



DEPARTMENT OF AUTOMATION AND ROBOTICS

Department of AUTOMATION and ROBOTICS B. Tech Structure (2023 Pattern)

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



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.

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



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.

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

Dr. Ram Joshi Dean Academics, 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.

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



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.







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

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

II. EntrepreneurIV. In house Project

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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



JSPM's

RAJARSHI SHAHU COLLEGE OF ENGINEERING





F. Y. B. Tech. Automation and Robotics

Academic Year -2024-2025 (Semester –I)

(Level 4.5- UG Certificate) -Semester – I

Course	Course	Course	Te	achin	ig Sch	eme	Credit	t Examina ISE MS		n Schem	ie	Total	Okin
Course	Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownership
BSC	ES1201T	Engineering Mathematics-I	3	1	0	4	4	20	30	50	50	150	Mathematics
BSC	ES1207T	Chemistry for Engineers	3	0	0	3	3	20	30	50	-	100	Chemistry
BSC	ES1207L	Chemistry for Engineers Laboratory	0	0	2	2	1	ISC	CE: 30	20	-	50	Chemistry
ESC	ME1201L	Workshop Practice	0	0	4	4	2	ISC	E: 60	40	-	100	Mechanical
HSSM (AEC)	HS1202T/ HS1203T/ HS1204T/ HS1205T	Professional English Communication /English Language skills /German/ Japanese	2	0	0	2	2	20	20 30		-	100	Humanities
HSSM (AEC)	HS1202L/ HS1203L/ HS1204L/ HS1205L	Professional English Communication /English Language skills /German/ Japanese	0	0	2	2	1	ISCE: 30		20	-	50	Humanities
ESC	EC1201T	Basic Electronics Engineering	2	0	0	2	2	20	20 30		-	100	E&TC
ESC	EC1201L	Basic Electronics Engineering Laboratory	0	0	2	2	1	ISC	CE: 30	20	-	50	E&TC
ESC	CS1201L	Introduction to Computer Programming	1	0	0	1	1		-	50	-	50	Computer and IT
ESC	CS1201T	Introduction to Computer Programming Laboratory	0	0	2	2	1	ISC	CE: 30	20	-	50	Computer and IT
HSSM (VSEC)	ES1208L	Introduction to Engineering and Engineering Products	-	-	2	2	1	ISCE: 50			-	50	Humanities
HSSM (IKS)	HS1207T	Indian Knowledge Systems	2	0	0	2	2	50 -		-	50	100	Respective Department
СС	AR1203	Co-curricular Courses	0	0	2	2	1	ISCE: 50		-	-	50	Respective Department
HSSM	HS1201	Induction Training						Non	on-credit course				
	Tot	al	13	01	16	30	22					1000	

Atus

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune





JSPM's

RAJARSHI SHAHU COLLEGE OF ENGINEERING

TATHAWADE, PUNE-33



F. Y. B. Tech. Automation and Robotics

Academic Year -2024-2025 (Semester -II)

(Level 4.5- UG Certificate) -Semester – II

			Те	achin	g Sche	eme	Credit	edit Examination Scheme				Total	
Course	Course Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownership
BSC	ES1202T	Engineering Mathematics- II	3	1	0	4	4	20	30	50	50	150	Mathematics
BSC	ES1206T	Physics for Engineers	3	0	0	3	3	20	30	50	-	100	Physics
BSC	ES1206L	Physics for Engineers Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	Physics
ESC	ME1202L	Engineering Drawing Laboratory	0	0	4	4	2	ISCI	E: 50	50	-	100	Mechanical
ESC	EE1201T	Introduction to Electrical Engineering	3	0	0	3	3	20 30		50	-	100	Electrical
ESC	EE1201L	Introduction to Electrical Engineering Laboratory	0	0	2	2	1	ISCE: 30		20	-	50	Electrical
ESC	CE1201T	Engineering Mechanics	3	0	0	3	3	20	30	50	-	100	Civil
ESC	CE1201L	Engineering Mechanics Laboratory	0	0	2	2	1	ISC	'E: 30	20	-	50	Civil
ESC	CS1202T	Fundamentals of Data Structure	1	0	0	1	1]	ISCE: 50		-	50	Computer and IT
ESC	CS1202L	Fundamentals of Data Structure Laboratory	0	0	2	2	1	ISCE: 30		20	-	50	Computer and IT
СЕР	ES1209L	Community Engagement Project	0	0	4	4	2	ISCE: 50		50	-	100	Engineering Science and Humanities
HSSM	HS1206	Indian Constitution						No	n-credit c	ourse			
	Tota	ıl	13	01	16	30	22	2 900					

Abbreviations:

 $L-Lecture, \, T-Tutorial, \, P-Practical, \, Hr-Hours, \, C-Credits, \, ISE-In \, Semester \, Evaluation, \, MSE-Mid \, Semester \, Evaluation, \, ESE-End \, Semester \, Evaluation$

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

For Tutorial: Assessment shall be ISE of the respective course.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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





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

List of Exit Courses after completion of Semester I and II

1. Exit option is available for students those who have earned the total 44 credits at the End of Second Semester.

2. Student who wants to avail the exit option after first year has to earn additional 8 credits from the list of courses shown below.

3. These courses student have to complete within summer vacation after 1st Year.

4. After fulfillment as mentioned in 1 to 3 above, Students can earn **U.G Certificate** and same will be issued by the Institute.

Sr. No.	Course code	Name	Credits
1.	EX-AR1201	Fundamentals of Automation System	2
2.	EX- AR1202	Fundamentals of Robotics	2
3.	EX- AR1203	Certification in Design and Simulation of Hydraulic/Pneumatic System	2
4.	EX- AR1204	Certified Programmer in C++	2
5.	EX- AR1205	Mini Project	2
6.	EX- AR1206	Internship at Industry (4 Weeks)	2

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



Course Type Abbreviations

BSC: Basic Science Course

ESC: Engineering Science Course

PCC: Programme Core Course

PEC: Programme Elective Course

MD M: Multidisciplinary Minor

OE: Open Elective

VSEC: Vocational and Skill Enhancement Course

HSSM: Humanities Social Science and Management

AEC: Ability Enhancement Course

IKS: Indian Knowledge System

VEC: Value Education Course

CEP: Comm. Engg. Project

FP: Field Project

CC: Co-curricular Courses

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





JSPM's

RAJARSHI SHAHU COLLEGE OF ENGINEERING

TATHAWADE, PUNE-33



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

S. Y. B. Tech (Automation and Robotics)

Academic Year -2024-2025 (Semester –III)

Proposed Structure Semester -III

 $(Level \ 5 \ \text{-} \ \text{UG-Diploma/Diploma-Eng}) \ \text{-} Semester \ III$

