergence theorem.	**6**

Text Books

1	P. N. and J. N. Wartikar, *"A Text Book of Applied Mathematics",* Vol I and II", Vidyarthi Griha Prakashan, Pune, 2006.
2	B .S. Grewal, *"Higher Engineering Mathematics"*, Khanna Publication, 44th Edition , 2017.
References	
1	Wylie C.R, "*Advanced Engineering Mathematics",* Tata McGraw Hill Publication, 8th Edition, 1999.
2	H. K. Dass, *"Higher Engineering Mathematics",* S. Chand & Company Ltd., 1st Edition 2014.
3	B. V. Ramana, *"Higher Engineering Mathematics",* McGraw Hill Publication, 2018.
4	Erwin Kreyszig, *"Advanced Engineering Mathematics"*, Wiley Eastern Limited Publication, 10th Edition, 2015.
Useful Links	
1	https://nptel.ac.in/courses/111107111.
2	https://nptel.ac.in/courses/111106111
3	https://nptel.ac.in/courses/111105134.
4	https://nptel.ac.in/courses/111106139.

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	1													
CO2	2	1												
CO3	2	1												
CO4	1	1												
CO5	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

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)

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	7EE201
Course Name	Understanding Incubation and Entrepreneurship (NPTEL)
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	03 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To develop an entrepreneurial mindset thereby encouraging the journey of transformation to convert an idea or a solution into a business.
2	To learn to form their problem statement, build teams, understand the rigorous customer discovery process and finally learn to use the Lean Canvas Model.
3	To help familiarize the entrepreneurial framework and the start-up projects which help them navigate through their own entrepreneurial journey.

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 Descriptor**
CO1	Define effective communication, empathy, relationship building, sustainable living, inner peace, goal setting, success, failure, social skills.	I	Remembering
CO2	Discuss healthy relationships, sustainable habits into daily life, resilience, stress management, environmental stewardship, leadership, success and failure.	II	Understanding
CO3	Explore relationship building, sustainable living, goal- setting and achievement strategies, teamwork, success-failure management, personal development plan.	III	Applying
CO4	Analyze relationships, sustainable practices, positive mindset, leadership, success failure balance, rapport building social skills, team dynamics.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction to Entrepreneurship,** What is Entrepreneurship GDC Program, Hand holding for Entrepreneurship GDC start-up stories	6
II	**Entrepreneurship Types** Team Building, Innovation and Entrepreneurship, Solar Oven case-study Paradigm shift from Design to Entrepreneurship	6
III	**Bio- Med Innovation and Entrepreneurship** New-age Entrepreneurship	6
IV	**Business Model Canvas** Technology led Entrepreneurship	6

V	**Entrepreneurship as Academic Program** IITH case study, Creativity and Generating Product Ideas, From Idea to Proof of Concept, Network Entrepreneurship	6
VI	**Learning from examples Start-up PITCHES** Using Lean Canvas Model Part 1, Using Lean Canvas Model Part 2	6

Textbooks	
1	Disciplined Entrepreneurship: 24 Steps to a Successful Startup by Bill Aulet
2	The Essence of Medical Device Innovation by B Ravi
3	THE FORTUNE AT BOTTOM OF PYRAMID: Eradicating Poverty Through Profits by C.K.Prahalad Stay Hungry

References	
1	Stay Foolish by Rashmi Bansal
2	The Entrepreneurial Connection: East Meets West in the Silicon Valley by Gurmeet Naroola
3	Innovation By Design: Lessons from Post Box Design & Development by B. K. Chakravarthy, Janaki Krishnamoorthi

Useful Links	
1	https://nptel.ac.in/courses/107101092

CO-PO Mapping

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

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Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	7VE201
Course Name	Value Education
Desired Requisites:	Open mind and a willingness to learn

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	02 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives

1	Develop holistic personal and professional skills by enhancing communication, emotional intelligence, and resilience to foster positive relationships and sustainable living practices.
2	Promote ethical and sustainable leadership through the application of integrity, teamwork, and a growth mindset to navigate success and failure while mastering effective presentation and communication skills.
3	Empower lifelong learning and contribution by reflecting on personal values, engaging in critical thinking, and committing to continuous self-assessment and professional development for addressing global challenges.

