

JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)



## DEPARTMENT OF AUTOMATION AND ROBOTICS

# Department of Automation and Robotics B. Tech Structure (2019 Pattern)



Dr. Ram Joshi

Dr. R. K. Jain

BOS Chairman (A & R)

Dean Academics RSCOE, Pune

Director, RSCOE

#### **DEPARTMENT OF AUTOMATION AND ROBOTICS**

#### Vision:

To become an ecosystem in the domain of Automation and Robotics that develops competent multidisciplinary professionals, researchers and entrepreneurs striving for technology led socio-economic development of the nation.

#### Mission:

- To impart high quality education through best of the teachingleaning process by using industry ready curriculum.
- To establish centres of excellence in the area of Automation and Robotics where ideas, innovations and research will synergize.
- To align the practices and initiatives with high ethical standards to meet the needs of the society and at large the nation.

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Dr. Ram Joshi Dean Academics



#### **DEPARTMENT OF AUTOMATION AND ROBOTICS**

#### **Program Outcomes (POs)**

**1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**12**. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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K. Jain **Director RSCOE**, Pune

#### **Program Specific Outcomes (PSOs)**

At the end of this program, students will be able to -

**PSO1:** To integrate principles of engineering in multidisciplinary approach to find out the solutions for complex engineering problems.

PSO2: To design & develop the Automation & Robotics systems for various applications

**PSO3:** To make a career in Automation & Robotics through industry, entrepreneurship, research and academia while contributing to the continuous development of individual, organisation, society and nation at large.

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## **DEPARTMENT OF AUTOMATION AND ROBOTICS**

Highlights of the Syllabus

The Curriculum of UG Program of AUTOMATION AND ROBOTICS has been designed in association with Experts from Academics, industries / Corporate & Distinguish Alumni. Major features of the curriculum are presented in the following diagram.



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#### **Unique Features of the Curriculum**

#### 1. Curriculum centered at Outcome Based Education:

The new Curriculum is based on student-centered instruction models that focus on measuring student performance through outcomes. The outcomes include subject knowledge, industry required skills and attitudes.

#### 2. Emphasize on Fundamentals:

The nature of the new curriculum is rigorous and well prescribed so that the students can spend more time on preparation and self-study. The students have to learn core subjects, solve practical based assignments and must attempt periodical quizzes. This will benefit them to grasp and keep a strong hold on fundamentals of Engineering in the most effective way.

#### 3. Experiential Learning:

The curriculum emphasizes on hands-on sessions along with theoretical information. The new curriculum considers Problem Based Learning (PBL) as a teaching pedagogy and includes different subjects that encourage the students for hands on learning through virtual labs, mini-projects, etc. Accordingly, the curriculum maintains good balance between theory and laboratory credits.

#### 4. Promote Creativity and Innovation:

Along with experiential learning, the curriculum also motivates the students to inculcate creativity and innovation. Apart from conventional lab, the curriculum provides a freedom for students to perform industry assignments, pilot projects, innovative development, etc.

#### 5. Inculcating Ethics and Values:

To improvise student's behavior, the curriculum has included systematic courses on ethics and values. The moral principles can help students to make right decisions, lead their professional lives and become ethical citizen.

#### 6. Blend of Curricular and Extracurricular Activities

The curriculum also gives importance of different activities like co-curricular, extracurricular, sports, culture, etc. This will help to do all round development of students in all possible ways.

#### 7. Four Tracks in B-Tech:

By offering various courses/electives, flexibility in choosing work in specified field as:

I. Industry Internship III. Higher Studies and Research IV. In house Project

II. Entrepreneur

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## Final Year B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester – VII

	Teaching Scheme				Sem	Credits					
Course Code	Course	тн	TU	LAB	ISE (15)	Theory MSE (25)	ESE (60)	TW	LAB	TOTAL	TOTAL
AR4101	Field and Service Robotics	3	0	2	15	25	60	-	25	125	4
AR4102	Augmented Reality and Virtual Reality for Robotics	3	0	2	15	25	60	-	25	125	4
AR4103	Elective –III	3	0	2	15	25	60	25	25	150	4
AR4104	Project Stage-I	0	0	12	-	-	-	100	100	200	6
Total	of Semester-VII	9	0	18	45	75	180	125	175	600	18

**Elective – III** 

Course Code	Course	Course Code	Course	Course Code	Course
AR4103A	Data Engineering forRobotics and Automation	AR4103B	Industry 4.0	AR4103C	AI andML for Robotics

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## University, Pune) Final Year B. Tech (Automation and Robotics)

Academic Year – 2024-2025 Semester – VIII TRACK - A - REGULAR

Course	Teaching Scheme			Se	Credits						
Code	Course	ТН	TU	LAB	ISE (15)	Theory MSE (25)	ESE (60)	TW	LAB	TOTAL	TOTAL
AR4105	Mobile Robotics	3	0	0	15	25	60	-	-	100	3
AR4106	Advance Robotics Applications	3	0	0	15	25	60	-	-	100	3
AR4107	Elective –IV	3	0	2	15	25	60	25	25	150	4
AR4108	Project Stage-II	0	0	16	-	-	-	150	100	250	8
Total	of Semester-VIII	9	0	18	45	75	180	175	125	600	18

Course Code	Course	Course Code	Course	Course Code	Course
AR4107A	Cyber Security	AR4107B	Design of Mechatronics System	AR4107C	Micro-Electro Mechanical systems (MEMS)

## Final Year B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester – VIII TRACK- B - FULL SEMSTER INTERNSHIP

Course		Teachi Sche		ching eme	Semester Examination Scheme of Marks						Credits
Code	Course	тн	TU	LAB	ISE (15)	The MSE (25)	ory ESE (60)	TW	LAB	TOTAL	TOTAL
AR4109	Industrial Internship/ Research Internship	0	0	20	-	-	-	200	150	350	10
AR4108	Project Stage- II	I	I	16	-	-	-	150	100	250	8
Total o	of Semester-VIII	0	0	36	0	0	0	0	350	250	600

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## Final Year B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester – VIII TRACK - C - HIGHER STUDIES AND RESEARCH

Course	Teaching Scheme				Semester Examination Scheme of Marks						Credits
Code	Course	ТН	TU	LAB	ISE	Theory MSE	ESE	TW	LAB	TOTAL	TOTAL
AR4110	Research Methodology	3	0	2	15	25	60	25	25	150	4
AR4111	Innovation and Design thinking for Robotics and Automation	3	0	0	15	25	60	-	-	100	3
AR4112	Product Life Cycle Management	3	0	0	15	25	60	-	-	100	3
AR4108	Project Stage-II	0	0	16	-	-	-	150	100	250	8
Total of Semester-VIII		9	0	18	45	75	180	175	125	600	18

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## Final Year B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester – VIII TRACK - D - Entrepreneurship

Course			Teaching Scheme			Semester Examination Scheme of Marks					
Code	Course	тн	TU	LAB	ISE (15)	Theory MSE (25)	ESE (60)	тw	LAB	TOTAL	TOTAL
AR4113	Economics and Finance Management	3	0	0	15	25	60	-	-	100	3
AR4114	Industrial Management & Operations Research	3	0	0	15	25	60	-	-	100	3
AR4115	Entrepreneurship Development for Robotics and Automation	3	0	2	15	25	60	25	25	150	4
AR4108	Project Stage-II	0	0	16	-	-	-	150	100	250	8
Total	of Semester-VIII	9	0	18	45	75	180	175	125	600	18

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## **SEMESTER VII Syllabus**

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#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VII [AR4101]: Field and Service Robotics

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<b>Teaching Scheme:</b>		Credit	<b>Examination Schem</b>	e:				
TH: 03Hours/Week		TH:03	In Sem. Evaluation:	15 Marks				
LAB:02 Hours/Week		LAB:01	Mid Sem. Exam: 25	Marks				
			End Sem. Exam : (	60 Marks				
			LAB Evaluation : 2	5 Marks				
Course Prerequisites: Sens	sor technolo	gy, Artificial Intelligence for	or robotics, robot progra	amming				
Course Objective:				-				
• The applications and	current tre	nd in field and service robo	t					
<ul> <li>Path planning algorithms inside a field/service robot for navigation</li> </ul>								
<ul> <li>Interaction interface concepts for humanoid robot</li> </ul>								
Course Outcome:	Course Outcome:							
After successful completion	of the cour	se, students will able to:	1 /					
COI: Describe the applicati	ons and cui	rrent trend in field and servi	ce robot					
CO2: Explain about the kind	ematic moc	lelling of mobile robots	1 / 1 • 1	· ·				
<b>CO3:</b> Identify, formulate and solve algorithm related to localization, obstacle avoidance, and mapping								
CO4: Apply and program robot for reactive concepts for robot interaction with human, between								
machines and among robots								
<b>CO5:</b> Analyze the concepts of balancing legged robots and interaction interface concepts for humanoid								
robot								
<b>CO6:</b> Implement path planning algorithms inside a field/service robot for navigation								
Course Contents								
UNIT-I		Introduction		07 Hours				
<b>UNIT-I</b> History of service robotics	– Present s	<b>Introduction</b> tatus and future trends – N	eed for service robots	<b>07 Hours</b> - applications-				
<b>UNIT-I</b> History of service robotics examples and Specifications	– Present s s of service	<b>Introduction</b> tatus and future trends – N and field Robots. Non-conv	eed for service robots rentional Industrial robo	<b>07 Hours</b> - applications- ots.				
UNIT-I History of service robotics examples and Specifications UNIT-II	– Present s s of service	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinemation	eed for service robots rentional Industrial robo	07 Hours - applications- ots. 08 Hours				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons	– Present s s of service straints – M	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic faneuverability – Workspace	eed for service robots rentional Industrial robots cs e – Control	07 Hours - applications- ots. 08 Hours				
UNIT-IHistory of service robotics examples and SpecificationsUNIT-IIKinematic Models and ConsUNIT-III	– Present s s of service straints – M	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization	eed for service robots rentional Industrial robots cs e – Control	07 Hours - applications- ots. 08 Hours 08 Hours				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons UNIT-III Introduction - Bayes filter -	– Present s s of service straints – M - Kalman F	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F	eed for service robots rentional Industrial robots cs e – Control ilter - Information Filte	07 Hours - applications- ots. 08 Hours 08 Hours er - Histogram				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons UNIT-III Introduction - Bayes filter - Filter - Particle Filter - C	– Present s s of service straints – M - Kalman F hallenges of	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Rep	eed for service robots rentional Industrial robots cs e – Control ilter - Information Filte resentation- Probabilist	07 Hours - applications- ots. 08 Hours 08 Hours er - Histogram ic Map based				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons UNIT-III Introduction - Bayes filter - Filter - Particle Filter - C Localization-Monte carlo	<ul> <li>Present s</li> <li>of service</li> <li>straints – M</li> <li>Kalman F</li> <li>hallenges of</li> <li>localization</li> </ul>	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Repu- t- Landmark based navis	eed for service robots rentional Industrial robo cs e – Control ilter - Information Filte resentation- Probabilist ration-Globally unique	07 Hours - applications- ots. 08 Hours 08 Hours er - Histogram cic Map based b localization-				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons UNIT-III Introduction - Bayes filter - Filter - Particle Filter - C Localization-Monte carlo Positioning beacon systems-	<ul> <li>Present s</li> <li>of service</li> <li>straints – M</li> <li>Kalman F</li> <li>hallenges of</li> <li>localization</li> <li>Route base</li> </ul>	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Repu- t- Landmark based navig ed localization	eed for service robots ventional Industrial robo cs e – Control ilter - Information Filte resentation- Probabilist gation-Globally unique	07 Hours - applications- ots. 08 Hours 08 Hours - 08 Hours - Histogram - constant of the sed - localization-				
UNIT-I History of service robotics examples and Specifications UNIT-II Kinematic Models and Cons UNIT-III Introduction - Bayes filter - Filter - Particle Filter - C Localization-Monte carlo Positioning beacon systems-	<ul> <li>Present s</li> <li>of service</li> <li>straints – M</li> <li>Kalman F</li> <li>hallenges of</li> <li>localization</li> <li>Route base</li> </ul>	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Repu 1- Landmark based navig ed localization	eed for service robots rentional Industrial robo cs e – Control ilter - Information Filte resentation- Probabilist gation-Globally unique	07 Hours - applications- ots. 08 Hours 08 Hours er - Histogram tic Map based e localization-				
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UNIT-IHistory of service robotics examples and SpecificationsUNIT-IIKinematic Models and ConstUNIT-IIIIntroduction - Bayes filter - Filter - Particle Filter - C Localization-Monte carlo Positioning beacon systems-UNIT-IVMapping - Metrical maps - C	<ul> <li>Present s</li> <li>of service</li> <li>straints – M</li> <li>Kalman F</li> <li>hallenges of</li> <li>localization</li> <li>Route base</li> <li>Grid maps -</li> </ul>	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic faneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Repu- h- Landmark based navig ed localization Mapping Sector maps – Hybrid Map	eed for service robots ventional Industrial robo cs e – Control ilter - Information Filter resentation- Probabilist gation-Globally unique	07 Hours - applications- ots. 08 Hours 08 Hours 08 Hours er - Histogram ic Map based				
UNIT-IHistory of service robotics examples and SpecificationsUNIT-IIKinematic Models and ConsUNIT-IIIIntroduction - Bayes filter - Filter - Particle Filter - C Localization-Monte carlo Positioning beacon systems-UNIT-IVMapping - Metrical maps - C	<ul> <li>Present s</li> <li>of service</li> <li>straints – M</li> <li>Kalman F</li> <li>hallenges of</li> <li>localization</li> <li>Route base</li> <li>Grid maps -</li> </ul>	Introduction tatus and future trends – N and field Robots. Non-conv Robot Kinematic aneuverability – Workspace Localization Filter - Extended Kalman F of Localization- Map Repu- to Localization- Map Repu- to Landmark based navig ed localization Mapping Sector maps – Hybrid Map	eed for service robots rentional Industrial robo cs e – Control ilter - Information Filte resentation- Probabilist gation-Globally unique	07 Hours - applications- ots. 08 Hours 08 Hours - Histogram ic Map based				
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	UNIT-V	Planning and Navigation	08 Hours						
Intro	duction-Path planning	g overview- Global path planning – A* Algorithm - local p	ath planning -						
Road	map path planning-	· Cell decomposition path planning-Potential field path plan	nning-Obstacle						
avoid	lance – Path control.								
	UNIT-VI	Humanoids	08 Hours						
Whee contr captu Tacti Appli	wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications.								
		Lab Contents							
The man etc), obje	The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), Autonomous syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.								
		Guidelines for Assessment							
Pradasse	<ul> <li>ctical/Oral examination</li> <li>essed jointly by intern</li> <li>Total marks assig</li> <li>Continuous assession submission of lab</li> </ul>	on based on the practical's performed in the lab. The Perform al and external examiners. ned are 25. sment will be carried out based on attendance, lab performance, file	mance will be , and timely						
Final practical examination for specific practical and oral examination will be conducted									
	[	List of Laboratory Assignments/Experiments							
1	Need for service rob	oot.							
2	Experiment on robot	tkinematics							
3	Probabilistic Map ba	ased Localization-Monte carlo localization							
4	Global & Local path	a planning in robotics							
5	Assignment on Metr	rical maps - Grid maps - Sector maps – Hybrid Maps.							
6	Case study on Huma	an activity recognition using vision, touch, sound etc.							
Text T T	<ul> <li>Text Books:</li> <li>T1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2011.</li> <li>T2. Riadh Siaer, "The future of Humanoid Robots- Research and applications", Intech Publications, 2012</li> </ul>								
Refe	rence Books:		2007						
<ul> <li>R1. Sebastian Thrun, Wolfram Burgard, Dieter Fox, Probabilistic Roboticsl, MIT Press, 2005.</li> <li>R2. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, —Principles of Robot Motion-Theory, Algorithms, and Implementation, MIT Press, Cambridge, 2005.</li> <li>R3. Bruno Siciliano, Oussama Khatib, Springer Hand book of Robotics, Springer, 2008</li> </ul>									
R	4. Karsten Berns, Ewa Robots", Vieweg T	ald Von Puttkamer, "Autonomous Land Vehicles Steps towards eubner Springer, 2009	s Service						
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#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VII [AR4102] - Augmented Reality and Virtual Reality for Robotics

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Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week	TH:03	In Sem. Evaluation:15 Marks
LAB:02 Hours/Week	LAB:01	Mid Sem. Exam: 25 Marks
		End Sem. Exam : 60 Marks
		LAB Evaluation : 25 Marks

#### **Course Prerequisites:**

#### **Course Objective:**

- Learn the concepts and principles of virtual and augmented reality
- Understand VR and AR environment and software.
- Gain knowledge about the applications for Robotic Engineering.