Course	Course	Course	Tea	achin	g Scho	eme	Credit	Exa	minatio	n Schem	e	Total	Ormerskin
Course	Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownersnip
BSC	ES2207T	Engineering Mathematics -III	3	0	0	3	3	20	30	50	-	100	Mathematics
РСС	AR2201T	Manufacturing Technology and Metrology	3	0	0	3	3	20	30	50	-	100	A & R
РСС	AR2201L	Manufacturing Technology and Metrology Laboratory	0	0	2	2	1	ISCI	E: 30	20	-	50	A & R
РСС	AR2202T	Electrical Machines and Control	3	0	0	3	3	20	30	50	-	100	A & R
РСС	AR2202L	Electrical Machines and Control Laboratory	0	0	2	2	1	ISCI	E: 30	20	-	50	A & R
РСС	AR2203T	Principles of Automation and Robotics	3	0	0	3	3	20	30	50	-	100	A & R
РСС	AR2203L	Principles of Automation and Robotics Laboratory	0	0	2	2	1	ISCI	E: 30	20	-	50	A & R
РСС	AR2204T	Innovation and Entrepreneurship	2	-	-	2	2	20	30	50	-	100	A & R
РСС	AR2205T	Industrial Psychology	2	-	-	2	2	20	30	50	-	100	A & R
HSSM	HS2203T	Universal Human Values and Ethics	2	-	-	2	2	20	30	50	-	100	Humanities
VEC	AR2206L	Introduction to Python Programming & Data Science- I	-	-	2	2	1	ISCE: 30		20	-	50	A & R
	Total		18	-	08	26	22					900	

Atty

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





JSPM's II SHAHU COLLEGE OF ENG

RAJARSHI SHAHU COLLEGE OF ENGINEERING





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

S. Y. B. Tech (Automation and Robotics)

Academic Year -2024-2025 (Semester -IV)

Proposed Structure Semester -IV (Level 5 - UG-Diploma/ Diploma-Eng) -Semester IV

Course	Course	Course	Т	eachir	ng Sch	eme	Credit	Examination		on Schem	e	Total	a 1
Course	Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownership
PCC	AR2207T	Sensors and Instrumentation	3	0	0	3	3	20	30	50	-	100	A & R
Skill Course (VSEC)	AR2207L	Sensors and Instrumentation Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
РСС	AR2208T	Hydraulic and Pneumatic Systems	3	0	0	3	3	20	20 30		-	100	A & R
Skill Course (VSEC)	AR2208L	Hydraulic and Pneumatic Systems Laboratory	0	0	2	2	1	ISCE: 30		20	-	50	A & R
РСС	AR2209T	Automatic Control System	3	0	0	3	3	20	20 30		-	100	A & R
РСС	AR2209L	Automatic Control System Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
РСС	AR2210L	Product Development and Modeling	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
HSSM	ES2206T	Environmental Science and Engineering	2	-	-	2	2	20	30	50	-	100	Humanities
MDM	ARM2201T	Multi- Disciplinary Minor -I	3	0	0	3	3	20	30	50	-	100	A & R
HSSM (AEC)	HS2206L	Soft skills	-	-	2	2	1	ISCE: 30		20	-	50	Humanities
HSSM	HS2205T	Economics	2	-	-	2	2	20 30		50	-	100	Humanities
СС	AR2211L	Co-Curricular Course-2	-	-	2	2	1	ISCE: 50		0	-	50	A & R
	Tota		16	-	12	28	22	2				900	

Abbreviations:

L-Lecture, T-Tutorial, P-Practical, Hr-Hours, C-Credits, ISE-In Semester Evaluation, MSE-Mid Semester Evaluation, ESE-End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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





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

List of Exit Courses after completion of Semester III and IV

1. Exit option is available for students those who have earned the total 88 credits at the End of fourth Semester.

2. Student who wants to avail the exit option after second year has to earn additional 8 credits from the list of courses shown below.

3. These courses student have to complete within summer vacation after 2nd Year.

4. After fulfillment as mentioned in 1 to 3 above, Students can earn UG-Diploma/ Diploma-Eng and same will be issued by the Institute.

Sr. No.	Course code	Name	Credits
1.	EX-AR2201	Certification of PLC and SCADA Software	2
2.	EX- AR2202	Programming with Python	2
3.	EX- AR2203	Certification on 3D Modeling Software	2
4.	EX- AR2204	Certification on Robotics System Simulation	2
5.	EX- AR2205	Minor Project on Embedded System/Mechatronics System	2
6.	EX- AR2206	Internship in Automation Industry (4 Weeks)	2

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







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

T. Y. B. Tech (Automation and Robotics)

Academic Year -2025-2026 (Semester –V)

Proposed Structure Semester -V

(Level 5.5 - B. Voc./ B.Sc. Engg) -Semester V

Course	Course	Comme	Tea	ching	Scher	me	Credit	t Examina		on Schen	ne	Total	A 1				
Course	Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownership				
РСС	AR3201T	Computer Integrated Manufacturing Systems	3	0	0	3	3	20	30	50	-	100	A & R				
РСС	AR3202T	Design of Machine Elements and Transmission System	3	0	0	3	3	20	30	50	-	100	A & R				
РСС	AR3203T	PLC and SCADA	3	0	0	3	3	20	30	50	-	100	A & R				
РСС	AR3203L	PLC and SCADA Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R				
PEC	AR3204T	Professional Elective- I	3	0	0	3	3	20	30	50	-	100	A & R				
PEC	AR3204L	Professional Elective- I Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R				
MDM	ARM3201T	Multi-Disciplinary Minor -II	3	0	0	3	3	20	30	50	-	100	A & R				
MDM	ARM3201L	Multi-Disciplinary Minor –II Lab	-	-	2	2	1	ISC	E: 30	20	-	50	A & R				
OE		Open Elective-I	3	0	0	3	3	20	30	50	-	100	Other Department				
СС	AR3205L	Co-Curricular Course-3	-	-	2	2	1	ISCE: 50		ISCE: 50		ISCE: 50)	-	50	A & R
	To	tal	18	-	8	26	22					800					

All

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





JSPM's RSHI SHAHU COLLEGE OF ENGINER





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

T. Y. B. Tech (Automation and Robotics) Academic Year -2025-2026 (Semester –VI)

Proposed Structure Semester -VI

(Level 5.5 - B. Voc./ B.Sc. Engg) -Semester VI

Course	Course Code	Course	Те	aching	g Sche	me	Credit	t Examina		on Schen	ne	Total	Ownership
course	Course Coue	course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownersmp
РСС	AR3206T	Robotics Kinematics and Dynamics	3	0	0	3	3	20	30	50	-	100	A & R
РСС	AR3206L	Robotics Kinematics and Dynamics Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
PEC	AR3207T	Professional Elective- II	3	0	0	3	3	20	30	50	-	100	A & R
PEC	AR3207L	Professional Elective- II Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
PEC	AR3208T	Professional Elective- III	3	0	0	3	3	20	30	50	-	100	A & R
PEC	AR3208L	Professional Elective- III Laboratory	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
MDM	ARM3202T	Multi- Disciplinary Minor -III	3	0	0	3	3	20	30	50	-	100	A & R
OE		Open Elective- II	3	0	0	3	3	20	30	50	-	100	Other Department
HSSM (VSEC)	AR3209L	Object Oriented Programming	-	1	2	3	2	ISCE: 30		20	50	100	A & R
Project	AR3210L	Engineering Innovation and Society-I	-	-	4	4	2	ISCE: 50		50	-	100	A & R
	Tota	1	15	01	12	28	22					850	

Abbreviations:

L-Lecture, T-Tutorial, P-Practical, Hr-Hours, C-Credits, ISE-In Semester Evaluation, MSE-Mid Semester Evaluation, ESE-End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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





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

List of Exit Courses after completion of Semester V and VI

1. Exit option is available for students those who have earned the total 132 credits at the End of sixth Semester.

2. Student who wants to avail the exit option after third year has to earn additional 8 credits from the list of courses shown below.