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 Descriptor**
CO1	Define effective communication, empathy, relationship building, sustainable living, inner peace, goal setting, success, failure, social skills.	I	Remembering
CO2	Discuss healthy relationships, sustainable habits into daily life, resilience, stress management, environmental stewardship, leadership, success and failure.	II	Understanding
CO3	Explore relationship building, sustainable living, goal-setting and achievement strategies, teamwork, success-failure management, personal development plan.	III	Applying
CO4	Analyze relationships, sustainable practices, positive mindset, leadership, success failure balance, rapport building social skills, team dynamics.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Building Relationships** Introduction to Relationships, Communication Skills, Emotional Intelligence, Conflict Resolution, Maintaining Healthy Relationships	5
II	**Sustainable Living** Introduction to Sustainability, Environmental Impact, Sustainable Practices, Community Involvement, Personal Action Plan	5

III	**Inner Peace and Resilience** Understanding Inner Peace, Mindfulness and Meditation, Stress Management, Building Resilience, Positive Mindset	5
IV	**The Art of Winning** Winning Mindset, Goal Setting, Perseverance and Adaptability, Teamwork and Leadership, Case Studies and Real-life Examples	5
V	**Success and Failure Management** Understanding Success and Failure, Learning from Failure, Growth Mindset, Balancing Success and Failure, Personal Development Plan	5
VI	**Social Skills** Building Rapport, Active Listening, Empathy and compassion, Collaboration and Team Dynamics, Respecting Boundaries	5

Textbooks	
1	Stephen R. Covey, *The 7 Habits of Highly Effective People*, Free Press, 25thAnniversary Edition, 2013.
2	Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ*, Bantam Books,10th Anniversary Edition, 2005.
3	Carol S. Dweck, *Mindset: The New Psychology of Success*, Ballantine Books, UpdatedEdition, 2016.
4	William McDonough and Michael Braungart, *Cradle to Cradle: Remaking the WayWe Make Things*, North Point Press, 1st Edition, 2002.
5	Garr Reynolds, *Presentation Zen: Simple Ideas on Presentation Design and Delivery*, New Riders, 2nd Edition, 2011.

References	
1	Daniel Kahneman. (2015). Thinking Fast and Slow
2	Rosenberg, M. B. (2015). Nonviolent Communication: A Language of Life. Puddle Dancer Press.
3	Carnegie, D. (1998). How to Win Friends and Influence People. Simon & Schuster.
4	Covey, S. R. (1989). The 7 Habits of Highly Effective People. Simon & Schuster.
5	James Clear, (2018). Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones

Useful Links	
1	https://ideas.ted.com/how-to-build-closer-relationships/
2	https://www.nationalgeographic.com/environment/article/sustainable-living
3	https://www.lexisnexis.in/blogs/family-law-in-india/
4	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8937019/
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8710473/

CO-PO Mapping

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

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AY 2024-25

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1CERA251
Course Name	Techno-Societal Case Study
Desired Requisites:	Mathematics Fundamentals

Teaching Scheme		**Examination Scheme (Marks)**			
Practicals	2 Hrs/week	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
		Credits: 1			

Course Objectives

1	Gain practical insights into industry operations through visits and interactions.
2	Promote an interdisciplinary approach to problem-solving, integrating technological, business, and societal perspectives
3	Instill a sense of ethical responsibility and social impact in the development and implementation of solutions.
4	Strengthen written and oral communication skills for presenting and defending case studies
5	Promote an interdisciplinary approach to problem-solving, integrating technological, business, and societal perspectives.

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	Demonstrate the ability to critically observe and understand the operations of various industries, and effectively identify key challenges and inefficiencies within these settings.	I	Remembering
CO2	Exhibit strong analytical skills, capable of conducting thorough research and systematic documentation.	II	Understanding
CO3	Showcase the ability to approach problem-solving from an interdisciplinary perspective, integrating technological, business, and societal considerations	III	Applying
CO4	Possess enhanced written and oral communication skills, enabling them to effectively present and defend their case studies.	IV	Analyzing

Exp. No.	**Exp. Title**
1	**Introduction and Fundamentals** • Overview of techno-societal case studies: definition, importance, and objectives. • Understanding industry operations, processes, and key performance indicators.
2	**Problem Identification and Research:** • Techniques for identifying operational challenges and inefficiencies. • Methods for collecting and documenting data during industry visits, including ethical
3	**Data Analysis and Solution Development** • Analytical methods and tools for interpreting collected data. • Developing innovative and feasible technological solutions. • Evaluating solutions based on feasibility, cost-effectiveness, and social impact.