#### **Course Outcome:**

After successful completion of the course, students will able to:

- **CO1:** Recall basic concepts of virtual and augmented reality.
- **CO2**: Describe the geometric modelling and Virtual environment..
- CO3: Work with Virtual Environment and Augmented Reality systems.
- CO4: Perform experiments with the Hardware and Software tools.
- CO5: Develop Virtual Reality applications

CO6: Summarize the applications of Block Chain Technology for Robotics

#### **Course Contents**

UNIT-1 Introduction to Augmented Keanty and Virtual Keanty 08 Hours
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Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark. Augmented Reality Concepts: History of Augmented Reality, Multimodal displays: Haptic, Tactile and Tangible Displays, Visual Perception

UNIT-II	Geometric Modelling	07 Hours

Geometric Modelling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation. Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

UNIT-III	Virtual Environment and Augmented Reality Systems	08 Hours
	· · · · · · · · · · · · · · · · · ·	

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system. Augmented Reality Systems – Types, Taxonomy of Augmented Reality, Helmet, Headup display, Smart Glasses, Projection

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UNI	Г-IV	VR Hardware and Software	08 Hours	
Hum hardy Mod Tool Platf	Human Factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Khronos Group – AR Toolkit – Augmented Reality Operating System – Role of Augmented Reality interfaces – Players and			
UNI	Γ-V	AV/VR Applications	07 Hours	
Intro intera Elast	duction, Engine action. Physical ic collisions, pro	ering, Entertainment, Science, Training. The Future: Virtual environm Simulation: Introduction, Objects falling in a gravitational field, Rotat ojectiles, simple pendulum, springs, Flight dynamics of an aircraft.	ent, modes of ting wheels,	
UNI	Г-VI	<b>AR/VR</b> for Robotic Applications	07 Hours	
AR a opera	assisted Robot P ation, AR for hu	rogramming System for Industrial Applications, AR based Mobile Rol man robot communication.AR and Cobots.	bot Tele	
		Lab Contents		
The nee Aut obje	instructor's ma d to include p onomous sylla ectives, outcome	nual is to be developed as a hands-on resource and reference. The inst rologue (about University/program/ institute/ department/foreword bus, conduction & Assessment guidelines, topics under conside es, set of typical applications/assignments/ guidelines, and references.	ructor's manual / preface etc), eration-concept,	
5	,	Guidelines for Assessment		
Pra ass Fin	<ul> <li>Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.</li> <li>Total marks assigned are 25.</li> <li>Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file</li> <li>Final practical examination for specific practical and oral examination will be conducted.</li> </ul>			
		List of Laboratory Assignments/Experiments		
1	Study of diffe	rent Equipment for AR apps		
2	Installation o documentation	f Unity and Visual Studio, setting up Unity for VR development n of the same	t, understanding	
3	Demonstration gear VR.	n of the working of HTC Vive, Google Cardboard, Google Daydrea	m and Samsung	
4	Develop a sce game objects.	ene in Unity that includes: i. a cube, plane and sphere, apply transform ii. add a video and audio source.	mations on the 3	
5	5 Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click			
6	Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models			
7	Mini Project: application of	Work on your own project and explore your capabilities in develops your choice	ing a VR or AR	
Text	Text Books: T1. John Vince, "Virtual Reality Systems", Pearson Education Asia, 2007			
	Ains	Entre Ch	\$/	
	Dr. A. M. Bada BOS Chairman (/	dheDr. Ram JoshiDr. R.A & R)Dean AcademicsDirector R	K. Jain SCOE, Pune	

T2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Addison-Wesley Professional, 2016.

#### **Reference Books:**

- R1. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.
- R2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
- R3.Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
- R4. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2008
- R5.Jon Peddie, "Augmented Reality Where We Will All Live", Springer International Publishing AG, 2017.

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#### **JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33** (An Autonomous Institute Affiliated to Savitribai Phule Pune



## University, Pune)

#### **Final Year B. Tech. (Automation and Robotics)** Academic Year – 2024-2025 Semester -VII AR4103A - Data Engineering for Robotics and Automation

Elective III				
<b>Feaching Scheme:</b>		Credit	<b>Examination S</b>	cheme:
ГН:03 Hours/Wee	k	TH:03	In Sem. Evalua	tion:15 Marks
LAB:01 Hours/We	ek	LAB:01	Mid Sem. Exar	n: 25 Marks
			End Sem. Exar	n : 60 Marks
			Lab Evaluation	1: 25 Marks
Course Prerequisit	tes:			
Course Objectives				
• To learn arc	hitecture compon	ents of data analytics		
• To understan	nd the basics of bi	ig data analytics		
• To know dif	ferent types of an	alytics		
Course Outcomes:				
After successful con	npletion of the co	ourse, students will able to:		
CO1: Recall the b	asics behind data	analytics		
CO2: Describe the	e architecture com	ponents of data analytics.		
CO3: Elaborate ad	lvanced analytics	platform		
CO4: Summarize	Map-Reduce and	the New Software Stack		
CO5: Compare an	d contrast issues	in Mining Data Streams		
CO6: Summarize	the concept of Lin	nk Analysis		
		Course Contents		
UNIT-I		Introduction		07 Hours
Velocity, Variety, V	Veracity; Drivers	for Big Data, Sophisticated C	onsumers, Auton	nation, Monetization,
Big Data Analyti	cs Applications	Social Media Command	Center, Produc	t Knowledge Hub,
infrastructure and	Operations Stud	ies, Product Selection, Desig	gn and Engineer	ing, Location-Based
Services, Online Ac	lvertising, Risk M	lanagement		1
UNIT-II		Architecture Components		07 Hours
Massively Parallel I	Processing (MPP)	Platforms, Unstructured Data	Analytics and Re	porting: Search and
Count, Context-Sen	sitive and Domain	n-Specific Searches, Categorie	s and Ontology, Q	Qualitative
Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines				
UNIT-III	<u>`</u>	Advanced Analytics Platforn	<u>1</u>	08 Hours
Real-Time Architec	ture for Conversa	tions, Orchestration and Synth	esis Using Analy	tics Engines, Entity
Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies Implementation of				
Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data				
with MDM, Evolvii	ng Maturity Level		<u> </u>	0.0 11
UNIT-IV	Map-H	Reduce and the New Softward	e Stack	08 Hours
Distributed File S	Systems, Physica -Reduce features	al Organization of Comput	e Nodes, Large ev. Reduce Task	Source States Section 5-Scale File-System
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Reduce Execution, Coping With Node Failures, Algorithms Using Map-Reduce for Matrix m	nultiplication,		
Relational Algebra operations, Workflow Systems, Recursive Extensions to Map-Reduce			
UNIT-V Mining Data Streams and Link Analysis 0	)7 Hours		
Stream Data Mode 1 and Management Stream Source, Stream Queries, and issues, Sampli	ing Data in a		
Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Co	Counting Ones		
in a Window, Decaying Windows.	le using Man		
Link Analysis: Page Ranking in web search engines, Efficient Computation of PageRank Reduce and other approaches, Topic-Sensitive Page Rank, Link Spam, Hubs and Authorities	s using Map-		
UNIT-VI Data Analytics and Robotic Process Automation (RPA) 0	)8 Hours		
Data Robotics – Robotic Process Automation (RPA) and Intelligent Process Automation (I	IPA), Role of		
RPA in Big Data Analytics, Predictive Data Analytics for Industrial Robots – Beh	navioural and		
Maintenance Analytics.			
Lab Contents			
The instructor's manual is to be developed as a hands-on resource and reference. The instruc-	ictor's manual		
need to include prologue (about University/program/ institute/ department/foreword/	preface etc),		
Autonomous syllabus, conduction & Assessment guidelines, topics under considera	ation-concept,		
objectives, outcomes, set of typical applications/assignments/ guidelines, and references.			
Guidelines for Assessment			
Practical/Oral examination based on the practical's performed in the lab. The Perform	nance will be		
assessed jointly by internal and external examiners.			
<ul> <li>Total marks assigned are 25.</li> <li>Continuous assassment will be carried out based on attendance, lab performance, and</li> </ul>	d timely		
- Continuous assessment will be carried out based on attendance, rab performance, and submission of lab file	1 timery		
<ul> <li>submission of fab file.</li> <li>Final practical examination for specific practical and oral examination will be conducted</li> </ul>			
List of Laboratory Assignments/Experiments			
1 Introduction to statistical learning and R-Programming			
2 Practice and analysis with R			
3 Case study on data management using Hadoop			
4 Predictive analytics project using Matlab			
5 Case study on scalable computations using MapReduce			
6 Case study on predictive/prescriptive analysis using Minitab			
Text Books:			
T1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi,, First			
Edition October 2012, IBM Corporation. T2 Mining of Massive Detector, Anond Paisners, June Lesheves, Jeffrey D. Lillman E. hash, 2012			
12. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman.E-book, 2013			
REFERENCEBOOKS:			
R1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, ebook of			
2012			

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University, Pune)



#### **Final Year B. Tech. (Automation and Robotics)** Academic Year – 2024-2025 Semester -VII AR4103B - Industry 4.0

**Elective III** 

Teaching Scheme: TH:03 Hours/Week	Credit TH:03	Examination Scheme: In Sem. Evaluation:15 Marks
LAB:02 Hours/Week	LAB:01	Mid Sem. Exam: 25 Marks
		End Sem. Exam : 60 Marks
		LAB Evaluation : 25 Marks
	1 9 1 11	

**Course Prerequisites:** Knowledge of Automation System and Electronics Engineering

#### **Course Objective:**

- To understand the basics, drivers and enablers of Industry 4.0
- To learn about the smartness in smart manufacturing factories, smart devices, smart cities and • smart services.
- To learn about the different enabling technologies and its role in establishing Industry 4.0
- To study different design principles of Industry 4.0
- To understand the impact of industry 4.0 on different sectors and challenges in implementing 4.0 •

#### **Course Outcome:**

After successful completion of the course, students will able to:

CO1: The basic knowledge on Industry 4.0, its drivers, enablers, and difference between Industry 4.0 factories with today's factory.

CO2: An idea of IoT, IIoT, smart manufacturing factories, smart devices, smart cities and smart services. **CO3:** The basic understanding of different technologies enabling Industry 4.0 with some case studies.

**CO4:** The awareness on different design principles could manufacture and connected factories.

CO5: The ability to understand the impact of Industry 4.0 in different sectors including challenges in implementing Industry 4.0.

Course Contents				
UNIT-I	Introduction to Industry 4.0	07 Hours		
Introduction to Inc	lustry 4.0- The Various Industrial Revolutions, Digitalization and t	he Networked		

Economy, Drivers, Enablers, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT-II Road to Industry 4.0		07 Hours	
Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big data, Value			
chains in Department of Robotics and Automation. Manufacturing companies, Smart factories, Smart			
Devices and Products, Smart Logistics, Smart Cities, smart services, Predictive Analytics, Case studies			

UNIT-III

**Technologies for Enabling Industry 4.0** 

**07 Hours** 

Cyber Physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Cyber Security, Augmented /Virtual reality, Artificial Intelligence, System integration, digital twin, 3D printing, Case studies

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UN	NIT-IV	Industry 4.0 Design Principles	07 Hours		
Introd for Ir transp	Introduction to Industry 4.0 design principles – Interoperability, Communication systems and standards for Industry 4.0, virtualization, Decentralization, Modularity, real time capability, information transparency – Foundation of Industry 4.0 - Could Manufacturing and the connected factories.				
U	NIT-V	Impact of Industry 4.0	07 Hours		
Introdu applicat Automa capture	ction Flexible tions, benefits ated Storage a	Manufacturing Systems, FMS components, Material handling and sto s, computer control systems, types of FMS Layout, FMS planning and and Retrieval Systems, AS/RS and Automatic parts identification syste	rage system, design issues, ms and data		
UN	NIT-VI	Applications of Industry 4.0	07 Hours		
Mobil identit Big ar	e devices. I fication), Adv alytics and a	nternet of things (IoT) platforms. Location detection technolog vanced human-machine interfaces, Authentication and fraud detection, dvanced processes.	ies (electronic Smart sensors,		
		Lab Contents			
The in need Auton object	structor's ma to include p omous syllal ives, outcome	nual is to be developed as a hands-on resource and reference. The instr rologue (about University/program/ institute/ department/foreword/ bus, conduction & Assessment guidelines, topics under conside es, set of typical applications/assignments/ guidelines, and references.	ructor's manual / preface etc), ration-concept,		
Durati		Guidelines for Assessment			
assess Final	<ul> <li>Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.</li> <li>Total marks assigned are 25.</li> <li>Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file</li> <li>Final practical examination for specific practical and oral examination will be carduated.</li> </ul>				
	-	List of Laboratory Assignments/Experiments			
1	Case Studie	s on Robot Assisted production			
2	Case Studie	s on Smart Home			
3	Case Studie	s on Manufacturing Techniques			
4	Case Studie	s on Traffic monitoring			
5	Case Studie	s on Predictive maintenance			
6	Case Studie	s on Quality Control			
7	Case Studie	s on design of Smart Sensors			
8	8 Case Studies on design of Automation vehicle connected Cars				
<ul> <li>Text Books:</li> <li>T1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.</li> <li>T2. Bruno S.Sergi, Elena G.popkova, et al. "Understanding Industry 4.0: AI, The internet of things, and the future of work", 2019, Emerald publishing limited.</li> </ul>					
Referen	Reference Books: R1: Kaushik kumar, DivyaZindani, J. Paulo Davim, "Digital manufacturing and assembly systems in				
ВС	Dr. A. M. Bada	dhe Dr. Ram Joshi Dr. R. A & R) Dean Academics Director R	K. Jain SCOE, Pune		

Industry 4.0", CRC Press, Taylor and Francis group, 2020.