3. These courses student have to complete within summer vacation after 3rd Year.

4. After fulfillment as mentioned in 1 to 3 above, Students can earn **B.Voc./ B.Sc. Engg** and same will be issued by the Institute.

Sr. No.	Course code	Name	Credits
1.	EX-AR3201	Certification on Fundamentals of Industry 4.0	2
2.	EX- AR3202	Certification on Augmented Reality and Virtual Reality Simulation Software	2
3.	EX- AR3203	Certification on AI & ML	2
4.	EX- AR3204	Internship at Industry on 3D Printing	2
5.	EX- AR3205	Certification Program on Automation System for suitable Industrial application	2
6.	EX- AR3206	Major Project on Implementation on IIOT	2

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







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

B. Tech (Automation and Robotics) Academic Year -2026-2027 (Semester –VII) Proposed Structure Semester -VII

(Level 6 – B. Tech) -Semester VII

Course	Course Code	Course	Tea	ching	Scher	ne	Credit	it Examin		on Schen	ne	Total	Ownershin
course	course coue	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	0 where ship
PCC	AR4201T	Additive Manufacturing	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4202T	Robotic Applications	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4203T	Microcontrollers and Embedded Systems	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4203L	Microcontrollers and Embedded Systems Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
PEC	AR4204T	Professional Elective- IV	3	0	0	3	3	20	30	50	-	100	A & R
PEC	AR4204L	Professional Elective- IV Laboratory	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
MDM	ARM4201T	Multi- Disciplinary Minor -IV	3	0	0	3	3	20	30	50	-	100	A & R
MDM	ARM4201L	Multi- Disciplinary Minor –IV Laboratory	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
Project	AR4205L	Engineering Innovation and Society-II	-	-	8	8	4	ISCI	E: 100	100	-	200	A & R
	Tota	ป	15	0	14	29	22					850	

Atus

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







B. Tech (Automation and Robotics) Academic Year -2026-2027 (Semester –VIII) Proposed Structure Semester -VIII (Level 6 – B. Tech) -Semester VIII

Track I – Regular Track

Comme	Course Code	Carrier	Te	achir	ıg Sch	eme	Credit	Ex	aminatio	on Schen	ne	Total	a
Course	Course Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	Ownership
PCC	AR4206T	Advance Manufacturing Techniques	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4206L	Advance Manufacturing Techniques Laboratory	0	0	2	2	1	ISC	E: 30	20	-	50	A & R
PCC	AR4207T	Mobile Robotics	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4207L	Mobile Robotics Laboratory	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
PCC	AR4208T	Skill Based Course	3	0	0	3	3	20	30	50	-	100	A & R
PCC	AR4208L	Skill Based Course Laboratory	-	-	2	2	1	ISC	E: 30	20	-	50	A & R
VSEC	AR4209T	SWAYAM Professional Elective Course	2	-	-	2	2	-	-	-	-	100	A & R
Project	AR4210L	Comprehensive Evaluation	-	-	4	4	2	ISCE: 100		0	-	100	A & R
	Total		11	0	10	21	16					650	

Abbreviations:

 $\begin{array}{l} L - \text{Lecture, } T - \text{Tutorial, } P - \text{Practical, } Hr - \text{Hours, } C - \text{Credits, } ISE - \text{In Semester Evaluation, } MSE - \text{Mid Semester Evaluation, } ISE - \text{End Semester Evalua$

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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





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

B. Tech (Automation and Robotics) Academic Year -2026-2027 (Semester –VIII) Proposed Structure Semester -VIII (Level 6 – B. Tech) -Semester VIII

Track II – Internship and Training

Course	Course	Course	Teaching Scheme L T P Hr				Credit	E	xaminat Schem	tion e		Total	Ownership
	Code		L	Т	Р	Hr	Cr	ISE	MSE	ESE	TW	Marks	-
Internship	AR4211L	Industry Internship Program	-	-	24	24	12	ISCE	E: 200	250	-	450	A & R
VSEC	AR4209T	SWAYAM Professional Elective Course	2	-	-	2	2	-	-	-	-	100	A & R
Project	AR4210L	Comprehensive Evaluation	-	-	4	4	2	ISCE: 100		-	100	A & R	
	Total		2	0	28	30	16					650	

Abbreviations:

 $\begin{array}{l} L - Lecture, \, T - Tutorial, \, P - Practical, \, Hr - Hours, \, C - Credits, \, ISE - In \, Semester \, Evaluation, \, MSE - Mid \, Semester \, Evaluation, \, ESE - End \, Semester \, Evaluation \\ \end{array}$

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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







PROFESSIONAL ELECTIVES

Elective	Automation (Track-I)	Robotics (Track -II)
Professional Elective- I	Artificial Intelligence and Machine Learning	Autonomous Robotics
Professional Elective- II	Integrated Automation	Wireless Sensors Network for Robotics
Professional Elective- III	Micro-Electro Mechanical systems (MEMS)	Cognitive Robotics
Professional Elective- IV	Design of Mechatronics System	Augmented Reality and virtual Reality for Robotics

Atus

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







Department of Automation and Robotics Open Elective (Offered to other department) Structure (Effective from 2024-25)

Course Code	Course	Teaching Scheme			Credit	Exa	aminatio	Total		
Course coue	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	Marks
T. Y. Sem V										
ARO3201T	Applications of R-IoT	3	-	-	3	3	20	30	50	100
	T. Y. Sem VI									
ARO3202T	Industry 4.0	3		-	3	3	20	30	50	100
,	Total	6	-	-	6	6				20

Abbreviations:

L – Lecture, T – Tutorial, P – Practical, Hr – Hours, C – Credits, ISE – In Semester Evaluation, MSE – Mid Semester Evaluation, ESE – End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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







Department of Automation and Robotics Multidisciplinary Minor (offered to other Departments) Multidisciplinary Minor in Industrial Automation and Robotics Structure (Effective from 2024-25)

Course Code	G		Teaching Scheme Cred		Credit	Exa	Total			
Course Code	Course	L	Т	Р	Hr	Cr	ISE	MSE	ESE	Marks
			S	. Y.	Sem IV	V				
ARM2201T	Industrial Sensors and its applications	3	-	-	3	3	20	30	50	100
	T. Y. Sem V									
ARM3201T	Robotics and its applications	3	-		3	3	20	30	50	100
ARM3201L	Robotics and its applications Laboratory	-	-	2	2	1	ISC	E: 30	20	50
			Т	. Y.	Sem V	Τ				
ARM3202T	Essentials of Industrial Automation	3	-	1	3	3	20	30	50	100
			В. Т	ech.	Sem V	VII				
ARM4201T	Fundamentals of PLC and SCADA	3	-	-	3	3	20	30	50	100
ARM4201L	Fundamentals of PLC and SCADA Laboratory	-	-	2	2	1	ISC	E: 30	20	50
Tot	al	12	-	4	16	14				500