4	**Case Study Development and Presentation** • Structuring and writing comprehensive case studies. • Enhancing communication skills for effective presentation and defense of case studies. • Practical industry exposure through visits and interaction with industry professionals, culminating in a capstone project that integrates all course elements.
Textbooks	
1	NA
Reference Books	
1	NA
Useful Links	
1	NA

CO-PO Mapping

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

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)

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AY 2024-25

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. III
Course Code	1VSRA251
Course Name	Programming and Problem-Solving Lab
Desired Requisites:	Mathematics Fundamentals

Teaching Scheme		**Examination Scheme (Marks)**			
Practicals	2 Hrs/week	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
		Credits: 1			

Course Objectives

1	Understand the fundamentals of robotic systems and their applications.
2	Gain hands-on experience in operating Dobot Magician using various end effectors and control interfaces.
3	Learn the basics of visual programming and scripting for robotic control using Blockly and Python.
4	Explore the integration of sensors like Intel RealSense, RTK modules, and LiDARs with robotic platforms.
5	Develop skills in using simulation tools like Blender for animation and robotic movement planning.
6	Familiarize with TurtleBot and its navigation principles in real-time environments.

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	Operate and configure Dobot Magician and its various end effectors for basic task automation.	I	Remembering
CO2	Use Dobot Studio, Blockly, and scripting to develop automated sequences and perform tasks using suction cups and grippers.	II	Understanding
CO3	Connect and control robotic arms using custom-developed APIs and Python scripting.	III	Applying
CO4	Demonstrate proficiency in Blender for 3D modeling, simulation, and animation relevant to robotic applications.	IV	Analyzing
CO5	Implement and analyze real-time sensor data from Intel RealSense, RTK, and LiDAR systems for robotic navigation and task execution.	V	Evaluating
CO6	Apply knowledge of TurtleBot operations for real-time navigation, mapping, and autonomous control.	VI	Creating

Exp. No.	**Exp. Title**	**Hours**
01	Introduction to Robotics	02
02	Installation of Dubot Studio	02
03	Implementation Of Suction Cup End Effector with Dubot Studio Teach and Play Back Application	02

04	Implementation of Suction Cup End Effector with Blockly and Script Application	02
05	Implementation of Gripper End Effector with Teach & Play Back, Blockly and Script Application	02
06	Implementation of Dobot Magician	02
07	Implementation Pen End Effector of Dobot Magician	02
08	Study of Blender a 3d Animation Tool	02
09	Generate Api to Connect and Move Dobot Arm From One Location to Another Using Python	02
10	Implementation of Blender	02
11	Study Of Intel Depth Realsense Camera.	02
12	Implementation Of Intel Depth Realsense Camera with Assigned Tasks	02
13	Study And Implementation of RTK Module	02
14	Study And Implementation of Lidar's	02
15	Study And Implementation of Turtlebot	02

Textbooks	
1	Eric Matthes, "Python Crash Course: A Hands-On, Project-Based Introduction to Programming" by
2	John J. Craig, "Introduction to Robotics: Mechanics and Control"
3	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist"
4	Michael Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems"
5	Nikolaus Correll, Bradley Hayes, and Alcherio Martinoli, "Introduction to Autonomous Robots"
Reference Books	
1	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"
2	Gary Bradski and Adrian Kaehler, "Learning OpenCV: Computer Vision with the OpenCV Library"
3	Jan Erik Solem, "Programming Computer Vision with Python"
4	Steven M. LaValle, "Planning Algorithms"
5	Lentin Joseph, "ROS Robotics Projects"
Useful Links	
1	AI : https://nptel.ac.in/courses/106106226
2	Python: https://www.youtube.com/watch?v=rfscVS0vtbw
3	Python : https://www.youtube.com/watch?v=QXeEoD0pB3E

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	3	2	1	-	2	-	-	-	-	-	1		-	-
CO2	3	3	2	-	2	1	-	1	1	-	1		-	-
CO3	3	3	2	1	3	1	-	1	-	1	2		-	-
CO4	3	3	1	2	3	1	-	1	-	1	2		-	-
CO5	3	3	3	2	3	1	-	1	1	-	3		-	-
CO6	3	3	3	2	3	1	1	3	2	1	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)

Walchand College of Engineering, Sangli
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Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1RA221
Course Name	Microcontroller Interfacing and Applications
Desired Requisites:	Digital Electronics, C Programming

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

Course Objectives

1	To explain the difference between microprocessor and microcontroller.
2	To understand architecture of microcontroller and usage of built-in special function blocks.
3	To explain Intel 8051 microcontroller and its programming in assembly and 8051 C language
4	To explain interfacing of external devices with Intel 8051 and 8051 C programming.
5	To impart knowledge on basics of embedded system architecture

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	Illustrate the architecture of Microcontroller in comparison with Microprocessor.	II	Apply
CO2	Demonstrate situation-based interfacing of external devices with Intel 8051.	II	apply
CO3	Write assembly and C language programs for Intel 8051 to meet given system requirements.	III	Analysing
CO4	Design 8051 microcontroller / Arduino /Raspberry pi based applications / systems.	IV	Create