R2: Antonio sartal, Diego Carou, J.Paulo Davim, "Enabling technologies for the successful deployment of Industry 4.0, CRC press, 2020.

R3: Alp Ustundag, Emrecavikcan, "Industry 4.0 Managing the digital transformation", springer international publishing, 2018

#### **On-Line resources:**

- 1. https://onlinecourses.nptel.ac.in/noc20\_cs69/preview
- 2. https://www.udemy.com/course/intro-to-industry-4/

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#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to SavitribaiPhule Pune

University,Pune)



#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VII AR4103C - AI and ML for Robotics

	<b>Elective-I</b>			
Teaching Scheme:	Credit	<b>Examination Sche</b>	me:	
TH: 03Hours/Week	TH:03	In Sem. Evaluation	n:15 Marks	
LAB:02 Hours/Week	LAB:01	Mid Sem. Exam: 2	5 Marks	
		End Sem. Exam	: 60 Marks 25 Marks	
Course Prerequisites: Basic Knowledge	of Mechatronics System and	d Automation system		
Course Objective:		j		
• Acquaint with fundamentals of art	tificial intelligence and mach	ine learning.		
• Learn feature extraction and selec	tion techniques for processir	ng data set.		
Understand basic algorithms used	in classification and regress	ion problems.		
Outline steps involved in develops	ment of machine learning me	odel.		
• Familiarize with concepts of reinf	orced and deep learning.			
• Implement and Analyze machine	learning model in mechanica	al engineering proble	ms.	
Course Outcome:				
After successful completion of the course	, students will able to:			
<b>CO 1.</b> Demonstrate fundamentals of artit	ficial intelligence and maching	ne learning.		
<b>CO 2.</b> Apply feature extraction and selec	ction techniques			
CO 3. Apply machine learning algorithm	is for classification and regre	ession problems.		
CO 4. Devise and develop a machine lea	rning model using various s	teps.		
CO 5. Explain concepts of reinforced and	d deep learning.	1.1		
CO 6. Simulate machine learning model	in mechanical engineering p	roblems		
	Course Contents			
UNIT-I	Introduction to AI & N	ML	08 Hours	
History of Al, Comparison of Al with D	ata Science, Need of AI in I	Mechanical Engineer	ing, Introduction	
to Machine Learning. Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning,				
Approaches to AI: Cybernetics and brain simulation. Symbolic Sub-symbolic Statistical				
Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.				
UNIT-II	Feature Extraction and Se	lection	08 Hours	
Feature extraction: Statistical features, Principal Component Analysis.				
Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first,				
Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical				
Engineering.				

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	UNIT III	Classification & Regression	08 Hours	
Classification: Decision tree, Random forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Mechanical Engineering				
	UNIT-IV	Development of MI Model	08 Hours	
<b>Proble</b> Collec Valida Recall	em identification: c ction, Data pre-proce ation), Model evaluation, True positive, false p	lassification, clustering, regression, ranking. Steps in ML essing, Model Selection, Model training (Training, Testing on (understanding and interpretation of confusion matrix, Acc positive etc.), Hyper parameter Tuning, Predictions.	modeling, Data g, K-fold Cross uracy, Precision,	
	UNIT-V	<b>REINFORCED AND DEEP LEARNING</b>	10 Hours	
Chara vs Neg Charad Applic	acteristics of reinforce gative Reinforced Lean cteristics of Deep Lean cation of Reinforced an	<b>ced learning; Algorithms:</b> Value Based, Policy Based, Mode rning; Models: Markov Decision Process, Q Learning. rning, Artificial Neural Network, Convolution Neural Network nd Deep Learning in Mechanical Engineering.	l Based; Positive	
	UNIT-VI	APPLICATIONS	08 Hours	
Huma Systen Tunin	n Machine Interaction n Order Reduction, Im g of control algorithms	<ul> <li>Predictive Maintenance and Health Management, Fault Detecting hage based part classification, Process Optimization, Material I s.</li> </ul>	ction, Dynamic Inspection,	
		Lab Contents		
need to include prologue (about University/program/ institute/ department/foreword/ preface etc), Autonomous syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.				
Guidelines for Assessment				
<ul> <li>Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.</li> <li>Total marks assigned are 25.</li> <li>Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file</li> <li>Final practical examination for specific practical and oral examination will be conducted</li> </ul>				
		List of Laboratory Assignments/Experiments		
1	To study supervised/	unsupervised/Reinforcement learning approach		
2	To acquire, visualize and analyze the data set (from time-domain/ frequency-domain/ etc.)			
3	To extract features from given data set and establish training data.			
4	To select relevant features using suitable technique.			
5	To use PCA for dimensionality reduction			
6	To classify features/To develop classification model and evaluate its performance (any one classifier).			
0	To develop regression model and evaluate its performance (any one algorithm).			
0 7	To develop regressio	on model and evaluate its performance (any one algorithm).		

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9	Reinforced Learning for optimizing engineering designs / Robot Guidance and Navigation.
10	GA for optimization of multi-dimensional function / path planning in robotics.
Text	Books:
Т	1. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
Т	2. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
Т	3. Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI
	learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015
Т	4. Stuart Russell and Peter Norvig (1995), "Artificial Intelligence: A Modern Approach," Third
	edition, Pearson, 2003.
Refe	rence Books:
R	1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global,
	2018.
R	2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
R	3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC
	Press, 2021.
R	4.Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
R	25. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH
On-I	Line resources:
1	
1.	http://nptel.ac.in/courses/111101003/
2.	https://nptel.ac.in/courses/106/106/106106202/
3.	https://nptel.ac.in/courses/112/103/112103280/
4.	https://www.analyticsvidhya.com/

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#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33



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#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VII AR4104 - Project Stage-I

Teaching Scheme:	Credit	Examination Scheme:	
LAB:12 Hours/Week	TH: 06	LAB Evaluation : 50 Marks	
		Term Work : 100 Marks	

Course Pre requisites:

Course Objective:

- To develop design skills according to a Conceive-Design-Implement Operate (CDIO) compliant methodology.
- To implement engineering skill and knowledge to complete the identified project work while encouraging creativity and innovation.
- To develop spirit of team work, communication skills through group-based activity and foster selfdirecting learning and critical evaluation.
- To make them aware in the selection of domain, area and topic of their interest.
- To orient the students to identify the problem precisely and subsequently do the synthesis.
- To orient the students to apply their knowledge preferably to real life engineering problem solving.
- To provide an opportunity to them to acquire hands on experience of manufacturing processes.

• To provide platform to learn how to work in a group and gain basic management skills.

Course Outcome:

After successful completion of the course, students will able to:

**CO1:** Ability to work in a group for a system design / design and fabrication project conceptualization, planning and execution..

**CO2:** Ability to do a detailed and optimized system design with various criterion of design like manufacturability, assembly, reliability, integration of mechanical and electronic systems, maintenance, cost, packaging etc

**CO3:** Ability to record the steps of design and prepare a design report in different forms like document, spreadsheet, presentations, production drawings, simulation images/videos etc.

CO4: Decide and apply the manufacturing techniques and instrumentation

**CO5:** To develop the procurement skills.

CO6: To assemble and demonstrate the working model.

**Guidelines for Project Stage -I** 

A. Project stage-I can be a group activity (Maximum 4 students) depending on the depth and scope of the topic.

B. Group formation, discussion with faculty advisor, formation of the Project statement, resource requirement should be carried out in the earlier part of the Semester.

C. Manufacturing /Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.

OR

D. Project should include mainly in the field of Automation and Robotics

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech

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Dr. Ram Joshi Dean Academics Dr. R. K. Jain Director RSCOE, Pune systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks/results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

E. Evaluation is based on reviews by evaluators internal and external members students has to follow guidelines as per mentioned in project stage time to time.

F. After interactions with course coordinator and based on comprehensive literature survey/ need Analysis, the student shall identify the title and define the aim and objectives of project.

G. Following work is expected to complete in Project stage-I

1. Abstract.

2. Introduction.

- 3. Problem statement & Objectives
- 4. Scope
- 5. Methodology
- 6. Literature Review
- 7. Simulation work (Analytical/CFD/FEM/Numerical)
- 8. Proposed experimental setup & work.
- 9. Concluding Remarks and Scope for the Future Work.
- 10. Completed documentation in the form of project report is to be submitted at the end of semester.

H. Review – I: during Mid Semester Examination as per the Academic Calendar.

I. Review – II: The last week of the Semester.

#### **Instructions for Report Writing**

It is important that the procedures listed below be carefully followed by all the students of Final Year

B. Tech. (Automation and Robotics).

1. Prepare Three Spiral Bound Copies of your manuscript.

2. Limit your Project Stage I to It is important that the procedures listed below to be carefully followed by all the students of Final Year B. Tech. (Automation and Robotics).

1. Prepare Three Spiral Bound Copies of your manuscript.

2. Limit your Project Stage I to 25–30 pages (preferably)

3. The footer must include the following:

Institute Name, Final year B. Tech (A & R) Times New Roman 10 pt. and centrally aligned.

4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.

- 5. Print the manuscript using
  - a) Letter quality computer printing.
  - b) The main part of manuscript should be Times New Roman 12 pt. with alignment justified.
  - c) Use 1.5 line spacing.
  - d) Entire report shall be of 5-7 chapters

6. Use the paper size  $8.5^{\circ} \times 11^{\circ}$  or A4 (210  $\times$  197 mm). Please follow the margins given below.

Margin Location Paper	Paper 8.5"x 11"	Paper A4(210 x 197mm)
Тор	1"	25.4 mm
Left	1.5"	37 mm
Bottom	1.25"	32 mm
Right	1"	25.4 mm

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7. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.

8. Section titles should be bold with 14 pt. typed in all capital letters and should be left aligned.

9. Sub-Section headings should be aligning at the left with 12 pt. bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

a) Illustrations should not be more than two per page. One could be ideal

b) Figure No. and Title at bottom with 12 pt.

c) Table No. and Title at top with 12 pt.

d) Legends below the title in 10 pt.

e) Leave proper margin in all sides

f) Illustrations as far as possible should not be photo copied.

11. Photographs if any should be of glossy prints

- 12. Please use SI system of units only.
- 13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only.

16. Following will be the order of report

.i. Cover page and Front page (as per the specimen on separate sheet)

ii. Certificate from the Institute (as per the specimen on separate sheet)

iii. Acknowledgements

iv. Contents

v. List of Figures

vi. List of Tables

vii. Nomenclature

viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt. and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

- 1. Introduction (2-3 pages) (TNR 14 Bold)
  - 1.1 Problem statement (TNR 12)
  - 1.2 Objectives

1.3 Scope

1.4 Methodology

1.5 Organization of Dissertation

2. Literature Review (12-16 pages)

Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (8 - 12 pages)

4. Experimental Validation - This chapter shall be based on your own experimental work (2 - 3 pages)

5. Concluding Remarks and Scope for the Future Work (1 - 2 pages)

References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure) 17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3 .... and for

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Dr. Ram Joshi Dean Academics



Dr. R. K. Jain Director RSCOE, Pune subheadings 1.1, 1.2... etc and section subheadings 2.1.1, 2.1.2... etc.

18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citation of it. Please follow the following procedure for references.

#### **Reference Books:**

**R1**. Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

#### Papers from Journal or Transactions :

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

#### **Papers from Conference Proceedings :**

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

#### Reports, Handbooks etc. :

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

#### Patent :

Patent no, Country (in parenthesis), date of application, title, year.

#### Internet :

www.(Site) [Give full length URL] accessed on date

#### **Evaluation Scheme:**

S. No.	Evaluation Elements	Weightage (%)
1	Semester VII Problem definition, Regular evaluation	15
2	Semester VII Final Design Detailing.	15
3	Semester VIII Regular evaluation	10
4	Semester VIII Final Evaluation showcase, project website and report	60

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University, Pune)



**SEMESTER VIII Syllabus** 

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**10 Hours** 

(An Autonomous Institute Affiliated to SavitribaiPhule Pune University,Pune)

#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester –VIII + TRACK- (A)-REGULAR AR4105 - Mobile Robotics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week	TH:03	In Sem. Evaluation:15 Marks
		Mid Sem. Exam: 25 Marks
		End Sem. Exam : 60 Marks

#### **Course Prerequisites:**

#### **Course Objective:**

- Learn the concepts of various mobile robots and its kinematics
- Understand the fundamentals of Sensors in the Mobile Robots
- Gain knowledge about the control aspects for various types of mobile robots .

#### **Course Outcome:**

**UNIT-I** 

After successful completion of the course, students will able to:

CO1: Classify the various types of Mobile Robots

CO2: Describe the Kinematics in the Mobile Robots

CO3: Apply the concepts of sensing elements to Mobile Robot Applications

CO4: Explain the various dynamic models of Mobile Robots

**CO5:** Summarize the control aspects involved in Mobile Robotics

CO6: Apply the fundamentals of Mobile Robotics to develop Practical Applications

#### **Course Contents**

Introduction to Mobile robots

Robot History - Locomotion: Introduction - Key issues for locomotion - Types of Robots: Legged Mobile Robots -Wheeled Mobile Robots - Driving Robots - Omnidirectional Robots - Balancing Robots - Walking Robots -Autonomous Planes - Autonomous Vessels & Underwater Vehicles.

Intelligence and embodiment, A roboticist's problem, challenges of mobile autonomous robots, Locomotion, static and dynamic stability, degrees of freedom. Coordinate systems and frames of reference, forward kinematics, inverse kinematics, inverse kinematics using feedback control.

UNIT-II	Path Planning	06 Hours	
Map representations, path planning algorithms, sampling based path planning, path smoothing, planning at different length scales. Uncertainty and error propagation in robotics, probabilistic robotics, basic concepts in probability.			
UNIT III	Recursive State Estimation06 Hours		
Robot environment interaction, Bayes filter, representation and computation. Gaussian filters, Kalman filter, extended kalman filter, information filter, histogram filter, particle filter.			
UNIT-IV	Robot Motion	07 Hours	

Kinematic configuration, probabilistic kinematics, velocity motion model, odometry motion model.