Abbreviations:

L – Lecture, T – Tutorial, P – Practical, Hr – Hours, C – Credits, ISE – In Semester Evaluation, MSE – Mid Semester Evaluation, ESE – End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune







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

Department of Automation and Robotics Minor in Emerging Area RPA and Data Science Structure (Effective from 2024-25)

Course	Course	Teaching Scheme				Credit Examination Scheme				Total
Code	Course	L	Т	Р	Hr	С	ISE	MSE	ESE	Marks
				S. Y.	Sem I	V				
ARH2201T	Robotic Process Automation	3	-	-	3	3	20	30	50	100
ARH2201L	Robotic Process Automation Laboratory	-	-	2	2	1	ISC	CE: 30	20	50
	T. Y. Sem V									
ARH3201T	Data Science	3		-	3	3	20	30	50	100
ARH3201L	Data Science Laboratory	-	-	2	2	1	ISC	CE: 30	20	50
				Т. Ү.	Sem V	VI				
ARH3202T	Industrial Internet of Things	3	1	-	3	4	20	30	50	100
			E	B. Tech	n. Sem	VII				
ARH4201T	Industry 5.0	3	-	-	3	3	20	30	50	100
ARH4202L	Mini Project	-	-	6	6	3	ISC	CE: 50	50	100
	Total	12	1	10	22	18				600

Eligibility for admission to the UG Bachelor's Degree with Double Minor: Minimum CGPA/CPI of 7.5 or minimum 75% after second semester for UG Bachelor's Degree

Abbreviations:

L – Lecture, T – Tutorial, P – Practical, Hr – Hours, C – Credits, ISE – In Semester Evaluation, MSE – Mid Semester Evaluation, ESE – End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune







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

Department of Automation and Robotics Honors with Research Structure (Effective from 2024-25)

Course	Course	Course Teaching Schem		eme	Credit	Credit Examination Scheme			Total	
Code	Course	L	Т	Р	Hr	С	ISE	MSE	ESE	Marks
B. Tech. Sem VII										
CSR4101T	Research Specific core course (Online NPTEL course)	4	-	-	4	4	20	30	50	100
CSR4102T	Design Thinking and Innovation (online/offline)	4	-	-	4	4	20	30	50	100
CSR4103L	Research Project Stage I	-	-	4	4	2	ISCI	E: 50	50	100
	B.Tech. Sem VIII									
CSR4104L	Comprehensive Evaluation	-	-	4	4	2	ISCE: 100		0	100
CSR4105L	Research Project Stage II	-	-	12	6	6	ISCE	: 100	100	200
Total		6	2	20	22	18				600

Eligibility for admission to the UG Bachelor's Degree with Research: Minimum CGPA/CPI of 7.5 or minimum 75% after sixth semester for UG Bachelor's Degree

Abbreviations:

L - Lecture, T - Tutorial, P - Practical, Hr - Hours, C - Credits, ISE - In Semester Evaluation, MSE -Mid Semester Evaluation. ESE – End Semester Evaluation

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing. For Lab courses: There shall be continuous assessment (ISCE consists of ISE and MSE). The ESE is a separate head of passing.

Note: For Evaluation of Online NPTEL course ISE Marks will be marks obtained by students in the assignments given by NPTEL, MSE will be the marks obtained in NPTEL certification.

Students who will secure NPTEL certification will be only eligible for ESE of the same course which will be conducted at institute.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



Director, RSCOE, Pune

SEMESTER III Syllabus

AUS

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III [ES2207T]: Engineering Mathematics-III

Teaching Scheme:	Credit TH-03	Examination Scheme:
111. 05110u15/ Week	111.05	Mid Sem. Exam: 30 Marks
		End Sem. Exam: 50 Marks

Course Prerequisites: Differential & Integral Calculus, Differential equations of first order & first degree, Fourier series, Algebra of Complex numbers and Vector algebra.

Course Objective:

To familiarize the students with concepts and techniques in Ordinary and Partial differential equations, Laplace transform & Fourier transform, Functions of a complex variable and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcome:

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

CO1: Solve higher order linear differential equations and its applications to model and analyse mass spring systems.

CO2: Apply Integral Transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.

CO3: Analyse Complex functions, Conformal mappings, Contour integration applicable to control theory and potential flow related to fluid dynamics

CO4: Perform Vector differentiation & integration, analyse the vector fields and apply to fluid flow problems.

CO5: Solve Partial differential equations such as wave equation, one &two dimensional heat flow equations.

Course Contents

UNIT-I **Linear Differential Equations (LDE) and Applications 08 Hours** LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, short methods, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of mass-spring systems, free and forced damped and undamped systems.

UNIT-II	Transforms	07 Hours
oplace Transform (IT):	Definition of LT and Inverse LT LT of standard functions	properties and

Laplace Transform (LT): Definition of LT and Inverse LT, LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE. Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.

UNIT-III	Complex Variables	08 Hours
unctions of a Complex v	variable, Analytic functions, Cauchy-Riemann equations, Confo	rmal mapping,
silinear transformation, C	Cauchy's integral theorem, Cauchy's integral formula, Lauren	it's series and
• 1 .1		

Residue theorem.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



Director, RSCOE, Pune

UNIT-IV		Vector Differential Calculus	08 Hours					
Physical interpretation	of Vector	differentiation, Vector differential operator, Gradient, I	Divergence and					
Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.								
UNIT-V		Vector Integral Calculus and Applications	08 Hours					
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.								
UNIT-VI	Арр	lications of Partial Differential Equations (PDE)	08 Hours					
Basic concepts, modell equations, method of se Transforms, Two-dimen	ing of Vi paration c sional way	brating String, Wave equation, one and two dimension of variables, use of Fourier series. Solution of Heat equation.	onal Heat flow tion by Fourier					
Text Books:								
T1. Higher Engineeri	ing Mathei	natics by B.V. Ramana (Tata McGraw-Hill).						
Reference Books:		nates by D. S. Olewar (Khanna I doneation, Denn).						
R1. Advanced Engine	eering Ma	thematics, 10e, by Erwin Kreyszig (Wiley India).						
R2. Advanced Engine	eering Ma	thematics, 2e, by M. D. Greenberg (Pearson Education).						
R3. Advanced Engine	eering Ma	thematics, 7e, by Peter V. O'Neil (Cengage Learning).						
R4. Differential Equa	ations, 3e b	by S. L. Ross (Wiley India).	TT'11 T					
R5.Complex Variabl	les and Ap	plications, 8e, by J. W. Brown and R. V. Churchill (McGr	aw-Hill Inc.).					
1993)	iai Equati	ons for Scientists and Engineers by S. J. Farlow (Dove	er Publications,					
MOOC(NPTEL) Cours	ses:							
NPTEL course on "Tran	sform and	Applications"						
https://onlinecourses-arc	hive.nptel	.ac.in/noc19_ma04/course						
NPTEL course on "Com	plex Anal	ysis"						
https://nptel.ac.in/course	<u>s/111/103</u>	/111103070/						

Atus

Γ

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

RIN





BOS Chairman (A & R)