Module	**Module Contents**	**Hours**
I	**8051 Microcontroller** Microprocessor Vs Microcontroller, Microcontrollers, 8051 Architecture Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	4
II	**8051 Instruction Set** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions. 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops.	8
III	**8051 Stack, I/O Port Interfacing and Programming** Interfacing led and switch with 8051; Interfacing devices like relay, seven segment display, character LCD, keypad interfacing, DAC0808, digital sensors, analogue sensors through ADC0808; External memory interface; Writing algorithm and program for interfaces.	8
IV	**8051 Timers and Serial Port** 8051 Timers and Counters – Timer modes, Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication .8051 UART and its working, Serial communication modes, Programming UART in C.	6

V	**8051 Interrupts and Interfacing Applications** 8051 Interrupts. Interrupts sources, Interrupt flags, Vector addresses, Interrupt structure, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to Dc Motor, Stepper motor and their 8051 C language interfacing programming.	7
VI	**Advanced Microcontrollers and Open Source Electronics Platforms** Introduction to Arduino, Setup computer to use Arduino, Arduino Libraries, Arduino Based Systems Design. Introduction to Raspberry Pi, Raspberry Pi Board and Processor, Operating System Benefits, Linux Basics.	6

Text Books	
1	Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications, 2nd Edition, Penram International Publication, revised edition 2009
2	Mohammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition, 2010.
3	Ramesh Gaonkar, Fundamentals of Microcontrollers and Applications in Embedded Systems, Penram International Publication (India), 2010
4	Michael Margolis, Arduino Cookbook, O'Reilly Publications 2020
5	Warren Gay "Advanced Raspberry Pi: Raspbian Linux and GPIO Integration"2020
References	
1	Intel 8051 datasheet (www.intel.com)
2	Keil A51 and C51 manuals
3	Hi-Tech C Compiler manual
4	Massimo Banzi, Michael Shiloh, Getting Started with Arduino, Shroff/Maker Media 2014
Useful Links	
1	https://nptel.ac.in/
2	https://www.coursera.org/
3	https://www.tutorialspoint.com/
4	https://www.javatpoint.com/

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			3									
CO4			3				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. 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 2025-26					
Course Information					
Programme	B. Tech. Robotics & Automation				
Class, Semester	Second Year B. Tech., Sem. IV				
Course Code	1RA222				
Course Name	Design of Machine Elements				
Desired Requisites:	Engineering Mathematics, Basics of Mechanical Engineering				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To formulate and analyze stress-strain in machine components for various loads
2	To design transmission components like shafts, key and couplings
3	To analyze and design mechanical springs
4	To design bearings and select rolling contact bearings for given applications

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	Understand the procedure of design of machine elements	II	Understanding
CO2	Estimate design parameters of machine elements	IV	Analyzing
CO3	Check the safety of the design.	V	Evaluating
CO4	Design various components/ joints as per failure criteria	VI	Creating

Module	Module Contents	Hours
I	**Basics of engineering design** General Design process and procedure, types of loads, factor of safety- its selection and significance, theories of failure and their applications, aesthetic and ergonomic considerations in design	4
II	**Design of Shaft and Coupling** Design of shaft based on strength, rigidity. Shaft subjected to combined twisting and bending moment, Design of Key and keyways, Rigid and flexible couplings	5
III	**Design of Welded joints** Types of welded, joints, design of welded joints subjected to transverse and eccentric loads	4
IV	**Design of bolted and joints** Types of bolted and riveted joints, design of bolted and riveted joints subjected to transverse and eccentric loads	4
V	**Springs** Design of springs for static and varying loads, Helical and leaf springs	4

VI	**Design of screws** Forms of threads, design of power screws and nuts, types of induced stresses, efficiency of power screw, self-locking and overhauling properties,	4
Textbooks		
1	VB Bhandari, Design of Machine Elements, 5th Edition, McGraw Hill publications, 2020	
2	Joseph Edward Shigley, Charles R. Mischke, Mechanical Engineering Design, McGrawhill International Edition, 1992.	
3	Sharma C.S, Kamlesh Purohit, Design of Machine Elements, Prentice Hall of India Pvt. Ltd, 2003	
References		
1	Dr. Sanjeev Reddy K. Hudgikar, Dr. Vishwanath Patil, Dr. Prashant G., Design of Machine Elements Kripa-Drishti Publications, 1st edition, 2023	
2	Robert L. Mott, Edward M. Vavrek Jyhwen Wang, Machine Elements In Mechanical Design, Pearson publications, 2018	
3	PSG Design Data Book, Third Edition, 2020	
Useful Links		
1	https://nptel.ac.in/courses/112105124	