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Director RSCOE, Pune

UNIT-V	Robot Perception	08 Hours		
Maps, Beam models of rang	ge finders, likelihood fields for range finders, correlation-based	sensor models,		
feature-based sensor models	3			
UNIT-VI	Mobile Robot Localization: Markov and Gaussian and	08 Hours		
	Occupancy Grid Mapping			
Mobile robot localization, M	Aarkov localization, EKF localization, Estimating corresponde	nces, multi-		
hypothesis tracking, grid loc	calization, Monte Carlo localization.			
Occupancy grid mapping, S	imultaneous localization and mapping, RGB-D SLAM.			
Text Books:				
T1. Sebastian Thrun, Wo	olfram Burgard & Dieter Fox, "Probabilistic Robotics", The M	4IT Press		
T2. Spyros G Tzafestas,	"Introduction to Mobile Robot Control", First Edition, Elsevie	er Insights, 2014.		
T3. Roland Siegwart, Illa	ah Reza Nourbakhsh and Davide Scaramuzza, "Introduction to	Autonomous		
Mobile Robots", Sec	cond Edition, MIT Press, 2011.			
Reference Books:				
R1.Eugene Kagan, Nir S	Shvalb & Irad Ben-Gal, "Autonomous Mobile Robots and Mul	ti-Robot Systems		
", First Edition, John	1 Wiley & Sons Ltd, 2020.			
R2. Nikolaus Correll, In	troduction to Autonomous Robots, 1st edition			
R3. Thomas Braunl, "En	nbedded Robotics", Third Edition, Springer, 2008.			
R4. Witold Jacak, "Intell	ligent Robotic Systems: Design Planning and Control", Kluwe	r Academic		
Publishers, 1999.				
R5.Luc Jaulin ,Mobile F	Robotics, Wiley, 2019	1 * 1		
R6. Gregory Dudek, Michael Jenkin, Computational Principles of Mobile Robotics, Cambridge				
Driversity Press,201	lU anomous Mahila Dahata Sansing Control Desision Making a			
K/. Frank L. Lewis, Autonomous Mobile Robots Sensing, Control, Decision Making and				
Applications, CRC P	1088,2010			

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Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester –VIII + TRACK- (A)-REGULAR

**AR4106 - Advance Robotics Applications** 

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week	TH:03	In Sem. Evaluation:15 Marks
		Mid Sem. Exam: 25 Marks
		End Sem. Exam : 60 Marks

#### **Course Prerequisites:**

#### **Course Objective:**

- To provide knowledge on the application of robotics in health care
- Sensor requirements for localization, control and tracking
- Understand the design aspects of medical robots

#### **Course Outcome:**

After successful completion of the course, students will able to:

**CO1:** Identify the type of medical robots and the concepts involved in it.

**CO2:** Define the applications of surgical robotics

CO3: Purpose of Rehabilitation interface

**CO4:** Classify the types of assistive robots

**CO5:** To analyze the design characteristics, methodology and technological choices for medical robots.

#### **Course Contents**

T1	N	ГТ	' <b>_</b> T	
U	LN.	11	-1	

Introduction to Medical Robotics

08 Hours

Introduction to medical robotics : applications and paradigms – Role of AI in medical robotics – Potential impact of medical robots, types of medical robots and level of human intervention – growing healthcare challenges

# UNIT-IIImage-Guided Interventions08 HoursMedical imaging modalities (e.g., MRI, US, X-ray, CT) - Robot compatibility with medical imagers –<br/>Image segmentation and modeling - Tracking devices - Frames and transformations - Surgical navigation -<br/>Calibration Rigid and non-rigid registration – Radiosurgery

UNIT III	Surgical Robotics	08 Hours	
Medical robots: History, Characteristics of medical robots, Automation and Navigation Challenges -			
obotics in surgery: Laparoscopic and Endoscopic Manipulators, Oncology robotics, Physically assistive			
robotics. Socially as	sistive robotics		

#### UNIT-IV

Minimally Invasive Surgery (MIS)

08 Hours

Human-machine interfaces - Teleoperation - Cooperative manipulation -Port placement for MIS - Robot design concepts - Video images in MIS - Augmented reality - Minimally invasive surgery training

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UNIT-V	Rehabilitation Robotics	08 Hours		
Physiological basis of	f neuro motor recovery, Framework for neuro rehabilitation robotics:	implication and		
recovery, Actuators	and sensors and prosthetic robots, Assistive controllers and modalities,	, Exoskeletons		
for upper limb and lo	ower limb rehabilitation, Software platforms for integrating robots and	l virtual		
environments, Wears	able robotic applications for neuro rehabilitation			
UNIT-VI	Medical robotics-applications, controversies and outcomes	08 Hours		
Applications in Bi	omedical Engineering – Bio Engineering Biologically Inspired	Robots, Neural		
Engineering, Applic	ation in Rehabilitation - Interactive Therapy, Bionic Arm, Clinica	l and Surgical –		
Gynecology, Orthop	edics, Neurosurgery, Controversies and outcomes			
Text Books:				
T1. Robert Schill	ing, Fundamentals of Robotics-Analysis and control, Prentice Hall, 20	03.		
T2. Paula Gomes	, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.			
T3. J.J. Craig, Int	roduction to Robotics, Pearson Education, 2005			
T4. Roberto Colo	ombo Vittorio Sanguineti, Rehabilitation Robotics, 1st Edition, Imprint	: Academic		
Press Publish	ed Date: 10th March 2018, Springer			
<b>Reference Books:</b>				
R1.R. D. Howe and Y. Matsuoka, "Robotics for surgery," Annual Review of Biomedical Engineering,				
vol. 1, pp. 211–240, 1999				
R2. A. R. Lanfranco, A. E. Castellanos, J. P. Desai, and W. C. Meyers, "Robotic surgery: a current				
perspective,"	Annals of Surgery, vol. 239, no. 1, pp. 14–21, 2004.			
R3.Introduction	to Robotics : Mechanics and Control John J. Craig			

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University, Pune) Final Year B. Tech. (Automation and Robotics)

Academic Year – 2024-2025 Semester -VIII

TRACK- (A) - Regular

AR4107A - Cyber Security

	I	Elective-IV		
<b>Teaching Scheme:</b>		Credit	Examination Sch	eme:
TH:03 Hours/Week		TH:03	In Sem. Evaluation	on:15 Marks
LAB:02 Hours/Week		LAB:01	Mid Sem. Exam:	25 Marks
			End Sem. Exam	: 60 Marks
			LAB Evaluation	: 25 Marks
Course Prerequisites:				
Course Objective:				
• To understand the basic	s of computer, ne	etwork and information	security.	
• To study operating system	em security and n	nalwares.		
• To acquaint with securi	ty issues in intern	et protocols.		
• To analyze the system f	or vulnerabilities			
Course Outcome:				
After successful completion of	the course, stude	nts will able to:		
CO1: Use cryptographic techni	ques in secure ap	plication development		
CO2: Apply methods for authe	ntication, access	control, intrusion detec	tion and prevention.	
<b>CO3:</b> To apply the scientific m	ethod for security	y assessment		
CO4: To develop computer for	ensics awareness			
	Cou	arse Contents		
UNIT-I		Security Fundamenta	als	06 Hours
An Overview of Information Security: The Basic Components, Threats, Policy and Mechanism,				
Assumptions and Trust, Assurance, Operational Issues, Human Issues, Security nomenclature. Access				
Control Matrix, Security Policies: Confidentiality, Integrity, Availability Policies and Hybrid Policies, OS				
Security				

UNIT-II	Modular Arithmetic a	08 Hours	
Modular Arithmetic : Modul	ar Arithmetic Notations, Moc	ular Arithmetic Operations, E	luclid's method of
finding GCD, The extended I	Euclid's algorithm.		
Cryptography: Classical end	cryption techniques, Block a	nd Chain ciphers, Data Enc	cryption Standard,
	1 5 6 5		

 Advanced Encryption Standard, RC5.

 UNIT-III
 Advanced Cryptography
 08 Hours

Chinese Remainder Theorem and its implication in Cryptography, Diffie-Hellman key exchange algorithm, RSA algorithm, Elgamal Arithmetic, Elliptic Curve Cryptography, Message Digest and Cryptographic Hash Functions, MD5 and SHA-1, Digital Signatures and Authentication.

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	UNIT-IV	Issues in Security Management and Cyber Laws	08 Hours	
Overvie Control program Cybercr perspect stalking	Overview, Risk identification, Risk Assessment, Risk Control Strategies, Quantitative vs. Qualitative Risk Control Practices. Risk Management. Laws and Ethics in Information Security, Codes of Ethics, Protecting programs and data. Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime, Types of Attacks, a Social Engineering, Cyber			
	UNIT-V	Key Management and Secure Communication	08 Hours	
Public K IPv6 and Function	Key Infrastructure (PK d IPSec, Web Security nalities	I), X.509 Certificate, Needham Schroeder algorithm and Kerberos. : SSL, HTTPS, Mail Security: PGP, S/MIME . Firewall : Different	IP Security: t Types and	
	UNIT-VI	Attacks, Malicious Logic and Countermeasures	08 Hours	
Phishing injection Detection	g, Password Cracking, n, Buffer Overflow, Sp on System : IDS fundation	Key-loggers and Spywares, Types of Virus, Worms, DoS and DD byware, Adware and Ransom ware. Antivirus and other security me mentals, Different types of IDS. Intrusion Prevention.	oS, SQL easures Intrusion	
		Lab Contents		
The ins need t Autono objecti	structor's manual is to to include prologue omous syllabus, con tves, outcomes, set of	b be developed as a hands-on resource and reference. The instru (about University/program/ institute/ department/foreword/ nduction & Assessment guidelines, topics under considera- typical applications/assignments/ guidelines, and references.	ctor's manual preface etc), ation-concept,	
		Guidelines for Assessment		
Final t	ed jointly by internal Total marks assigne Continuous assessm submission of lab fi practical examination	and external examiners. d are 25. ent will be carried out based on attendance, lab performance, ar le for specific practical and oral examination will be conducted	nd timely	
1	Implement Euclid's algorithm to find the	algorithm to find the GCD of two integers. Further implement extre multiplicative inverse of the given integer.	ended Euclidean	
2	Develop the program	n to implement DES algorithm for encryption and decryption. Ass	ume suitable	
3	Develop the program Private and Public K	n to implement RSA algorithm for encryption and decryption. Ass Keys.	ume suitable	
4	Write a program to	implement SHA1 algorithm using libraries (API)		
5	Configure and demo	onstrate use of vulnerability assessment tool like Wireshark or SNC	ORT	
Text Bo T1. Wi T2. Nin Legal I	ooks lliam Stallings, Comp na Godbole, Sunit Be Perspectives, Wiely In	puter Security: Principles and Practices, Pearson 6 Ed, ISBN 978 lapure, Cyber Security- Understanding Cyber Crimes, Compute ndia Pvt.Ltd, ISBN- 978-81-265-2179-1	8-0-13- 335469- er Forensics and	
Referen R1.Br W R2.Cl R3.Be R4.M	nce Books: ruice Schneier , Appli Tiely India Pvt Ltd, 2n K Shyamala et el., Cr erouz Forouzan, Cryp ark Merkow, Informa	ed Cryptography- Protocols, Algorithms and Source code in C, d Edition, ISBN 978-81-265-1368-0. yptography and Security, Wiley India Pvt. Ltd, ISBN-978-81-26 tography and Network Security, TMH, 2 edition, ISBN -978-00 ation Security-Principles and Practices, Pearson Ed., ISBN- 978-	Algorithms, 65-2285-9. )-707-0208-0. -81-317-1288-7.	
	-Atus	Kibluiz Of	>	
F	Dr. A. M. Badadhe 3OS Chairman (A & R)	Dr. Ram Joshi Dr. R. Dean Academics Director R	K. Jain SCOE. Pune	



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Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (A) - Regular AR4107B - Design of Mechatronics Systems