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



S. Y. B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester -III

AR2201T - Manufacturing Technology and Metrology								
Teaching Scheme:		Credit	Examination Scheme:					
TH:03 Hours/Week		TH: 03	In Sem. Evaluation:20	Marks				
			Mid Sem. Exam: 30 M	arks				
			End Sem. Exam: 50 M	arks				
Course Prerequisites: The stu	ident should	have completed two	o semesters of UG Engineer	ring				
Course Objective:								
• To understand various	conventional	manufacturing and	finishing processes					
• To Classify, describe a	nd configure	the principles of va	rious joining processes					
• To understand various	non-conventi	onal manufacturing	g processes					
Generate CNC program	n for appropri	iate machining proc	cesses like turning and milli	ing.				
• Select suitable instrum	ent / gauge / i	nethod of inspectio	on for determining geometri	cal and				
dimensional measurem	ents.							
• Understand the advanc	es in Metrolo	gy such as use of C	CMM, Laser, Machine Visio	on System for				
Metrology etc.								
Course Outcome:								
After successful completion of	the course, s	tudents will able to	:					
CO1: Student should be able t	o apply the k	nowledge of variou	s manufacturing processes.					
CO2: Classify and Explain dif	ferent joining	g processes						
CO3: Identify and implement	advanced ma	nufacturing process	ses.					
CO4: Generate CNC program	for Turning /	Milling processes	and generate tool path usin	g CAM software.				
CO5: Understand the metho	ods of meas	urement, selection	of measuring instrumen	ts / standards of				
measurement and gauge design	1							
CO6: Learn the applications of	of advance me	strology into variou	is manufacturing systems					
		Course Conten	ts					
UNIT-I		Manufacturing	Processes	07 Hours				
Primary processes – Casting –	Forging – For	rming – Extrusion-	wire drawing process – Rol	ling				
Machining operations – Millin	g - types of c	operations, types of	milling machines, milling	cutters				
Turning – types of operations	, tool holder	s, inserts, operating	g conditions, work holding	devices, Milling				
and drilling jigs and fixtures. C	<u>ərinding – typ</u>	bes of operations.						
UNIT-II		Joining Pro	ocesses	07 Hours				
Joining processes-Welding-	Gas welding	g-Arc Welding, sl	hielded metal arc welding	g, submerged arc				
welding, GTAW, plasma are	e welding, u	ltrasonic welding,	friction welding, resistant	nce spot welding,				
resistance seam welding, stud	l welding, pe	rcussion welding-	-Soldering-techniques, typ	pes of solders and				
fluxes- Adhesive bonding-t	ypes of adh	esives-curing tecl	nniques. Selection of joi	ning process for				
various applications, case stu	dies.							
Unit-III	Adv	ances in Manufac	cturing Processes	07 Hours				
Non-conventional processes - EDM, ECM, USM, EBM, LBM, IBM, WJM, AWJM, LJM, ECG, PCM,								
process capabilities, applications, fused ion beams -principle and application, abrasive water jet machining.								
Net shape and near net shape	manufacturi	ng, additive manuf	acturing, Powder metallurg	y, selective laser				
No. C			<u> </u>	15 1				
AIMX	(cipher I						
Dr. A. M. Badadhe	Dr	. Ram Joshi	Dr. R. K	. Jain				

Dean Academics, RSCOE, Pune

Director, RSCOE, Pune

sintering and selective laser melting, fused deposition modeling, laminated object manufacturing, laser engineered net-shaping, laser welding, stereo-lithography, LIGA process;

Rapid prototyping, introduction, product prototyping, solid modeling, reverse engineering, process chain, advantages of RP (Basic concepts). Selection of rapid prototyping process and design considerations

Unit-IV	CNC Machines and Programming	07 Hours					
Numerical controlled Machines – CNC machines, basic structures of machining and turning centers. Tools,							
tool holders and tool indexing. Axis configurations and fundamentals of CNC codes. Datum and tool offset							
settings, Incremental and absolute programming, canned cycles. Practical programming (simple) examples							
in milling and turning using (G, M codes. APT programming						

UNIT-V	Linear and Angular Measurements	07 Hours						
Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design -								
terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring								
instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment								
telescope – Autocollimator	– Applications.							

UNIT-VI	Advances in Metrology	07 Hours	
Basic concept of lasers A	Advantages of lasers - laser Interferometers - types - DC	and AC Lasers	
interferometer - Applications - Straightness - Alignment. Basic concept of CMM - Types of CMM -			
Constructional features – F	Probes – Accessories – Software – Applications – Basic conce	epts of Machine	
Vision System - Element -	Applications		

Text Books:

- T1. Manufacturing Engineering and Technology, Kalpakjian and Schmid, Prentice Hall, New Jersey, 2013.
- T2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons, Inc,New Jersey, 2010.
- T3. Mechatronics by HMT, Tata McGraw Hill, 2010.
- T4. Manufacturing Engineering, D.K. Singh, Ane Books India, 2008
- T5. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Pearson Education, 5/e.
- T6. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.
- T7. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
- T8. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

Reference Books:

- R1.RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
- R2.RAO, Manufacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
- R3. Cyril Donaldson and George H LeCain, Tool Design, TMH

R4. Handbook of Fixture Design - ASTME

- R5. Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
- R6.P R Beeley, Foundry Technology, Elsevier, 2001
- R7.Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting, Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
- R8. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006.
- R9. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
- R10.Berry Leathan Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
- R11. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.

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



On-Line resources:

- 1. https://onlinecourses.nptel.ac.in/noc19_me44
- 2. <u>https://onlinecourses.nptel.ac.in/noc21_me89</u>
- 3. <u>https://onlinecourses.nptel.ac.in/noc22_me28</u>
- 4. https://onlinecourses.nptel.ac.in/noc19_me47
- 5. https://onlinecourses.nptel.ac.in/noc19_me45
- 6. <u>https://onlinecourses.nptel.ac.in/noc19_me70</u>
- 7. https://onlinecourses.nptel.ac.in/noc19_me46
- 8. nptel.ac.in/courses/112106179
- 9. www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/

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

KIMIL







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

S. Y. B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester -III

AR2201L -Manufacturing Technology and Metrology Laboratory			
Teaching Scheme:	Credit	Examination Scheme:	
LAB:02 Hours/Week	LAB: 01	ISCE: 30 Marks	
		ESE: 20 Marks	
		Total: 50 Marks	

Course Prerequisites: The student should have completed two semesters of UG Engineering

Course Objective:

- To understand various conventional manufacturing and finishing processes
- To Classify, describe and configure the principles of various joining processes
- To understand various non-conventional manufacturing processes
- Generate CNC program for appropriate machining processes like turning and milling.
- Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
- Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.

Course Outcome:

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

CO1: Student should be able to apply the knowledge of various manufacturing processes.

CO2: Classify and Explain different joining processes

CO3: Identify and implement advanced manufacturing processes.

CO4: Generate CNC program for Turning / Milling processes and generate tool path using CAM software.