CO-PO Mapping

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

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1RA223
Course Name	Robot Drive Systems
Desired Requisites:	Essential components of Robotic systems

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

Course Objectives

1	Understanding Fundamental Concepts of different drive systems used in robots
2	Learn the principles of electric drives and fluid power and their application in industrial robotic systems.
3	Understand the different types of electric motors and their applications in robots
4	Learn different sensors and their use within drive systems and know motion control for robot drive 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	Classify and describe different types of drive systems.	II	Remembering
CO2	Estimating and interpreting the pneumatic and hydraulic drive systems	II	Understanding
CO3	Associating the concepts of smart sensors	III	Applying
CO4	Understanding miscellaneous sensors and their working principles	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Drive Mechanisms** Objectives, motivation, open loop control, closed loop control with velocity and position feedback. Types of Drive Systems: Lead Screws, Ball Screws, Chain and linkage drives, Belt drives, Gear Drives, Precision gear boxes, Harmonic drives, Cyclo-speed reducers.	7
II	**Hydraulic Drives** Introduction, Requirements, Hydraulic piston and transfer valve, hydraulic circuit incorporating control amplifier, hydraulic fluid considerations, hydraulic actuators Rotary and linear actuators. Hydraulic components in robots.	7
III	**Pneumatic Drives** Introduction, Advantages, Pistons-Linear Pistons, Rotary pistons, Motors-Flapper motor, geared motor, Components used in pneumatic control. Pneumatic proportional controller, pneumatically controlled prismatic joint.	6
IV	**Electric Drives** Introduction, Types, DC electric motor, AC electric motor, stepper motors, half step mode operation, micro step mode. Types of stepper motors, Direct drive actuator	6
V	**Sensors** Introduction: An Introduction to sensors and transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics.	6

VI	**End Effectors** Classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control	6

Text Books	
1	S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009
2	Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
References	
1	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2	Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGraw Hill, 1987. https://www.robots.com/applications.
Useful Links	
1	https://roboticscasual.com/ros-tutorial-pick-and-place-task-with-the-moveit-c-interface/
2	https://roboticscasual.com/ros-tutorial-simulate-ur5-robot-in-gazebo-urdf-explained/
3	https://www.ieee-ras.org/educational-resources-outreach/educational-material-in-robotics-andautomation
4	https://www.academia.edu/20361073/Web_Based_Control_and_Robotics_Education_pdf

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	2											2	
CO3	2		3	2									2	1
CO4	2		2	3									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)

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1RA224
Course Name	Sensors and Instrumentation
Desired Requisites	Elements of Robotics and Automation

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

Course Objectives

1	To familiarize students with the types, characteristics, and operating principles of sensors and transducers used in robotics.
2	To provide a foundation in signal conditioning and interfacing techniques.
3	To understand how to integrate sensors into robotic and control systems.
4	To enable students to design and evaluate instrumentation setups for real-time robotic applications.

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	Classify and describe different types of sensors and transducers.	II	Remembering
CO2	Understand the physical principles and mathematical models behind sensor operation.	II	Understanding
CO3	Design instrumentation systems and implement them in robotic scenarios.	III	Applying
CO4	Perform sensor data acquisition, conditioning, and calibration.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Sensors and Transducers for Robotics** Importance of sensors in robotic and automated systems, overview of measurement systems, classification of sensors, basic construction and working principles of common transducers (e.g., force, proximity, temperature) transducer characteristics: static & dynamic, Sensor selection criteria in different robotic subsystems.	6
II	**Mechanical and Motion Sensors:** Potentiometers, LVDT, optical encoders (incremental and absolute), magnetic sensors, MEMS-based accelerometers, MEMS-based gyroscopes, strain gauges, load cells, odometry, robotic joint feedback, force-controlled end-effectors.	7
III	**Thermal and Environmental Sensors:** Thermocouples, RTDs, thermistors, IC temperature sensors, capacitive sensors, resistive types sensors, MQ gas sensors, ultrasonic sensors, ambient monitoring, fire detection, robotic path correction.	7
IV	**Optical and Vision Sensors:** Photodiodes, LDRs, IR sensors, time-of-flight sensors, Fiber-optic sensors: types and uses in automation, introduction to machine vision including camera calibration and image acquisition, stereo vision, LiDAR, and integration into robotic perception systems.	6
V	**Instrumentation, Signal Conditioning, and Interfacing:** Signal conditioning: amplification, filtering, signal isolation, data acquisition	7

	systems (DAQ) architecture and usage, wiring and shielding techniques in sensor circuits, sensor fusion and its use in robotics.	
VI	**Sensor Integration and Applications in Robotics:** Sensor selection and calibration, real-time control and closed-loop feedback using sensor data, integration of multiple sensors in robotics, case studies (such as line follower robots and sensor-guided robotic arms), introduction to fault tolerance in sensor-based systems.	6