AR410/B - Design of Mechatronics Systems Elective-IV				
Teaching Scheme: TH:03 Hours/Week LAB:02 Hours/Week		Credit TH:03 LAB:01	Examination Sche In Sem. Evaluatio Mid Sem. Exam End Sem. Exam LAB Evaluation	eme: on:15 Marks 25 Marks : 60 Marks : 25 Marks
<b>Course Prerequisites:</b>				
<ul> <li>Course Objective:</li> <li>Basic of systems and</li> <li>Fundamentals Contro</li> <li>Various interfacing t</li> </ul>	its design. I and drives echniques of Mecl	natronics System		
Course Outcome: After successful completion CO1: Demonstrate an under CO2: Analyze various drive CO3: Explain real interface CO4: Analyse the concept of CO5: Design case studies of CO6: Design case studies of	of the course, stuc standing of the co s and control in Mechatronics f Automotive mec data acquisition data acquisition	lents will able to: ncepts of systems ar chatronics and control	ıd design.	
Course Contents				
UNIT-I		System and Des	ign	08 Hours
Mechatronic systems – Integrated design issue in mechatronic – mechatronic key element, mechatronics approach – control program control – adaptive control and distributed system – Design process – Type of design – Integrated product design – Mechanism, load condition design and flexibility – structures – man machine interface, industrial design and ergonomics, information transfer, safety.				
approach – control program design – Integrated product machine interface, industrial	control – adaptive design – Mechani design and ergon	e control and distribution of the second sec	lesign and flexibility – st ransfer, safety.	tructures – man
approach – control program design – Integrated product machine interface, industrial <b>UNIT-II</b>	control – adaptive design – Mechani design and ergon	e control and distribution of sm, load condition of omics, information the <b>Drives and Cont</b>	lesign and flexibility – st ransfer, safety. <b>rol</b>	08 Hours
approach – control program design – Integrated product machine interface, industrial <b>UNIT-II</b> Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors	control – adaptive design – Mechani design and ergon ydraulic control d continuous and b , fixed ratio, invar	e control and distribu- sm, load condition of omics, information t <b>Drives and Cont</b> evices, electro pneu limited rotation – H riant motion profile,	lesign and flexibility – st ransfer, safety. rol matic proportional contr tydraulic motor: continu variators.	<b>08 Hours</b> rols – Rotational ous and limited
approach – control program design – Integrated product machine interface, industrial UNIT-II Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors UNIT-III	control – adaptive design – Mechani design and ergon ydraulic control d continuous and b , fixed ratio, invar	e control and distribu- sm, load condition of omics, information t <b>Drives and Cont</b> evices, electro pneu limited rotation – H riant motion profile, <b>Real time Interf</b>	lesign and flexibility – st ransfer, safety. rol matic proportional contr cydraulic motor: continu variators. ace	08 Hours ols – Rotational ous and limited 08 Hours
approach – control program design – Integrated product machine interface, industrial <b>UNIT-II</b> Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors <b>UNIT-III</b> Real time interface – Introo process, installation of I/O c	control – adaptive design – Mechani design and ergon ydraulic control d continuous and 1 s, fixed ratio, invar luction, Elements ard and software –	e control and distribu- sm, load condition of omics, information t <b>Drives and Cont</b> evices, electro pneu limited rotation – H riant motion profile, <b>Real time Interf</b> of a data acquisition	lesign and flexibility – st ransfer, safety. rol matic proportional contr lydraulic motor: continu variators. ace on and Control system, o pplication software – ov	08 Hours         ols – Rotational         ous and limited         08 Hours         overview of I/O         er framing.
approach – control program design – Integrated product machine interface, industrial UNIT-II Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors UNIT-III Real time interface – Introc process, installation of I/O c	control – adaptive design – Mechani design and ergon ydraulic control d continuous and b , fixed ratio, invan luction, Elements ard and software –	e control and distribu- sm, load condition of omics, information t <b>Drives and Cont</b> evices, electro pneu limited rotation – H riant motion profile, <b>Real time Interf</b> of a data acquisition - Installation of the a <b>Automotive mechat</b>	rol matic proportional control ydraulic motor: continu variators. ace on and Control system, o pplication software – ov ronics	08 Hours         ols – Rotational         ous and limited         08 Hours         overview of I/O         er framing.         07 Hours
approach – control program design – Integrated product machine interface, industrial <b>UNIT-II</b> Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors <b>UNIT-III</b> Real time interface – Introc process, installation of I/O c <b>UNIT-IV</b> Transmission Control – Au	control – adaptive design – Mechani design and ergon ydraulic control d continuous and b , fixed ratio, invan luction, Elements ard and software –	e control and distribu- sm, load condition of omics, information t <b>Drives and Cont</b> evices, electro pneu limited rotation – H riant motion profile, <b>Real time Interf</b> of a data acquisition - Installation of the a <b>Automotive mechan</b>	ace and Control system – Design pro- transfer, safety. Trol matic proportional contri- tydraulic motor: continu- variators. ace on and Control system, or pplication software – ov ronics – Control Modes - control	08 Hours         ols – Rotational         ous and limited         08 Hours         overview of I/O         er framing.         07 Hours         trol algorithm –
approach – control program design – Integrated product machine interface, industrial UNIT-II Control devices – Electro h drives – Pneumatic motors: rotation – Motion convertors UNIT-III Real time interface – Introc process, installation of I/O c UNIT-IV Transmission Control – Au	control – adaptive design – Mechani design and ergon ydraulic control d continuous and b s, fixed ratio, invan luction, Elements ard and software – tomatic transmiss Dr. R	e control and distribu- sm, load condition of omics, information to <b>Drives and Cont</b> evices, electro pneu limited rotation – He riant motion profile, <b>Real time Interf</b> of a data acquisition - Installation of the a <b>Automotive mechan</b> sion – Mechanism -	ace and Control system – Design pro- ransfer, safety. arol matic proportional contri- tydraulic motor: continu- variators. ace on and Control system, or pplication software – ov ronics – Control Modes - control Dr. R.	08 Hours         ols – Rotational         ous and limited         08 Hours         overview of I/O         er framing.         07 Hours         trol algorithm –         K. Jain

sensors	s - Mechatronic gear Proving Control of	r shift – Power train, Braking Control– Tire Road Interface – Ve	ehicle dynamics
Contro	l– Drive by Wire – S	Sensors – Actuators – Communication – Four wheel Steering System	stems
	UNIT-V	Case studies –I	07 Hours
Case s	studies on data acc	uisition – Testing of transportation bridge surface material	s – Transducer
calibra	tion system for A	utomotive application - strain gauge weighing system - so	olenoid force –
Displac	cement calibration s	ystem – Rotary optical encoder – controlling temperature of a ho	ot/cold reservoir
- sense		Constantiated manufacturing	07 Цания
C		Case studies –II	07 Hours
case s	Deicing temperati	use control system – skip control of a CD player – Auto focu	s Camera, Case
studies	on design of med	chatronic product $-$ pick and place robot $-$ car park barrier	s - car engine
manag	ement – Barcode rea	nder.	
		Lab Contents	
The 11	nstructor's manual is	s to be developed as a hands-on resource and reference. The instru- institute (about University/program/ institute/ department/foreword/	uctor's manual
Autor	nomous svllabus, c	conduction & Assessment guidelines, topics under consider	ration-concept.
object	tives, outcomes, set	of typical applications/assignments/ guidelines, and references.	1 /
		Guidelines for Assessment	
Pract	ical/Oral examination	on based on the practical's performed in the lab. The Perfor	mance will be
asses	sed jointly by intern	al and external examiners.	
	Continuous assess	ned are 25. sment will be carried out based on attendance, lab performance,	and timely
	submission of lab	file	and annoty
Final	practical examination	on for specific practical and oral examination will be conducted	
1	Process Trainer Sy	vstem	
2	Design of Tempera	ature Control System	
3	PID Controller: Co	oncept and Tuning	
4	Development of a software.	data acquisition / mechatronics system using low cost open source	ce hardware and
5	Stepper motor inte	rfacing	
6	Modeling and anal software.	ysis of mechanical system and its verification using suitable sim	ulation
7	PID control of Me verification (verifi	chanical System using suitable simulation software and experime cation only if experimental setup is available).	ental
8	Case Study: Desig	n of Mechatronic System	
Text B	looks		
T1	. Georg pelz, "Mech	natronic Systems: Modeling and simulation" with HDL"s, John	wiley and sons
T2	1, 2003. Alciatore David	G & Histand Michael B "Introduction to Mechatronics an	d Measurement
sys	stems", 4th edition, 7	Fata McGraw Hill, 2006.	a measurement
Refere	ence Books:		
R1. I	Bolton, "Mechatron	<u>ics – Electronic Control Systems in Mechanical and Electrica</u>	I Engineering",
	Alus	Estuiz ( )	/
	Dr. A. M. Badadhe	Dr. Ram Joshi Dr. R.	K. Jain
В	OS Chairman (A & R)	Dean Academics Director RS	SCOE, Pune

Pearson Education Limited, 2015

- R2. Devdas Shetty, Richard A. Kolkm, "Mechatronics System Design", Cengage Learning, 2010
- R3.Smaili and F. Mrad, "Mechatronics- integrated technologies for intelligent machines", Oxford university press, 2008.
- R4.Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
- R5.Lawrence J. Kamm, "Understanding Electro Mechanical Engineering", An Introduction to Mechatronics, Prentice Hall of India Pvt., Ltd., 2000.
- R6.De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.
- R7.Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.
- R8. Theory and Practice of Mechatronics System, Pearson Education, 2007.
- R9.Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.

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Dr. R. K. Jain **Director RSCOE**, Pune



#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)



Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (A) - Regular

AR4107C - Micro-Electro Mechanical systems (MEMS)

Teaching Scheme:		Credit	Examination Scheme:
TH:03 Hours/Week		TH:03	In Sem. Evaluation:15 Marks
LAB:02 Hours/Week		LAB:01	Mid Sem. Exam: 25 Marks
			End Sem. Exam : 60 Marks
			LAB Evaluation : 25 Marks
	. 1 . 1 111	1 1 1 1 1 1	

Course Prerequisites: The student should have knowledge on Electrical and Electronics Engineering

#### **Course Objective:**

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

#### **Course Outcome:**

After successful completion of the course, students will able to:

**CO1:** Ability to understand and apply basic science, circuit theory, and Electro-magnetic field theory control theory and apply them to engineering problems.

C02: Ability to understand and analyze, linear and digital electronic circuits.

- **C03:** Understand the applications of sensors in industries
- C04: Understand the importance of Micromachining

#### **Course Contents**

UNIT-I	Introduction	08 Hours
Intrinsic Characteristics of	MEMS – Energy Domains and Transducers- Sensors an	nd Actuators –
Introduction to Micro fabr	ication - Silicon based MEMS processes - New Materials	s – Review of
Electrical and Mechanical	concepts in MEMS - Semiconductor devices - Stress and st	train analysis –
Flexural beam bending- Tor	sional deflection	

UNIT-II	Sensors and Actuators-I	<b>08 Hours</b>

Electrostatic sensors – Parallel plate capacitors – Applications – Inter digitized Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

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UNIT-III	Sensors and Actuators-II	08 Hours
Piezoresistive sensors – P Applications to Inertia, Pr piezoelectric effects – piezo	Piezoresistive sensor materials - Stress analysis of mechan ressure, Tactile and Flow sensors – Piezoelectric sensors pelectric materials – Applications to Inertia , Acoustic, Tactile a	ical elements – and actuators – .nd Flow sensors
UNIT-IV	Micromachining	07 Hours
Silicon Anisotropic Etching Deep Reaction Ion Etching surface micro machining pro – Striction and Antistriction	g – Anisotropic Wet Etching – Dry Etching of Silicon – Pla (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case ocesses – Structural and Sacrificial Materials – Acceleration of methods – LIGA Process - Assembly of 3D MEMS – Foundry	asma Etching – studies - Basic sacrificial Etch process.
UNIT-V	Polymer and Optical Mems	07 Hours
Polymers in MEMS-Polim	ide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA	– Parylene –
Fluorocarbon - Application	to Acceleration, Pressure, Flow and Tactile sensors- Optical M	EMS – Lenses
and Mirrors – Actuators for	Active Optical MEMS	
UNIT-VI	Industrial Applications of MEMIS in Automation Industry	07 Hours
Accelerometers for airbag	sensors, inkjet printer heads, computer disk drive heads, pro-	ojection display
chips, blood pressure sensor	rs, optical switches, microvalves, biosensors.	
The instructor's manual is need to include prologue Autonomous syllabus, co objectives, outcomes, set o Practical/Oral examination assessed jointly by interna • Total marks assign • Continuous assessi submission of lab f Final practical examination 1 Design of MEMS act	to be developed as a hands-on resource and reference. The inst e (about University/program/ institute/ department/foreword onduction & Assessment guidelines, topics under conside of typical applications/assignments/ guidelines, and references. <b>Guidelines for Assessment</b> n based on the practical's performed in the lab. The Perfor l and external examiners. Hed are 25. ment will be carried out based on attendance, lab performance, file n for specific practical and oral examination will be conducted tuator for Automation Industry	ructor's manual / preface etc), ration-concept, rmance will be and timely
2 Case Study on Therm	nal-Based Micro sensors	
3 Case Study on MEM	S Oscillators	
4 Case Study on LIDA	R Technology	
5 Case Study on Accel	erometers used in Industries	
6 Case Study on Magne	etometers used in Industries	
7 Case Study on RF M	EMS used in Industries	
8 Industrial Report on I	MEMS	
Text Books T1. Chang Liu, "Foundati T2. Stephen D Senturia, " T3. Tai Ran Hsu, "MEMS 2002	ions of MEMS", Pearson Education Inc., 2006. 'Microsystem Design", Springer Publication, 2000. S & Micro systems Design and Manufacture" Tata McGraw Hi	ll, New Delhi,
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Dr. R. K. Jain Director RSCOE, Pune

#### **Reference Books:**

- R1.James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
- R2.Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
- R3. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000
- R4.Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
- R5. Thomas M. Adams and Richard A. Layton, "Introduction MEMS, Fabrication and Application," Springer 2012.

#### **On-Line resources:**

- 1. Online Resources in MEMS Technology for Professional and Educational Development | W. Pleil | International Journal of Evaluation and Research in Education (IJERE) (iaescore.com)
- 2. Metallurgy Engineering and Material Science (MEMS) विद्यार्जन संसाधन केंद्र | Learning Resource Center (iiti.ac.in)

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#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phule Pune



(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (A)-REGULAR AR4108 - Project Stage-II

	4108 - Project Stage-II	
Teaching Scheme:	Credit	Examination Scheme:
LAB:16 Hours/Week	LAB:08	LAB Evaluation : 100 Marks
	****	Term Work : 150 Marks
Course Pre requisites:		
Course Objective:		
• To make them aware in the selec	tion of domain, area and topi	c of their interest.
• To orient the students to apply th	eir knowledge preferably to a	real life engineering problem solving.
• To provide an opportunity to the	m to acquire hands on experie	ence of manufacturing processes.
• To provide an opportunity to the	m to acquire hands on experie	ence of manufacturing processes.
• To provide platform to learn how	to work in a group and gain	basic management skills
• To expose them to the process of	selection of manufacturing r	nethods and materials.
Course Outcome:	<u> </u>	
After successful completion of the cours	e, students will able to:	
CO1: Define/Develop/Select methodolo	gy for executing the project v	work
CO2: Apply theoretical concepts for sol	ving the project problem	
CO3: Decide and apply the manufacturing	ng techniques and instrument	tation
<b>CO4:</b> Develop the procurement skills		
<b>CO5:</b> Assemble and demonstrate the wo	orking model.	
CO6: Develop skills of technical report	writing and presentation.	
	<b>Course Contents</b>	
1. Following work is expected to comp	lete in Project stage-II:	
a. Abstract.		
b. Introduction.		
c. Problem statement & Objectives		
d. Scope		
e. Methodology		
f. Literature Review		
g. Simulation work(Analytical/CFD/	FEM/Numerical)	
h. Experimental validation		
i. Result discussion		

j. Conclusion & future scope

2. Completed documentation in the form of project report is to be submitted at the end of semester.

- 1. Review I: during Mid Semester Examination as per the Academic Calendar.
- 2. Review II: The last week of the Semester.

#### **Guidelines for Assessment**

A. Project stage-I can be a group activity (Maximum 4 students) depending on the depth and scope of the

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B. Group formation, discussion with faculty advisor, formation of the Project statement, resource requirement should be carried out in the earlier part of the Semester.

C. Manufacturing /Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.

D. Project should include mainly in the field of Automation and Robotics

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks/results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

E. Evaluation is based on reviews by evaluators internal and external members students has to follow guidelines as per mentioned in project stage time to time.

F. After interactions with course coordinator and based on comprehensive literature survey/ need Analysis, the student shall identify the title and define the aim and objectives of project.

G. Following work is expected to complete in Project stage-I

- 1. Abstract.
- 2. Introduction.
- 3. Problem statement & Objectives
- 4. Scope
- 5. Methodology
- 6. Literature Review
- 7. Simulation work (Analytical/CFD/FEM/Numerical)
- 8. Proposed experimental setup & work.
- 9. Concluding Remarks and Scope for the Future Work.

10. Completed documentation in the form of project report is to be submitted at the end of semester.

H. Review – I: during Mid Semester Examination as per the Academic Calendar.

I. Review – II: The last week of the Semester.

#### **Instructions for Report Writing**

It is important that the procedures listed below be carefully followed by all the students of Final Year B. Tech. (Automation and Robotics).