CO5: Understand the methods of measurement, selection of measuring instruments / standards of measurement and gauge design

CO6: Learn the applications of advance metrology into various manufacturing systems

Lab Contents 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 50.
- 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

List of Laboratory Assignments/Experiments

1 Introduction to workshop safety, measuring instruments and operating instructions.

2 Casting of the component.

- **3** Hot working process/ Sheet Metal work and die penetration test.
- 4 Programming and operation of a CNC Lathe

5 Programming and operation of a VMC

6 Manufacturing of a component using 3D printing

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



7	Measurement of Taper Angle using Sine Bar
8	Optical profile projector-study of profile of gear tooth, screw threads.
9	Toolmaker's microscope-to study cutting tool geometry, screw threads.
10	Tool wear and surface finish measurement.
11	Dimensional measurement of machined components using, bore gauge, air gauge and Height master
Text	Books:
Т	1. Manufacturing Engineering and Technology, Kalpakjian and Schmid, Prentice Hall, New Jersey,
	2013.
Т	2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons, Inc, New Jersey,
т	2010. 2 Maghetropies by HMT. Tata McGrayy Hill 2010
т Т	4 Manufacturing Engineering DK Singh Ane Books India 2008
Т	5 Manufacturing Processes for Engineering Materials, Kalpakijan and Schmid, Pearson Education
-	5/e.
Т	6. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.
Т	7. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
Т	8. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
Refe	rence Books:
R	1. RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
K D	2. RAO, Manufacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
R	A Handbook of Fixture Design – ASTME
R	5 Campbell J. S., Principles of Manufacturing Materials and Processes. Tata McGraw Hill, 1999
R	6.P R Beeley, Foundry Technology, Elsevier, 2001
R	7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting, Charles
	Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
R	8. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
R	9. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
R1	0.Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
	. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.
On-L	Ine resources:
	$\frac{\text{https://onlinecourses.nptet.ac.in/noc19_me44}}{\text{https://onlinecourses.nptet.ac.in/noc11_me89}}$
4	3. https://onlinecourses.nptel.ac.in/noc22_me28
4	4. https://onlinecourses.nptel.ac.in/noc19_me47
	5. https://onlinecourses.nptel.ac.in/noc19_me45
(5. <u>https://onlinecourses.nptel.ac.in/noc19_me70</u>
,	7. <u>https://onlinecourses.nptel.ac.in/noc19_me46</u>
	8. <u>nptel.ac.in/courses/112106179</u>
	www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/

A148

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

RW







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III AR2202T-Electrical Machines and Control

	AR2202	2T-Electrical Machines and	l Control	
Teaching Scheme TH:03 Hours/We	e: eek	Credit TH:03	Examination Sch In Sem. Evaluati Mid Sem. Exam: End Sem. Exam:	neme: TH on:20 Marks 30 Marks 50 Marks
Course Prerequi	sites: Basic Electr	rical & Electronics engineering		
Course Objective	es:			
 To understar special purpe To understar To understar To Understar 	nd construction, wo ose motors nd speed control r nd the application nd basics of elect	vorking and operation of induction nethods of three phase induction of induction motor, synchronous rical drives and its control	n motor, synchronou motor. machine and special	s machine and l purpose Motors.
To understar	nd and evaluate ar	nalyze dc and induction motor dri	ves	
Course Outcome	s:			
CO1: learn the v CO2: learn the v CO3: describe th CO4: explain co for different appli CO5: explain ba CO6:analysis ar	working principle construction, work he different paran onstruction, working cation. asics of electrical and understand of d	and operation of single-phase tracking principle and characteristics neters & speed control methods of ng principle of synchronous mach drives and its working.	nsformer of DC machines f three phase inductionine & apply special	on motor purpose motors
Course Contents				
UNIT-I		Transformers		07 Hours
Constructional De Parameters Refer efficiency- Testin	etails – Principle red To HV/LV g – open and Shor	of Operation – EMF Equation – Windings – Equivalent Circuit rt Circuit Test – Polarity Test	– Transformer - No – Voltage Regu	Load & Full load, lation – losses &
UNIT-II		D.C. Machines		07 Hours
Constructional details – EMF equation – methods of excitation– characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. Motors-Armature reaction & commutation process				
UNIT-III		Induction Motors		07 Hours
Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – Losses and power stages- Torque & Slip characteristics - single-phase induction motors (only qualitative analysis).				
UNIT-IV	S	Synchronous and Special Machi	ines	07 Hours
Construction of S reluctance motor under different po	Synchronous mac – stepper motor - wer factors	chines-types – induced emf – C servo motor- BLDC motor- PMD	Generator on No los OC motor- armature i	ad and full load – reaction & its effect
			~ ~	

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

QU

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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

UNIT-V	Basics of Electric Drives and Control	07 Hours		
Introduction, adv	antages of electric drives- components of electric drives system, select	tion factors, DC &		
AC drives, Speed	control – classification- close loop control			
UNIT-VI	DC and Induction Motor Drives	07 Hours		
DC motors and the	eir performance, starting, transient analysis, speed control, controlled a	rectifier fed drives,		
Induction motors,	starting and speed control methods, V/P control, close loop control for	induction motors.		
Text Books:				
T1. B.L. Theraja -	Electrical Technology Vol. II AC/DC Machines I, S. Chand, 2008.			
T2. Vedam Subra	maniam, -Electric Drives-Concepts and applications I, Tata McGraw Hi	11		
Publishing Co.,Lt	d., New Delhi 2003			
T3. G.K. Dubey, -	Fundamentals of Electric Drives", Alpha Science International Ltd. 200	1.		
T4. R. Krishnan –	Electric Motor & Drives: Modeling, Analysis and Control II, Prentice Ha	all		
of India, 2001.				
REFERENCE B	OOKS:			
R1. J.B. Gupta, -7	Theory and Performance of Electrical Machines ^{II} , J.K. Kataria & Sons, 1	3 th edition, 2004.		
R2. Bimal K. Bos	e, -Modern Power Electronics and AC Drives", Prentice-hall of India	a Pvt. Ltd, 2005.		
R3.M.H.Rashid,"	Power Electronic Circuits, Devices and Applications", Prentice Hall			
International, 2007 Edition, Newness Publications, 2006.				
R4. H. Partab,-Art and science and utilization of electrical energy ,Dhanpat Rai and Sons, 1999				
On-Line Resour	ces:			
On-Line Resour 1. https://onl	tes: inecourses.nptel.ac.in/noc22_ee111/preview,			
On-Line Resource 1. <u>https://onl</u> 2. https://npt	:es: inecourses.nptel.ac.in/noc22_ee111/preview, el.ac.in/courses/108108077			
On-Line Resource 1. <u>https://onl</u> 2. <u>https://npt</u> 3. https://npt	ces: <u>inecourses.nptel.ac.in/noc22_ee111/preview</u> , <u>el.ac.in/courses/108108077</u> el.ac.in/courses/108105131			