Text Books	
1	D. Patranabis, "Sensors and Transducers," PHI Learning.
2	E.O. Doebelin, "Measurement Systems: Application and Design."
3	David G. Alciatore, "Introduction to Mechatronics and Measurement Systems."
4	D.V.S. Murty, “Transducers and Instrumentation,” PHI Learning
References	
1	Jon S. Wilson, "Sensor Technology Handbook."
2	John G. Webster, "Measurement, Instrumentation, and Sensors Handbook."
3	Robert B. Northrop, "Introduction to Instrumentation and Measurements."
4	A.K.Sawhney,”A Course In Electronics Measurements And Instrumentation”.
5	R.K. Rajput, “Electrical And Electronic Measurements And Instrumentation”
Useful Links	
1	https://archive.nptel.ac.in/courses/108/108/108108147/
2	https://archive.nptel.ac.in/courses/108/105/108105064/
3	https://archive.nptel.ac.in/courses/112/105/112105249/
4	https://www.ti.com/sensors/overview.html

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

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1RA271
Course Name	Microcontroller Interfacing and Applications Lab
Desired Requisites:	Digital Electronics, C Programming

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

Course Objectives

1	To explain debugging of an assembly and 8051 C program for 8051 microcontrollers in keil micro-vision C51 IDE
2	To show downloading and testing of 8051 C program for 8051 microcontroller using development board.
3	To explain the interfacing with different peripheral interfacing.
4	To explain development of 8051 C program for implementing given system requirements using 8051 microcontroller.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Level	Descriptor
CO1	Use keil micro-vision C51 IDE to debug an assembly and C programs for 8051Microcontroller	II	Understand
CO2	Apply the fundamentals of assembly level programming of microcontroller	II	Apply
CO3	Write a program for on chip peripheral configuration and external peripheral interfacings	II	Apply
CO4	Test C programs written for 8051 microcontroller using development board as well as Ardinuo /Raspberry pi simulation software	III	Analyze

List of Experiments / Lab Activities

List of Experiments:

1. Introduction to software tool and hardware of 8051
2. Assembly language programs to perform different operations, Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).
3. Assembly language programs to perform different operations, implement if else, for loop, while loop, logic gates and to study block transfer
4. Assembly language programs to perform different operations, Boolean & Logical Instructions (Bit manipulations)
5. 8051 C program for LED blinking and operating LED using SWITCH
6. Interfacing Motor, Relay etc. with 8051 microcontroller
7. Interfacing 4 digits Multiplexed Display with 8051 microcontroller
8. Interfacing 16x2 characters LCD with 8051 microcontroller
9. Interfacing 4x4 Matrix Keyboard with 8051 microcontroller
10. Interfacing DAC0808 with 8051 microcontroller
11. Interfacing ADC0809 with 8051 microcontroller
12. Using Timer as Timer and Timer as Counter and hardware delay generation

13. Serial communication programming and Multiprocessor communication 14. Design, implementation and demonstration of microcontroller based applications using 8051/Arduino/Raspberry pi Boards. (Mini-Project)	
Text Books	
1	Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications, 2nd Edition, Penram International Publication, revised edition 2009
2	Mohammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education,2nd edition, 2010.
3	Ramesh Gaonkar, Fundamentals of Microcontrollers and Applications in Embedded Systems, Penram International Publication(India), 2010
4	Narayan M kakry "Introduction of Embedded System and Robotics"
5	Michael Margolis, Arduino Cookbook, O'Reilly Publications 2020
References	
1	Intel 8051 datasheet (www.intel.com)
2	Keil A51 and C51 manuals
3	Hi-Tech C Compiler manual
4	Massimo Banzi, Michael Shiloh, Getting Started with Arduino, Shroff/Maker Media 2014
Useful Links	
1	https://nptel.ac.in/
2	https://www.coursera.org/
3	https://www.tutorialspoint.com/
4	https://www.javatpoint.com/

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			3									
CO4			3			1								2
The strength of mapping: 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. Lab ESE is treated as End Semester Exam and is based on all experiments/lab activities.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab Performance and documentation	Lab Course faculty	During Week 13 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The actual schedule shall be as per the academic calendar. Lab activities/Lab performance shall include performing experiments, mini-projects, 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.				