- 1. Prepare Three Spiral Bound Copies of your manuscript.
- 2. Limit your Dissertation report to 60-80 pages (preferably)
- 3. The footer must include the following:

Institute Name, Final Year B. Tech. (Automation and Robotics) Times New Roman 10 pt. and centrally aligned.

- 4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.
- 5. Print the manuscript using
- a) Letter quality computer printing.
- b) The main part of manuscript should be Times New Roman 12 pt. with alignment justified.
- c) Use 1.5 line spacing.
- d) Entire report shall be of 5-7 chapters
- 6. Use the paper size  $8.5^{\circ} \times 11^{\circ}$  or A4 (210  $\times$  197 mm). Please follow the margins given below.
- 7. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each

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paragraph will begin with without any indentation.

8. Section titles should be bold with 14 pt. typed in all capital letters and should be left aligned.

9. Sub-Section headings should be aligning at the left with 12 pt. bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

a) Illustrations should not be more than two per page. One could be ideal

b) Figure No. and Title at bottom with 12 pt.

c) Table No. and Title at top with 12 pt.

d) Legends below the title in 10 pt.

e) Leave proper margin in all sides

f) Illustrations as far as possible should not be photo copied.

11. Photographs if any should be of glossy prints

12. Please use SI system of units only.

13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only

16. Following will be the order of report

i. Cover page and Front page (as per the specimen on separate sheet)

ii. Certificate from the Institute (as per the specimen on separate sheet)

iii. Acknowledgements

iv. Contents

v. List of Figures

vi. List of Tables

vii. Nomenclature

viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt. and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

#### 1. Introduction (2-3 pages) (TNR – 14 Bold)

- 1.1 Problem statement (TNR 12)
- 1.2 Objectives
- 1.3 Scope

1.4 Methodology

1.5 Organization of Dissertation

#### 2. Literature Review (20-30 pages)

Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

**3.** This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15- 20 pages)

4. Experimental Validation - This chapter shall be based on your own experimental work (15- 20 pages)

5. Concluding Remarks and Scope for the Future Work (2-3 pages)

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Dr. R. K. Jain Director RSCOE, Pune References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3,. And for subheadings 1.1, 1.2, ....etc and section subheadings 2.1.1, 2.1.2, .... etc.

18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citatation of it. Please follow the following procedure for references

Margin Location Paper	Paper 8.5"x 11"	Paper A4(210 x 197mm)
Тор	1"	25.4 mm
Left	1.5"	37 mm
Bottom	1.25"	32 mm
Right	1"	25.4 mm

Oral examination based on the project completed in the semester. The Performance will be assessed jointly by internal and external examiners.

- Total marks for Assessment 250
- It should be continues assessment where performance is judged based on the performances
- Oral at the end of semester Total 250 to be recommended

#### **Text Books:**

**T1**. Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

#### **Reference Books:**

R1. Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90–98.

R2. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.

#### Papers from Journal or Transactions :

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

#### **Papers from Conference Proceedings :**

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

#### Reports, Handbooks etc. :

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

#### Patent :

Patent no, Country (in parenthesis), date of application, title, year.

#### Internet :

www.(Site) [Give full length URL] accessed on date

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#### **JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33** (An Autonomous Institute Affiliated to Savitribai Phule Pune





#### **Final Year B. Tech. (Automation and Robotics)** Academic Year - 2024-2025 Semester -VIII **TRACK- (B) - FULL SEMESTER INTERNSHIP AR4109 - Industrial Internship**

	Industrial Internsting	
Teaching Scheme: LAB:20 Hours/Week	Credit LAB:10	Examination Scheme: LAB Evaluation : 150 Marks Term Work : 200 Marks
Course Prerequisites:		
Course Objective:		
• To get an opportunity to observe curren	t technological development	nts relevant to the subject
• To opportunities to learn, understand an	d sharpen the real time tech	hnical skills
• To gate exposure to the industrial enviro	onment	
• To nurture professional and societal eth	ics.	
• To create awareness of social, economic	c and administrative consid	erations in the working
environment of industry organizations.		
Course Outcome:		
After successful completion of the course, st	udents will able to:	
<b>CO1:</b> Understand the attitudes and approach	of the workers to problem	solving
<b>C02:</b> Gain experience in writing technical re	eports	
<b>C03:</b> Create competent professional environ	ment	
<b>C04:</b> Choose appropriate technology and too	ols to solve given problem	
<b>C05:</b> Analyze various career opportunities a	nd decide career goals.	
<b>C06:</b> Demonstrate abilities of a responsible	professional and use ethica	l practices in day-to-day life.
	Course Contents	
Guidelines for students		
1. The candidate should submit a syn	nopsis of the proposed w	ork to be done during Internship
programme to department.		
2. Two guides will supervise the interns	ship project work, one from	the department and another
one from industry		
3. Minimum 3 monthly evaluations/revi	ews	
4. Industry must submit the month-wise	satisfactory attendance of	the students to the
institute/department	u mhiah ia ta anltinata tha h	abit of dominanting
5. Student must regularly use daily diary	y which is to cultivate the r	labit of documenting
o. The presentation is way to evaluate s	ludent performance, so stud	lent must be ready as they
7. Student must submit a comprehensive	and external examiner a report to the department h	afore presentation
Duration:		before presentation
Internship is to be completed after seme	ester 6 and before commen	cement of semester 7 of at least 20
to 24 weeks: and it is to be assessed and	evaluated in semester 6	cement of semester 7 of at least 20
Steps to apply for internship	e valuated in semester o.	
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	2	
Dr. A. M. Badadhe Dr.	. Kam Joshi	Dr. R. K. Jain

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1 Student ask for permission Letter from the office of Training & Placement cell of the college with consultation of guide (institute) to allot various slots of 4-6 weeks during as internship periods

2 Students on joining Training at the concerned Industry must submit the permission letter from the office of Training & Placement cell of the college

3 Student must regularly use daily diary to record the details and submit attendance in internship report

4 Students will be obtained Training Certificate from industry

5 Students will submit training report after completion of internship to guide

#### **Internship Diary/ Internship Workbook:**

Students must maintain Internship Diary/Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor. Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

#### **Evaluation process for internship**

1 Students must submit training report and training certificate from industry after completion of internship to guide.

2 Guide will the student performance through presentation which is evaluated by institute guide, internal and external examiner.

#### **Internship Report:**

A report containing maximum 60 pages should be submitted based on the industry in-plant training, Internship completion certificate, Internship Place Details- Company background-organization and activities/Scope and object of the study / Supervisor details, background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review carried out, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions, Suggestions / Recommendations for improvement to industry, if any extracted and proposed future work (if any), Attendance Record followed by acknowledgement referencing and appendices (if any)

#### **Guidelines for Assessment**

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks for Assessment 350
- College will give Internship Diary/ Internship Workbook internee has to filled infront of Company Engineer.
- It should be continues assessment where performance is judged based on the performance reports submitted by the Faculty Guide and Project/Company engineer allotted by Company on weekly attendance/reporting/weekly performance reports. At the end Practical/Oral at the end of semester Term Work 200 Marks +Oral Exam150Marks Total 350 to be recommended

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## Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (C) - HIGHER STUDIES AND RESEARCH

AR4110 – Research Methodology				
Teaching Scheme:		Credit	Examination Sch	eme:
TH:03 Hours/Week		TH:03	In Sem. Evaluation	on:15 Marks
LAB:02 Hours/Week		LAB:01	Mid Sem. Exam:	25 Marks
			End Sem. Exam	: 60 Marks
			LAB Evaluation	: 25 Marks
Course Prerequisites:				
Course Objective:				
• Learn to focus on Re	search, Problem	selection and literature r	eview using scientific	e methods.
Learn about Research	h methodologies	for data analysis, graphi	cal representation and	l technical
report writing and do	ocumentation.			
Course Outcome:				
After successful completion	of the course, stu	idents will able to:		
<b>COI:</b> Analyze and select an	important and aj	ppropriate research probl	em.	
CO2: Review the various jo	urnal publication	is and books on the selec	ted topic	
<b>CO3:</b> Analyze the different	methodologies fo	or mathematical modelin	g and simulation.	
<b>CO4:</b> Learn about writing so	tance of intellect	ual property potents and do	converight	
<b>COS:</b> Onderstand the impor	cal and graphical	methods for the scientifi	copyright.	
COU. Appry various statistic			c analysis of data.	
Course Contents				
UNIT-I	Rese	arch Problem and For	mulation	08 Hours
Types of Research, Signific	ance of Research	Approaches, Research	Methods and Method	lology, Criteria
of good research, Feasibilit	y study of resear	ch problem, Criteria of	good research proble	em, Concept of
research formulation.				
UNIT-II	Litera	ture Survey and Resea	rch Ethics	08 Hours
Literature review and analysis, Research Ethics, Approaches of investigation and solution, data collection,				
Data analysis by software and interpretation.				
UNIT-III	Mathe	matical Modeling and	Simulation	08 Hours
Concepts of modeling – Cla	ssification of ma	thematical models – Mo	deling with – Differe	ntial equations –
Partial differential equations	– Graphs – Proc	ess of model formulation	n and simulation.	_
UNIT-IV		<b>Research Communica</b>	tion	07 Hours
Writing scientific paper, co	onference paper,	Technical report, Deser	rtation/ Thesis writin	g, Presentation
techniques, documentation software such as Word, Latex.				
techniques, documentation s	software such as	Word, Latex.		
UNIT-V	software such as	Word, Latex. Intellectual Property	7	07 Hours
UNIT-V       Types of Intellectual Proper	ty: Patents, Desig	Word, Latex. Intellectual Property ons, Trademarks and Cop	yright. Process of Pa	07 Hours tenting and
UNIT-V       Types of Intellectual Proper	ty: Patents, Desig	Word, Latex. Intellectual Property gns, Trademarks and Cop	yright. Process of Pa	07 Hours tenting and
UNIT-V Types of Intellectual Proper	ty: Patents, Desig	Word, Latex. Intellectual Property gns, Trademarks and Cop	y pyright. Process of Pa	07 Hours tenting and
Types of Intellectual Proper	ty: Patents, Desig	Word, Latex. Intellectual Property gns, Trademarks and Cop	yright. Process of Pa	07 Hours tenting and K. Jain
Types of Intellectual Proper Dr. A. M. Badadhe BOS Chairman (A & R)	ty: Patents, Desig U Dr. Dean	Word, Latex. Intellectual Property gns, Trademarks and Cop July Ram Joshi Academics	yright. Process of Pa Dr. R. Dr. R. Director R	07 Hours tenting and K. Jain SCOE, Pune

Development: technological research and innovation, International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patent Rights. Licensing and transfer of technology. Patent information and databases. INTERPRETATION AND REPORT WRITING: Techniques of interpretation, precautions in interpretation, significance of report writing, different steps in report writing, layout of research report, mechanics of writing research report. **UNIT-VI** 07 Hours **Quantitative Techniques and Statistics** Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation, Uni-variate and bi-variate analysis of data, techniques such as ANOVA, Chi-square test and Nonparametric tests. PROCESSING AND ANALYSIS OF DATA Use of statistics for data analysis, measures of central tendency, dispersion, skewness and relationship. Sampling distributions, sampling theory, determination of sample size, chi-square test, analysis of variance, multiple regression analysis, neural networks. Lab Contents The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), Autonomous syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references. **Guidelines for Assessment** Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners. Total marks assigned are 25. Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file Final practical examination for specific practical and oral examination will be conducted 1 Case study on different steps involved in a research process 2 Case study on defining a research problem 3 Case study on Developing a Research Plan 4 Case study on Sampling Design 5 Case study on Measurement and Scaling Techniques 6 Case study on Methods of Data Collection Descriptive Analysis through SPSS -Frequency distribution, Measures of Central Tendency 7 Defining Mean, Median, Mode, Minimum, Maximum, etc. 8 Writing a research proposal based on the problem identification 9 Writing a research paper based on the research proposal **Text Books:** T1. C.R Kothari "Research Methodology" Wishwa Prakashan, ISBN: 8173280363 T2. P.G Triphati "Research Methodology" Sultan Chand & Sons, New Delhi. T3. J. W Barnes, "Statistical Analysis for Engineers and Scientists" McGraw Hill, New York. ISBN: 0078396085

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T4. Ranjit Kumar "Research Methodology" Pearson Education, ISBN: 9788131704967

T5. R. V. Rao "Decision making in the manufacturing environment using graph theory and fuzzy multiple attribute decision making" Springer-Verlag, London. ISBN: 1846288193

T6. Rao S. S., "Optimization", Wiley Eastern, New Delhi, 1995. ISBN: 0471550345

#### **Reference Books:**

R1.Gupta S.L. and Gupta Hitesh (2011), "Research Methodology-Text and cases with SPSS applications" International Book House Pvt. Ltd., New Delhi

R2. Product Design by Niebel, McGraw Hill

R3. Introduction to Design by Asimov, Prentice Hall

R4. Resisting Intellectual Property by Halbert, Taylor & Francis Ltd, 2019.