A148

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

RU







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III

	AK2202L-EI	curical Machines and Control			
Teach	ning Scheme:	Credit	Examination Scheme:		
LAB:	02 Hours/Week	LAB: 01	ISCE: 30 Marks		
			ESE: 20 Marks		
			Total: 50 Marks		
Cours	se Prerequisites: Basic Elect	rical & Electronics engineering			
Cours	se Objectives:				
• ′	To understand construction, w	orking and operation of induction	motor, synchronous machine and		
5	special purpose motors				
• ′	To understand speed control r	nethods of three phase induction m	otor.		
• ′	To understand the application	of induction motor, synchronous n	nachine and special purpose Motors.		
• ′	To Understand basics of elect	rical drives and its control			
• '	To understand and evaluate a	nalyze dc and induction motor drive	28		
Cours	se Outcomes:				
After	successful completion of the	course, students will able to:			
CO	: learn the working principle	and operation of single-phase trans	sformer		
CO	2: learn the construction, work	king principle and characteristics of	⁵ DC machines		
CO	3: describe the different paran	neters & speed control methods of t	hree phase induction motor		
CO4	4: explain construction, worki	ng principle of synchronous machin	ne & apply special purpose motors		
for di	ferent application.				
CO	5: explain basics of electrical	drives and its working.			
CO	5: analysis and understand of c	lc and induction motor drives			
	,	Lab Contents			
		Guidelines for Assessment			
Prace	tical/Oral examination base	d on the practical's performed i	n the lab. The Performance will be		
asses	sed iointly by internal and e	xternal examiners.			
-	Total marks assigned are 50).			
-	Continuous assessment wil	be carried out based on attendance	e, lab performance, and timely		
	submission of lab file.		,, <u>r</u>		
-	Final practical examination	for specific practical and oral exam	nination will be conducted		
List of Laboratory Experiments					
1 Open circuit and short circuit tests on single phase transformer (Determination of equivalent					
-	circuit parameters)				
2	2 Polarity test on single phase transformer				
3	3 Speed control of D C shunt motor				
4	Load test on D C shunt mot	or.			
5	Load test on DC series mot	tor			
6	No load and blocked rotor te	ests on three phase induction motor	(Determination of equivalent circuit		
0	parameters)	sets on three phase induction motor			
7	Load test on Three phase inc	fuction motor			
,			<u> </u>		
	AMAS	Kinghus I	() there		

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



Director, RSCOE, Pune

- 8 Direct Loading test on alternator
- 9 Rotor resistance speed control of three phase slip ring induction motor
- **10** Speed control of squirrel cage induction motor

11 Test on single phase full controlled rectified fed DC drive

12 Test on three phase full controlled rectified fed separately excited DC motor

Text Books:

T1. B.L. Theraja –Electrical Technology Vol. II AC/DC Machines I, S. Chand, 2008.

T2. Vedam Subramaniam, -Electric Drives-Concepts and applications ||, Tata McGraw Hill Publishing Co., Ltd., New Delhi 2003

T3. G.K. Dubey, -Fundamentals of Electric Drives", Alpha Science International Ltd. 2001. T4. R. Krishnan -Electric Motor & Drives: Modeling, Analysis and Control II, Prentice Hall of India, 2001.

REFERENCE BOOKS:

R1. J.B. Gupta, –Theory and Performance of Electrical Machines II, J.K. Kataria & Sons, 13th edition, 2004. R2. Bimal K. Bose, —Modern Power Electronics and AC Drives'', Prentice-hall of India Pvt. Ltd, 2005. R3.M.H.Rashid, "Power Electronic Circuits, Devices and Applications", Prentice Hall International, 2007 Edition, Newness Publications, 2006.

R4. H. Partab,-Art and science and utilization of electrical energy||, Dhanpat Rai and Sons, 1999

On-Line Resources:

- 1. https://onlinecourses.nptel.ac.in/noc22_ee111/preview,
- 2. <u>https://nptel.ac.in/courses/108108077</u>
- 3. https://nptel.ac.in/courses/108105131

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III AR2203T-Principles of Automation and Robotics

Teaching Scheme TH:03 Hours/We	e: eek	Credit TH:03	Examination So In Sem. Evalua Mid Sem. Exan End Sem. Exan	cheme: TH tion:20 Marks n: 30 Marks n: 50 Marks	
Course Prerequi	sites: F	Knowledge of basic electronics and electrical engi	ineering.		
Course Objective To help str To underse To outline To plan an To identify To introdu and enable	 Course Objective: To help students gain essential and basic knowledge of automated systems To understand the applications of automation in various sector To outline the basic concepts of Industrial Robots and drive system. To plan and to analyze the design concepts and applications of end effectors To identify the appropriate sensors for various robotics applications. To introduce the concepts such as Direct and inverse kinematics, DH parameters related to robotics and enable the students to design appropriate robotic systems and program them. 				
After successful c CO 1. Apply auto CO 2. Identify th CO 3. Outline the CO 4. Describe c CO 5. Select the effectors for CO 6. Identify th industrial a	omplet omation e autor e funda ontrol suitabl or vario e appli	tion of the course, students will able to: n principles and strategies mation need, type and method for various applica mentals of robotics and its components systems and select suitable robot drive e sensors for real time working of robotic arm and ous applications cations of robotics in various sectors and Prepare tions	tions d Design appropri Robot program fo	ate end or various	
		Course Contents			
UNIT-I		Fundamentals of Automation		07 Hours	
Definition, Types of an automatic sy	Definition, Types of Automation, Advantages, Goals and Issues in Automation, Industry 4.0, Components of an automatic system, Trends in Automation – PLC, DCS, SCADA, AI based Automation.				
UNIT-II	UNIT-II Applications of Automation 07 Hours				
Case Studies in Industrial Automation, Home Automation, Building Automation, Agricultural Automation, Medical Automation, Smart Cities and other applications, Future of Robotics and Automation					
UNIT-III		Fundamentals of Robotics		07 Hours	
Historical develop Asimov's laws of volume and work Resolution, accura	oment o robotio envelo acy and	of Robotics, Definitions of Industrial Robot, Type cs, Robot configurations, Robot Components, Ro pe, Robot Joints and symbols, Robot Coordinates I precision of Robot, Work cell control	e and Classificatio bot Degrees of Fr s, Robot Referenc	on of Robots, eedom, Work e Frames,	