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1RA272
Course Name	ROS Simulation Lab
Desired Requisites:	Basics of Python programming

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

Course Objectives

1	To provide an introductory understanding on robotic operating system and gazebo simulation environment.
2	Set up and configure Gazebo simulations, including robot models and simulation environments
3	Implement and test navigation algorithms and path planning strategies within the simulation environment.
4	Use ROS's built-in tools to examine the topics and services used by a given node

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the fundamental concepts of ROS nodes, topics, services, and parameters, and how they interact within the ROS ecosystem.	II	Understanding
CO2	Apply the principles of ROS for module development of robotic systems.	III	Applying
CO3	Apply the knowledge of robotic system and ROS for mobile robot control, navigation and environment mapping using ROS simulators.	IV	Analysing
CO4	To simulate sensors and actuators in Gazebo and interface them with ROS nodes.	V	Evaluating

List of Experiments / Lab Activities

List of Experiments:

1. "ROS architecture & philosophy, ROS master, nodes, and topics
   Console commands, Catkin workspace and build system, Launch-files, Gazebo simulator - Programming Tools"
2. "ROS package structure
   Integration and programming with Eclipse, ROS C++ client library (roscpp)
   ROS subscribers and publishers, ROS parameter server, RViz visualization"
3. "TF Transformation System, rqt User Interface
   Robot models (URDF), Simulation descriptions (SDF)"
4. "ROS services
   ROS actions (actionlib), ROS time, ROS bags
   Debugging strategies, Introduction to ROS2"
5. Simulating with ROS2: Gazebo simulator, robot models (URDF) and simulation environments (SDF)
6. Case study: Using ROS in complex real-world applications in Gazebo
7. Creating your own mobile robot and robot arm simulation

8. Turtlebot control application	
Text Books	
1	Joseph, Lentin, and Jonathan Cacace. Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System. Packt Publishing Ltd, 2018.
2	Programing Robots with ROS', M. Quigley, B. Gerkey, and W. D. Smart, Oreilly Publishers, 2015.
3	Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018
References	
1	Koubâa, Anis, ed. Robot Operating System (ROS). Vol. 1. Cham: Springer, 2017.
2	'ROS Robotics by example', Fairchild & Harman, PACKT Publishing, 2016
3	Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.
Useful Links	
1	https://wiki.ros.org/ROS/Tutorials
2	https://www.theconstruct.ai/ros-for-beginners-how-to-learn-ros/
3	https://rsl.ethz.ch/education-students/lectures/ros.html

CO-PO Mapping

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

The strength of mapping: 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. Lab ESE is treated as End Semester Exam and is based on all experiments/lab activities.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab Performance and documentation	Lab Course faculty	During Week 13 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates the starting week of a semester. The actual schedule shall be as per the academic calendar. Lab activities/Lab performance shall include performing experiments, mini-projects, 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.

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Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	7AE201
Course Name	Employability Skills
Desired Requisites:	Basics of mathematics

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

Course Objectives

1	To improve the problem-solving skills of students
2	To understand the approach towards problem solving
3	Understanding the sectional cut-offs for different companies.

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	Ability to improve the accuracy percentage.	II	Remembering
CO2	Understand the current changing recruitment trends.	II	Understanding
CO3	Understanding the differential marking scheme in papers.	III	Applying
CO4	Performance improvement in competitive exams like CAT, GATE	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Arithmetic I** Ratio, Proportion, Mark Up & Discount, Averages, Mixtures & Alligations, Simple & Compound Interest	4
II	**Arithmetic II** Percentages, Profit & Loss, Time & Work, Time, Speed & Distance, Boat & Streams, Linear Races	4
III	**Numbers** Cyclicity, Remainders, Cyclicity of Remainders, Indices, Factors, LCM, HCF	4
IV	**Permutation, Combination, Probability** Fundamental principal of counting, Arrangements, Selection, Grouping, Distribution, Independent Events, Conditional Probability, Binomial Distribution	4
V	**Logical Reasoning** Clocks, Calendars, Games & Tournaments, Analytical Puzzles, Binary Logic, Blood relations, Directions, Coding, Decoding, Seating Arrangement (Linear, Circular & Rectangular)	4
VI	**Verbal Ability I** Vocabulary - Synonyms, Antonyms, Analogies Reading Comprehension, Para Jumbles Parts of Speech, Tenses, Subject Verb Agreement	5

Text Books

1	Quantitative Aptitude - Abhijit Guha
2	Quantitative Aptitude - Sarvesh Agarwal

References

1	Quicker Maths - M. Tyra

2	Quantitative Aptitude - Chandresh Agarwal
3	Puzzles to puzzle you - Shakuntala Devi
Useful Links	
1	www.campusgate.co.in
2	www.lofaya.com
3	www.brainbashers.com

CO-PO Mapping

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

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)

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

AY 2025-26

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	Refer List
Course Name	Introduction to Ancient Indian Technology
Desired Requisites:	General curiosity, maturity expected from adult student.