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Dr. A. M. Badadhe BOS Chairman (A & R)

Dr. R. K. Jain **Director RSCOE**, Pune



#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phule Pune



(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

#### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (C) - HIGHER STUDIES AND RESEARCH A R4111- Innovation and Design thinking for Robotics and Automation

ARTIII- Innovation and Design thinking for Robotics and Automation			
Teaching Scheme:	Credit	Examination Scheme:	
TH: 03 Hours/Week	TH:03	In Sem. Evaluation:15 Marks	
		Mid Sem. Exam: 25 Marks	
		End Sem. Exam : 60 Marks	

#### **Course Prerequisites:**

#### **Course Objective:**

- Has a special focus on skill development through active engagement in real world problems.
- To familiarize students with basic of systems and its design.
- This course covers the design, material selection, construction, and testing of the robotic systems
- To understand the concepts of Computer Aided Design

#### **Course Outcome:**

After successful completion of the course, students will able to:

CO1: Generate and develop design ideas through different technique

CO2: Identify the significance of reverse engineering to understand products

CO3: conceive, organize, lead, implement, and evaluate successful projects in any robotics and automation discipline

**CO4:** Students able to identify the materials used for the development of different robotic systems.

CO5: Demonstrate and understanding of the concepts of various design methodology

**CO6:** Understanding of the concepts of Advanced topics on Robotics Design

#### **Course Contents**

UNIT-I	Preparing Your Mind for Innovation	<b>08 Hours</b>

Experimentation

 UNIT-II
 Idea Generation
 06 Hours

UNIT-IIIdea Generation06 HoursThe Idea Generation Process - The Me You Health Story Part I: What Is? - The Me You Health Story<br/>Part II: What If? - Mind Mapping ToolIdea Generation

#### UNIT III

The IBM Story - Learning Launch Tool - Strategic Opportunities – case studies relevant to Robotics and Automation

**UNIT-IV** 

Design Thinking

08 Hours

06 Hours

Introduction to Design Thinking - What Is Design Thinking? - The Good Kitchen Story - Business Model Innovation - Challenges Best-Suited for Design Thinking - Visualization Tool

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UNIT-V	Embodiment Design for Robotics	<b>08 Hours</b>
Embodiment in Philoso	ophy and Ethics, Embodiment in Psychology and Communication, En	mbodiment
in Robotics and Design	n, Design Space, Design Paradigms, Behavior Design, Product Archit	tecture –
arrangement of the phy	vsical functions, Configuration Design – preliminary selection of mat	erials,
modeling and size of pa	arts, Parametric Design – creating a robust design, and selection of fi	nal
dimensions/parameters	and tolerances	
UNIT-VI	Advanced Topics on Robotics Design	<b>08 Hours</b>
Fabrication of different	t joints, Hands on practice and assignments for 3D design, Introduction	on to Bio-
inspired design of robo	t, Basic concepts on Sensor design.	
Text Books:		
T1. M.F. Ashby, Mater	ials Selection in Mechanical Design, 3rd Ed., Elsevier, 2005	
T2. Ibrahim Zied, CAD / CAM: Theory and Practice, McGraw-Hill,2014		
T3. Plan ET, Khandani S. Engineering design process,2005		
Reference Books:		
R1. Hugh Jack, Engineering Design, Planning, and Management, 1st Edition		
R2. Gerhard Pahl, and Wolfgang Beitz. Engineering design: a systematic approach. Springer Science		
& Business Media, 2013.		
R3. Wang, Wanjun. "Sensors and Actuators in Mechatronics." Mechatronics in Engineering Design		
and Product Development (1998): 15-16.		
R4. Taya, Minoru, Makoto Mizunami, Elizabeth Van Volkenburgh, and Sh-hei Nomura. Bioinspired		
actuators and sensors.	Cambridge University Press, 2016.	-
R5. Gomis - Bellmunt, Oriol, and Lucio Flavio Campanile. Design rules for actuators in active		
mechanical systems. Springer Science & Business Media, 2009.		

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Dr. R. K. Jain Director RSCOE, Pune



#### **JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33** (An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)



## **Final Year B. Tech. (Automation and Robotics)** Academic Year - 2024-2025 Semester -VIII **TRACK- (C) - HIGHER STUDIES AND RESEARCH**

AR4112 - Product Life Cycle Management				
Teaching Scheme: TH: 03 Hours/Week		Credit TH:03	Examination Scheme In Sem. Evaluation: 1 Mid Sem. Exam: 25 End Sem. Exam : 6	: 5 Marks Marks 60 Marks
Course Prerequisites:				
Course Objective:				
Familiarize with	i various strategi	es of PLM.		
• Understand the	concept of produ	ct design and simulation.		
Develop New p	roduct developm	ent, product structure and su	ipporting systems	
• Interpret the tec	hnology forecast	ing and product innovation	and development in bus	iness
processes.	duct building and	Product Configuration		
Course Outcome:	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		
CO1. Explain the vorie	stion of the cours	e, students will able to: I M and Broduct Data Man	agamant	
<b>CO1:</b> Explain the variation of the control of the	ous strategies of r	t design and model simulat	ion	
<b>CO3:</b> Apply the concer	of New Produc	t Development and its struct	turing	
<b>CO4:</b> Analyze the tech	nological forecas	ting and the tools in the inn	ovation.	
<b>CO5:</b> Apply the virtual	product develor	ment and model analysis.		
<b>CO6:</b> Create the aware	ness knowledge	and optimization of design p	products & digital manu	facturing
Course Contents				
UNIT-I	Introduction	n To Product Life Cycle M	Ianagement(PLM)	08 Hours
Definition, PLM Lifecy	cle model, Threa	ads of PLM, Need for PLM,	Opportunities and bene	efits of
PLM, Views, Compone	nts and Phases o	f PLM, PLM feasibility stud	dy, PLM visioning.	
UNIT-II	PLN	I Concepts, Processes and	Workflow	06 Hours
Characteristics of F	LM, Environn	nent driving PLM,PLM	Elements, Drivers	of PLM,
Conceptualization, Design, Development, Validation, Production, Support of PLM.				
UNIT III	Product Data	a Management (PDM) Pro	cess and Workflow	06 Hours
PDM systems and impo	ortance, reason fo	or implementing a PDM syst	tem, financial justificati	on of PDM
implementation. Versioning, check-in and checkout, views, Metadata, Lifecycle, and workflow.				
Applied problems and solution on PDM processes and workflow.				
UNIT-IV	C	ollaborative Product Deve	lopment	08 Hours
Engineering vaulting, product reuse, smart parts, engineering change management, Bill of materials				
and process consistency	y, Digital mock-	up and prototype developm	ent, design for environ	nent, virtual
testing and validation, r	narketing collate	ral.		
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- ILVI				
Dr. A. M. Badadh	5	Dr. Kam Joshi	Dr. R.	K. Jain
BUS Chairman (A &	. K)		Director RS	SCOE, Pune

Director RSCOE, Pune

UNIT-V	Tools of Communication for Collaborative Work	<b>08 Hours</b>	
Embodiment in Philos	ophy and Ethics, Embodiment in Psychology and Communication, En	mbodiment	
in Robotics and Design	n, Design Space, Design Paradigms, Behavior Design, Product Archit	ecture –	
arrangement of the phy	vsical functions, Configuration Design – preliminary selection of mate	erials,	
modeling and size of p	arts, Parametric Design - creating a robust design, and selection of fi	nal	
dimensions/parameters	s and tolerances		
UNIT-VI	Knowledge and Optimization of Design Products & Digital	08 Hours	
	Manufacturing – PLM	00 110015	
Know how, best practi	ces, parameterization of design, Applied problems and Solution on op	otimization	
of products using powe	er copy, publication, parameters, formula, rule, check, design table,		
configuration, reaction			
Digital manufacturing,	benefits manufacturing, manufacturing the first-one, Ramp up, virtua	al learning	
curve, manufacturing t	he rest, production planning.		
Text Books:			
T1. Stark, John. Produc	ct Lifecycle Management: Paradigm for 21st Century Product Realisa	ation,	
Springer-Verlag, 2004. ISBN 1852338105			
T2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach,			
Taylor & Francis 2020			
Reference Books:			
R1. Saaksvuori Antti/ Immonen Anselmie, product Life Cycle Management Springer, Dreamtech, 3-			
540-25731-4			
R2. Product Lifecycle	Management, Michael Grieves, Tata McGraw Hill		

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Dr. R. K. Jain Director RSCOE, Pune



#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phule Pune



(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

## Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (D) - ENTREPRENEURSHIP

**AR4113 - Economics and Finance Management Teaching Scheme:** Credit **Examination Scheme:** TH: 03Hours/Week **TH:03** In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Course Prerequisites: The student should have knowledge on Economics and Finance Terms **Course Objective:** • Develop the ability to explain core economic terms, concepts, and theories. Explain the function of market and prices as allocative mechanisms Identify the basic financial environment and institutions. Perform analytical reviews of financial results, proposals, and plans. **Course Outcome:** After successful completion of the course, students will able to: **CO1:** Define the key terms in economics CO2: Make use of the basic concepts of Demand, Supply, Demand Forecasting, Equilibrium and their determinants CO3: Analyze cost function and the difference between short-run and long-run cost function and establish the relationship between production function and cost function. CO4: Explain the basic concepts related to Accounting **CO5:** Analyze the importance of Financial Statements in an Organisation **CO6:** Analyze the importance of Cost statements in an Organisation **Course Contents UNIT-I Introduction to Economics 08 Hours** Managerial Economics: Concept of Economics, Microeconomics and Macroeconomics, Basic Economic Problem, Circular Flow of Income in two, Three and Four Sectors, Nature and Scope of Managerial Economics, Managerial Economics and decision-making, Concept of Firm, Objectives of Firm: Profit Maximization and Wealth Maximization, Role of Profit in Market System, Adam Smith and Invisible Hand **UNIT-II 08 Hours Supply Analysis** Introduction, Meaning of Supply and Law of Supply, Exceptions to the Law of Supply, Changes or Shifts in Supply. Elasticity of supply, Factors Determining Elasticity of Supply, determinants of supply, supply schedule, supply curve and its slope, movements along and shifts in supply curve, price elasticity of supply; measurement of price elasticity of supply - (a) percentage change method and (b) geometric method **UNIT III Market Structure 08 Hours** 

Introduction, Market and Market Structure, Perfect Competition, Price-Output Determination under Perfect Competition, Short-run Industry Equilibrium under Perfect Competition, Short-run Firm Equilibrium under Perfect Competition, Long-run Industry Equilibrium under Perfect Competition, Long-run Firm

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Dr. Ram Joshi Dean Academics

Dr. R. K. Jain Director RSCOE, Pune

Equilibrium under Perfect Competition. Pricing Under Monopolistic Competition Introduction, Monopoly, Price Discrimination under Monopoly, Break Even analysis       08 Hours         Ountread       08 Hours         Forms of Business Organization. Meaning and Importance of Accounting in Business Organization, Basic concepts and terms used in accounting, Capital & Revenue Expenditure, Capital & Revenue Receipts, Users of Accounting Information. Accounting Concepts and Conventions, Fundamental Accounting Equation, Journal, Ledger and Trial Balance.       08 Hours         Meaning of Financial Statements       Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary firm.       08 Hours         UNIT-VI       Short Term Business Decision Techniques – Marginal Costing       08 Hours         Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.       Text Books:         T1. Management Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni       Reference Books:       Reference Books:         R1. Financial Cost and Management, S. N. Maheshwari R4. Management Accounting, F. N. Maheshwari R4. Management Accounting, Madhu Vij       On-Line resources:       I. experian.com         0. experian.com       2. alipay.com       3. bin// (waw isee ac in/onlineresources brul       Imagement Accounting       Imagement brul				
Price Discrimination under Monopoly, Break Even analysis           UNIT-IV         Introduction to Accounting         08 Hours           Forms of Business Organization. Meaning and Importance of Accounting in Business Organization, Basic concepts and terms used in accounting, Capital & Revenue Expenditure, Capital & Revenue Receipts, Users of Accounting Information. Accounting Concepts and Conventions, Fundamental Accounting Equation, Journal, Ledger and Trial Balance.         08 Hours           UNIT-V         Financial Statements         08 Hours           Meaning of Financial Statements, Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary firm.         08 Hours           UNIT-VI         Short Term Business Decision Techniques – Marginal Costing         08 Hours           Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions – Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.           Text Books:         T1. Management Accounting, H. V.Jhamb         T3. Managerient Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting for Management, S. N, Maheshwari R4. Management Accounting, Madhu Vij           On-Line resources:         1. experian.com         2. alipay.com         3. btrue	Equilibrium under Perfect Competition. Pricing Under Monopolistic Competition Introduction, Monopoly,			
UNIT-IV         Introduction to Accounting         08 Hours           Forms of Business Organization. Meaning and Importance of Accounting in Business Organization, Basic concepts and terms used in accounting, Capital & Revenue Expenditure, Capital & Revenue Receipts, Users of Accounting Information. Accounting Concepts and Conventions, Fundamental Accounting Equation, Journal, Ledger and Trial Balance.         08 Hours           UNIT-V         Financial Statements         08 Hours           Meaning of Financial Statements, Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary Tirm.         Short Term Business Decision Techniques – Marginal Costing         08 Hours           Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.         Text Books:           T1. Management Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni         Reference Books:         R1. Financial Cost and Management, Accounting, P.Periasamy         R2. Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari R4. Management Accounting, Madhu Vij         On-Line resources:         1         experian.com         2         alipay.com         3         3         Adustry of Management Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management	Price Discrimination under Monopoly, Break Even analysis			
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Users of Accounting Information. Accounting Concepts and Conventions, Fundamental Accounting Equation, Journal, Ledger and Trial Balance.           UNIT-V         Financial Statements         08 Hours           Meaning of Financial Statements, Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary firm.         08 Hours           UNIT-VI         Short Term Business Decision Techniques – Marginal Costing         08 Hours           Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.           Text Books:         T1. Management Accounting, Khan and Jain, Tata McGraw Hill T2. Fundamentals of Management Accounting, H. V.Jhamb T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni           Reference Books:         R1. Financial Cost and Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari R4. Management Accounting, Madhu Vij           On-Line resources:         1. experian.com 2. alipay.com           1. experian.com 2. alipay.com         1. hipplicate ac in/online resources html	concepts and terms used in a	ccounting, Capital & Revenue Expenditure, Capital & Revenu	ie Receipts,	
Equation, Journal, Ledger and Trial Balance.       68 Hours         UNIT-V       Financial Statements       08 Hours         Meaning of Financial Statements, Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary firm.       08 Hours         UNIT-VI       Short Term Business Decision Techniques – Marginal Costing       08 Hours         Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.       Text Books:         T1. Management Accounting, Khan and Jain, Tata McGraw Hill       72. Fundamentals of Management Accounting, H. V.Jhamb       73. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni         Reference Books:       R1. Financial Cost and Management Accounting, P.Periasamy       R2. Financial Cost and Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari R4. Management Accounting, Madhu Vij       On-Line resources:       1       experian.com         1. experian.com       2. alipay.com       3       http://www ieec ac in/onlineresources html       5	Users of Accounting Informa	ation. Accounting Concepts and Conventions, Fundamental Ad	ccounting	
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Meaning of Financial Statements, Importance and Objectives of Financial Statements. Preparation of Final Accounts of sole proprietary firm.       VNIT-VI       Short Term Business Decision Techniques – Marginal Costing       08 Hours         Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.       Text Books:         T1. Management Accounting, Khan and Jain, Tata McGraw Hill       T2. Fundamentals of Management Accounting, H. V.Jhamb       T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni         Reference Books:       R1. Financial Cost and Management Accounting, P.Periasamy         R2. Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari         R4. Management Accounting, Madhu Vij         On-Line resources:         1. experian.com         2. alipay.com         3. http://www.isec.ac.in/onlineresources.html	UNIT-V	Financial Statements	00 11001 5	
Accounts of sole proprietary firm.         UNIT-VI       Short Term Business Decision Techniques – Marginal Costing       08 Hours         Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.         Text Books:       T1. Management Accounting, Khan and Jain, Tata McGraw Hill T2. Fundamentals of Management Accounting, H. V.Jhamb T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni         Reference Books:       R1.Financial Cost and Management Accounting, P.Periasamy R2.Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari R4. Management Accounting, Madhu Vij         On-Line resources:       1. experian.com         1. experian.com       3. alipay.com         3. http://www.isec.ac.in/onlineresources.html       Hill	Meaning of Financial Statem	ents, Importance and Objectives of Financial Statements. Prep	paration of Final	
UNIT-VI         Short Term Business Decision Techniques – Marginal Costing         08 Hours           Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.         Text Books:           T1. Management Accounting, Khan and Jain, Tata McGraw Hill T2. Fundamentals of Management Accounting, H. V.Jhamb T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni T4. Management Accounting, Dr. Mahesh Kulkarni         Reference Books:           R1. Financial Cost and Management Accounting, P.Periasamy R2. Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning R3. Accounting For Management, S. N. Maheshwari R4. Management Accounting, Madhu Vij         On-Line resources:           1. experian.com         2. alipay.com         3. http://www.iscc.ac.ip/onlineresources.html	Accounts of sole proprietary	firm.		
Meaning, Principles, Advantages and Limitations, Contribution, P/V Ratio, Break-Even Point (BEP), Cost         Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy         (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions. <b>Text Books:</b> T1. Management Accounting, Khan and Jain, Tata McGraw Hill         T2. Fundamentals of Management Accounting, H. V.Jhamb         T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni         T4. Management Accounting, Dr. Mahesh Kulkarni <b>Reference Books:</b> R1. Financial Cost and Management Accounting, P.Periasamy         R2. Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning         R3. Accounting For Management, S. N. Maheshwari         R4. Management Accounting, Madhu Vij <b>On-Line resources:</b> 1. experian.com         2. alipay.com         3. http://www.isec.ac.in/onlineresources.html	UNIT-VI	Short Term Business Decision Techniques – Marginal	08 Hours	
<ul> <li>Volume Profit (CVP) Analysis, Short Term Business Decisions–Product Mix Decisions, Make or Buy (Outsourcing) Decisions, Accept or Reject Special Order Decisions, Shutting Down Decisions.</li> <li><b>Text Books:</b> <ul> <li>T1. Management Accounting, Khan and Jain, Tata McGraw Hill</li> <li>T2. Fundamentals of Management Accounting, H. V.Jhamb</li> <li>T3. Managerial Accounting, Dr. Mahesh Abale and Dr. Shriprakash Soni</li> <li>T4. Management Accounting, Dr. Mahesh Kulkarni</li> </ul> </li> <li><b>Reference Books:</b> <ul> <li>R1. Financial Cost and Management Accounting, P.Periasamy</li> <li>R2. Financial Accounting for Management, Shankarnarayanan Ramanath, CENGAGE Learning</li> <li>R3. Accounting For Management, S. N. Maheshwari</li> <li>R4. Management Accounting, Madhu Vij</li> </ul> </li> <li><b>On-Line resources:</b> <ul> <li>experian.com</li> <li>alipay.com</li> <li>http://www.isce.ac.in/onlineresources.html</li> </ul> </li> </ul>	Maaning Principles Advent	costing	oint (BED) Cost	
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3 http://www.isec.ac.in/onlineresources.html	2. alipay.com			
5. http://www.isec.ac.in/oninteresources.num	3. http://www.isec.ac.ir	n/onlineresources.html		