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

Course Objectives

1	The course is designed for undergraduate students, interested in learning about the ancient Indian technology which is the hallmark of glorious Indian civilization.
2	The objective is to emphasize on nature centric aspects of ancient Indian technologies that can be adopted in modern time.
3	The course is to expose the students to ancient science and technologies which can be adopted for modern technological development.

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	Name the ancient Indian technological achievements	I	Remembering
CO2	Comprehend the concept of Indian traditional knowledge and its relevance	II	Understanding
CO3	Explain the Indian contribution to the world at large	II	Understanding
CO4	Judge the ancient Indian technology.	V	Evaluating

Module	**Module Contents**	**Hours**
I	Introduction: Why are ancient Indian science and technology relevant today? What is science? How is it different from technology? .	4
II	Philosophy of ancient Indian technology, how is different from modern technology? Ancient Indian Scientific methods. Glimpses of ancient Indian science and technology?	4
III	Material technology in ancient India : Mining, Metals and Metallurgy, Iron Making and craftsmanship, Wootz Steel Technology	5
IV	Extraction of Zinc in ancient India, Glass making, Bead making Techniques, Ceramic Technology.	4
V	Water Harvesting Technology, Irrigation Systems. Town planning, Building construction, Sanitation from ancient India period.	5
VI	Agriculture and Textile Technology in context of ancient India i.e Bharat.	4

Text Books

1	Transcript of the NPTEL course available at https://archive.nptel.ac.in/courses/101/104/101104065/. Title of the course "Introduction To Ancient Indian Technology" by Prof. D.P. Mishra Department of Aerospace Engineering, IIT Kanpur

References

1	The NPTEL course available at https://archive.nptel.ac.in/courses/101/104/101104065/. Title of the course "Introduction To Ancient Indian Technology" by Prof. D.P. Mishra Department of Aerospace Engineering, IIT Kanpur

Useful Links	
1	https://archive.nptel.ac.in/courses/101/104/101104065/

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

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

AY 2027-28

Course Information

Programme	B. Tech. Robotics & Automation
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	1VSRA245
Course Name	Mini Project
Desired Requisites	Basic and advanced concepts and principles in graduate level courses. Latest developments in engineering fields.

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

Course Objectives

1	To help students to identify real life needs and discuss project requirements.
2	To give technical solutions through the latest design & development tools.
3	To learn to translate feasible business ideas into compelling business strategies and successful start-ups.
4	Ability to develop innovative and entrepreneurial mindset.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Level	Descriptor
CO1	Will be able to understand the importance of team work and will be able to work in a team for achieving group goals / will be prepared to assume a leadership role in any team.	III	Applying
CO2	Will have ability to explain various concepts and tools used in their project	IV	Analyzing
CO3	Will be able to analyze and give solutions for a specific problem statement related to their project.	V	Evaluating
CO4	Will be able to prepare and present a detailed report based on project work spread over two semesters.	VI	Creating

List of Experiments / Lab Activities

1. Group of 2 to3 students per project
2. Completion of algorithm/computer program/ data analysis/ manufacturing / processing-assembly / testing / analysis / simulation work of the project.
3. Testing, result analysis with clear conclusions etc.
4. Demonstration of the working of the project set-up / model / software program as applicable.
5. Rectifications/ correction if required to be completed.
6. Students are encouraged to publish a technical paper in conference / reputed peer reviewed journals based on their mini project work.
7. Students are encouraged to file a patent or refine it for the startup idea

Project shall be assessed based on following points;

1. Novelty of the problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model project set-up / model / software program as applicable.
5. Potential of patentability, publications and startup idea

6. Effective use of skill sets 7. Effective use of standard engineering norms 8. Contribution of an individuals as member or leader 9. Fluency in written and oral communication 10. Quality of project report

Text Books	
1	Suitable books based on the contents of the project selected.
References	
1	Suitable books based on the contents of the project selected and research papers from reputed national and international journals and conferences.
Useful Links	
1	As per the need of the project

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	3							3			3		3	
CO2		3	3	3	3	2		3		3			2	1
CO3		3					3		3	3				1
CO4							1		1		2		2	1
The strength of mapping: 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. Lab ESE is treated as End Semester Exam and is based on all experiments/lab activities.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab Performance and documentation	Lab Course faculty	During Week 13 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates the starting week of a semester. The actual schedule shall be as per the academic calendar. Lab activities/Lab performance shall include performing experiments, mini-projects, 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.