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Dr. R. K. Jain Director RSCOE, Pune



#### JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33 (An Autonomous Institute Affiliated to Savitribai Phyle Pune



(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

### Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VII TRACK- (D) - ENTREPRENEURSHIP

#### **AR4114 - Industrial Management & Operations Research**

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week	TH:03	In Sem. Evaluation:15 Marks
		Mid Sem. Exam: 25 Marks
		End Sem. Exam : 60 Marks

#### **Course Prerequisites:**

#### **Course Objective:**

- To make aware students about Industrial Management concepts.
- To understand the importance of inspection, quality, and standards.
- To understand the use of IT, Ethics and Modern tools in industries.
- To understand the concept in operation research
- To understand the Transportation and Network models and various techniques to solve them.
- To understand Game Theory and Sequencing models and various techniques to solve them.

#### **Course Outcome:**

After successful completion of the course, students will able to:

CO1: Apply the different management concepts and tools for given business situation

**CO2:** Explain the importance of quality and environmental standards.

- **CO3:** Explain ethical practices, Role of Information Technology and use modern tools
- **CO4:** Describe characteristics and scope of operation research and formulate mathematical problems
- CO5: Build and solve Transportation Models and Network Models.

CO6: Build and solve Game Theory and Sequencing Models.

#### **Course Contents**

UNIT-I	<b>Concepts of Industrial Management</b>	08 Hours
Managamant hugin	ass abarratoristics and alassifications types of business organizat	tions Morits and

Management, business characteristics and classifications, types of business organizations, Merits and Demerits, levels of management, Functions of management, Developing Business environment: SWOT analysis, BCG Matrix, Porter's 5 forces of competition. Management techniques for developing strategy: Balanced score card Performance Management and analysis techniques: Ishikawa diagrams, Business process Re-engineering

UNIT-II	Quality Management	08 Hours
Definition of quality	, goalpost view of quality, continuous improvement definition of	quality, types of
quality quality of	design conformance and performance phases of quality management	ent Juran's and

quality – quality of design, conformance and performance, phases of quality management, Juran's and Deming's view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke. Quality circles, TQM, Kaizen, 5S, Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard- ISO 27001:2005 Information Security Management System

UNIT III

Professional ethics, IT and e-business, Management tools

08 Hours

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Dr. A. M. Badadhe BOS Chairman (A & R) Dr. Ram Joshi Dean Academics

Dr. R. K. Jain Director RSCOE, Pune

Concept of Ethics, ethics and	l morals, Professional ethics, Introduction to Management Inf	ormation System			
(MIS), Enterprise Resource Planning Systems (ERP), e-business and strategies, Tools: P-D-C-A cycle,					
Total Quality Management (TQM), 5 Whys? '5 S', Kaizen, Introduction to Six sigma					
UNIT-IV	<b>Operation Research – An Introductions</b>	08 Hours			
The history of OR, Definition	on, Features, of OR, models, and modelling in OR, OR appr	roach to problem			
solving, methods for solving	g OR models, phases of OR, Advantages of OR study, Shor	rtcomings of OR			
approach, OR Models in Prac	ctice, Applications of OR.				
UNIT-V	Transportation Models and Network Models	08 Hours			
Transportation problem intro	oduction, mathematical model of transportation problem, Alg	gorithm, methods			
for finding initial solution n	orthwest corner method, least cost method, Vogel's Approx	imation method,			
test for optimality steps of	MODI method, maximization problem, unbalanced, degend	eracy, prohibited			
transportation Routes problem	m. . route Minimal anonning tree. Maximum flow models. F	Decidat patroals			
CPM and PEPT networks	route – Minimal spanning tree – Maximum now models – P	Toject network –			
	Come Theory and Sequencing	08 Hours			
	Game Theory and Sequencing	e mile Different			
Game Theory: Two-person Z	cero sum game, Solution with/without saddle point, dominance	e rule, Different			
Sequencing: Basic assumption	ons n Jobs through 2-3 machines 2 Jobs on m machines	ining.			
Taxt Books	sins, il 500s through 2-3 machines, 2 500s on in machines.				
T1 P Khanna "Industrial F	Engineering and Management" Dhannatrai publications I to N	Jew Delhi			
T <sub>2</sub> L C Ihamb Savitri Iha	amb Industrial Management – I Everest Publishing House	iew Denn.			
T3. P K Gupta and D S Hira	"Operations Research". S. Chand and Company LTD. Public	cations. New			
Delhi – 2007	,	·····, · · · · ·			
T4. Hamdy A. Taha, "Opera	ations Research, An Introduction", 7th Edition, PHI Private Lir	nited, 2006.			
Reference Books:					
R1. Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Cengage Learning, Second					
Edition, USA.		-			
R2. Davis and Margrethe H.	Olson, "Management Information Systems", Mc-Graw-Hill I	nternational			
Editions.					
R3. Azar Kazmi, "Strategic Management & Business Policy", Tata McGraw Hill, New Delhi					
R4. Gail Freeman- Bell and	R4. Gail Freeman- Bell and James Balkwill, "Management in Engineering" (PHI), 02nd Ed.				
R5.R. L. Daft, "The New Era of Management", THOMSON (India Edition), 11th Ed.					
Ro. Gene, Burton, Manao Thakur, Management Today – Principles and Practice, McGraw Hill, 02nd Ed R7 Hamdy A. Taha, "Operations Research" Pearson Publication					
R8. Stef Tijs, "Introduction to game theory", Hindustan Book Agency, New Delhi					
R9. A M Natarajan, P Balasubramani, "Operations Research", Pearson Education, 2005					
<b>On-Line resources:</b>					
1. <u>www.youtube.com/v</u>	watch?v=SF53ZZsP4ik				
2. <u>www.youtube.com/v</u>	watch?v=iPZlQ3Zx5zc				
3. <u>web.stanford.edu/cla</u>	ass/cee320/CEE320B/CPM/				
4. <u>www.netmba.com/o</u>	perations/project/pert/				
5. <u>https://onlinecourses</u>	<u>s.nptel.ac.in/noc22_ma48/preview</u>				
0. <u>nttps://arcnive.nptel.</u> 7 <u>https://archive.nptel</u>	ac.in/courses/112/100/112100134/				
7. <u>https://archive.nptel</u> .	.ac.111/courses/112/10//11210/143/				
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Dr. R. K. Jain Director RSCOE, Pune



#### **JSPM's RAJARSHI SHAHU COLLEGE OF ENGINEERING TATHAWADE, PUNE-33** (An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)



Director RSCOE, Pune

## Final Year B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -VIII TRACK- (D) - ENTREPRENEURSHIP

#### **AR4115 - Entrepreneurship Development for Robotics and Automation Teaching Scheme:** Credit **Examination Scheme: TH:03 Hours/Week** In Sem. Evaluation:15 Marks **TH:03**

LAB:02 Hours/Week	LAB:01	Mid Sem. Exam: 2 End Sem. Exam :	25 Marks 60 Marks
		LAB Evaluation :	25 Marks
<b>Course Prerequisites:</b>			
Course Objective:			
• Fundamentals of Business p	romotion process.		
• Fundamentals of Success in	business.		
• Ethics of Entrepreneurship			
<b>Course Outcome:</b>			
After successful completion of the c	course, students will able to:		
<b>CO1:</b> Recall the basics for entrepre	neurship		
<b>CO2:</b> Analyze the challenges in ent	repreneurship		
<b>CO3:</b> Examine the responsibilities	for entrepreneurship		
<b>CO4:</b> Understand the ethics in entre	epreneurship		
<b>CO5:</b> Analyze the support for entre	preneur		
<b>CO6:</b> Analyze the financial and acc	counting needs		
Course Contents			
UNIT-I	<b>Basics for Entrepre</b>	eneurship	08 Hours
The entrepreneurial culture and st	tructure -theories of entrepren	eurship -entrepreneurial t	raits - types -
behavioural patterns of entreprener	urs -entrepreneurial motivatior	n -establishing entrepreneu	urial systems -
idea processing, personnel, financia	al information and intelligence	, rewards and motivation of	concept bank -
Role of industrial Fairs.			
UNIT-II	Challenges for Entrep	oreneurship	08 Hours
Setting quality standards- recruit	ment strategies- time schedul	es- Financial analysis - c	credit facilities
Marketing channel – advertisemen	nt- institutions providing techn	ical, financial and market	ing assistance-
factory design -design requirement	ts -applicability of the Factories	s Act.	
UNIT-III	<b>Responsibilities in Entr</b>	epreneurship	08 Hours
Steps for starting a small industry -s	selection of type of organization	n -Incentives and subsidies	- Central Govt.
schemes and State Govt. Schemes	-incentives to SSI -registration	, Registration and Licensir	ng requirements
for sales tax, CST, Excise Duty -H	Power -Exploring export possi	bilities- incentives for exp	ports -import of
capital goods and raw material	s- Entrepreneurship developr	nent programmes in Ind	dia- Role and
An C		C.E.	
-TIM>	KINIL		
Dr. A. M. Badadhe	Dr. Ram Joshi	Dr. R. I	K. Jain

10.1 Dr. A. M. Badadhe BOS Chairman (A & R)

Dr. Ram Joshi **Dean Academics** 

	UNIT-IV	Ethics in ENTREPRENEURSHIP	07 Hours
Effe	ctive Costumer Care -N	Mechanism for Handling Complaints - Business Etique	ttes and Body Language
- Eth	nics, Values and Morale	e at Workplace - Managing Ethical Behaviour at Work	place
	UNIT-V	Support to Entrepreneurs	07 Hours
Sickn	ess in small Business –	Concept, Magnitude, Causes and Consequences, Corre	ective Measures -
– Exp	ansion. Diversification	Joint Venture, Merger and Sub Contracting	ategies in small industry
<u></u>	UNIT-VI	Financing and Accounting	07 Hours
Need Capita	– Sources of Finance, al, Costing, Break Even	Term Loans, Capital Structure, Financial Institution, M Analysis, Taxation – Income Tax, Excise Duty – Sale	Management of working s Tax.
-		Lab Contents	
The need Auto objec	instructor's manual is to to include prologue nomous syllabus, con ctives, outcomes, set of	to be developed as a hands-on resource and reference. T (about University/program/ institute/ department/fo nduction & Assessment guidelines, topics under Etypical applications/assignments/ guidelines, and refer	The instructor's manual reword/ preface etc), consideration-concept, rences.
		Guidelines for Assessment	
Fina	<ul> <li>Total marks assigne</li> <li>Continuous assessm submission of lab fi</li> <li>l practical examination</li> </ul>	ed are 25. nent will be carried out based on attendance, lab performile if for specific practical and oral examination will be condu	nance, and timely
1	Apply creativity to ide	entify a problem from a selected domain and provide inno	vative solution for it.
2	Apply Design Thinkin	ng for solving a problem selected in workshop	
3	3 Make a presentation on understanding of Entrepreneurial mindset		
4 Visit to Industries & Interaction with Successful Entrepreneur			
5 Prepare company Profile- Name, Logo, Vision, Mission, Quality policy and visiting card.			
6 Develop a startup company website.			
7 Prepare a Business Plan- Goals, target market, revenue chart.			
8 Prepare Business Proposal- Discussion about how budget and funds will be used.			
9 Prepare market plan- developing new products/services, choosing the right price, place and promotion and brand development			
Refer	ence Books:		
Rí Rí	1. Mariana Mazzucato, 5 2. Thomas Zimmerer et. Pearson Education, 20 3. Greene, Entrepreneur	Strategy for Business- A Reader, SAGE Publications 2 .al., Essentials of Entrepreneurship and small business 1 008.	002 Management 3rd Ed.
R4	4. Edward Freeman, Sar Ethics, 2002.	nkaran Venkataraman "Ethics and Entrepreneurship" Se	ociety for Business
D	5 Dobort Crossey Dovel	los Cumming Christing Mallin Entrennen aurohin Com	ornance and Ethics

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