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

Q11



UNIT-IV	Robot Drive Systems and Control System	09 Hours
Pneumatic Drives Motors, A.C. Ser Micro actuators, s Control Techniqu feedback control, Nonlinear nature	s, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo I vo Motors, BLDC-Salient Features, Applications and Comparison of a election of drive. les- Transfer function and state space representation, Performance a PID control of a single link manipulator, selection of PID controller gains of manipulators, and need for nonlinear control techniques	Motors, Stepper Ill these Drives, and stability of 3;
UNIT-V	Robot Sensors and End Effectors	09 Hours
Sensors in roboti Photo Electric Se Sensors- Range F Light Curtain, Las Grippers, Mechan grippers, Soft Ro end effectors inter	cs, Principles and applications of the following types of sensors- Pro ensors, Position sensors – Piezo Electric Sensor, LVDT, Resolvers, En- Finders, Laser Range Meters, Touch Sensors, Force and torque sensors, ser Area Scanner, Safety Switches, Machine vision. nical Grippers, Magnetic Grippers, Vacuum Grippers, Advance Grip botics Grippers, Tactile Sensor Grippers; Various process tools as end e face, Active and passive compliance, Selection and Design Consideration	ximity Sensors, coders, Range Safety Sensor: opers- Adaptive effectors; Robot
UNIT-VI	Robotic Applications and Robot Programing	09 Hours
Consumer Applic Emerging Applica Entertainment Ro AGVs, Underwate Introduction to Ro Motion Interpolat design considera Applications	ations. ations: Mobile Robots, Mining Robots, Medical Robots, Space Robots, D boots, Soft Robots, Collaborative Robots, Cloud Robots, Micro robots er Robots, Robotics and AI, RPA, obotic Programming, Various Teaching Methods, A Robot Program as a ion, various Textual Robot Languages, A robot-based manufacturing sys- tions and selection of robot, Robot Economics, Functional Safet	Pefense Robots, , Tele Robots, Path in Space, stem, robot cell ty in Robotic
Text Books: T1. Groover, M. Technology. T2. S. R. Deb, R T3. Groover M. Prentice Hal	P. Weiss, M. Nagel, R.N. &Odrey, N.G., Ashish Dutta, Industrial Robotic, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. Ne Robotics Technology and Flexible Automation, Tata McGraw Hill. PAutomation, production systems and computer integrated manufacturin 1 of India.	cs, w Delhi 1g-
Reference Books R1.S B Niku, Ir 2015. R2.Mikell P. Gu Learning Pv R3.John Craig, R4.R K Mittal & R5.Mike Wilson On-Line resourc 1. <u>https://onl</u> 2. <u>https://onl</u> 3. <u>https://onl</u>	troduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wil roover, Automation, Production Systems & Computer Integrated Manufac t. Ltd., New Delhi, ISBN: 987-81-203-3418-2, 2012 Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Ec & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015. n, Implementation of Robotic Systems, ISBN: 978-0-124-04733-4 es: inecourses.nptel.ac.in/noc19_me78 inecourses.nptel.ac.in/noc20_me58	ey Publication, cturing, PHI lucation, 2009

A148

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

Riphu.







S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III

	AR2203	L-Principles of Automation and Roboti	cs Laboratory
Teach LAB:	ning Scheme: 02 Hours/Week	Credit LAB: 01	Examination Scheme: ISCE: 30 Marks ESE: 20 Marks Total: 50 Marks
Cours	se Prerequisites: I	Knowledge of basic electronics and electrical eng	gineering.
Cours	se Objective: To help students To understand th To outline the ba To plan and to ar To identify the ap To introduce the and enable the st	gain essential and basic knowledge of automated e applications of automation in various sector sic concepts of Industrial Robots and drive syste alyze the design concepts and applications of er opropriate sensors for various robotics application concepts such as Direct and inverse kinematics, udents to design appropriate robotic systems and	l systems m. ad effectors ons. DH parameters related to robotics program them.
Cours After CO 1. CO 2. CO 3. CO 4. CO 5. CO 6.	se Outcome: successful complet Apply automatio Identify the autor Outline the funda Describe control Select the suitabl effectors for vario Identify the appli	ion of the course, students will able to: n principles and strategies nation need, type and method for various applic mentals of robotics and its components systems and select suitable robot drive e sensors for real time working of robotic arm an ous applications cations of robotics in various sectors and Prepar ions	ations nd Design appropriate end e Robot program for various
		Lab Contents	
Pracasse	etical/Oral examination ssed jointly by inte Total marks ass Continuous ass submission of l Final practical	Guidelines for Assessment ation based on the practical's performed in the rnal and external examiners. igned are 50. essment will be carried out based on attendance, ab file examination for specific practical and oral exami-	e lab. The Performance will be lab performance, and timely ination will be conducted
		List of Laboratory Assignments/Experin	nents
1 D	Demonstration of au	tomation systems in lab / industry.	
2 D	Demonstration of va	arious robotic configurations using industrial rob	oot
3 D	Design and selection	n of Gripper/End effector	
4 R	Robot programming	and simulation for pick and place	

All

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



5	Robot programming and simulation for Color identification
6	Robot programming and simulation for Shape identification
7	Robot programming and simulation for machining (cutting ,welding)
8	Robot programming and simulation for simple assembly process
9	Industrial visit for study the Industrial Automation and robotic applications

A1118

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -III AR2204T - Innovation and Entrepreneurship

Teaching Scheme TH:02 Hours/Wee	: ek	Credit TH:02	Examination S In Sem. Evalua Mid Sem. Exar End Sem. Exar	cheme: TH ntion:20 Marks n: 30 Marks n: 50 Marks
Course Prerequis	ites:			
Course Objective				
 To understa To select th To understa Finance, Co To understa 	and an he app and the osting and Bu	entrepreneur through case studies of success ropriate Product or Service for a business and e pain areas of an entrepreneur and study site and applied management in Business. usiness model Canvas and prepare Project Re	sful entrepreneurs. d Innovate in Global 7 e selection, market sur	Thrust Areas. wey, production, pusiness.
Course Outcome:				
After successful co	mplet	ion of the course, students will able to:		
CO 3. Apply the CO 4. Apply th	Auto he kno he Reg	mation, Environment, Health care, Energy, A owledge to start Business (Micro / Small Ent gistration process of an enterprise / Startup Course Contents	AI & ML. terprise)	indice and 1000
UNIT-I		To understand Entrepreneu	r	06 Hours
Who is an Entrepre Business Opportun	eneur? ity Ide	Case Studies of Successful Entrepreneurs. entification. Case study of any two products	or services.	1
UNIT-II		Innovation		06 Hours
What is Innovation	? Inno	ovation Principles to Ideate. Idea Generation	in global Thrust areas	5.
UNIT-III		Procedure for Investment		07 Hours
Planning a Micro, Investment, Payba	Small ck Per	Enterprise. Whom to contact for what. Mark iod, Break Even Analysis, Basics of Costing	et Survey tools. Retur	rn on
UNIT-IV		Registration of Startup		07 Hours
Business Model Ca Startup India Regis	anvas. stratio	Startup potential in India. Udyam Registration n on Startup India portal.	on on Ministry of MS	ME online.
			<u>∩</u> £	

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



Text Books:

- T1. The Dynamics of Entrepreneurship Development and Management by Vasant Desai Himalaya Publishing House.
- T2. A Manual for Entrepreneurs by Dr. Dinesh Awasthi, Entrepreneurship Development Institute of India, Ahmedabad.
- T3. Introduction to Entrepreneurship by Dr Santosh Kumar Sahu, Bookscape Publication.

Reference Books:

- R1.Entrepreneurship 11th Edition by Robert Michael P.,Peters Dean A.,Shephers Sabyasachi Sinha, Publication MC Graw Hill India
- R2. Project Management and Entrepreneurship by Dr. Vasant Desai, Himalaya Publishing House.

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









S. Y. B. Tech. (Automation and Robotics) Academic Year - 2024-2025 Semester -III **AR2205T - Industrial Psychology Teaching Scheme: Examination Scheme: TH** Credit **TH:02 Hours/Week TH:02** In Sem. Evaluation:20 Marks Mid Sem. Exam: 30 Marks End Sem. Exam: 50 Marks **Course Prerequisites: Course Objective:** The Objective of this course is to make students learn and understand basic concepts and principles of Economics applicable to the engineering profession and its environment, and to apply the knowledge gained to analyze, create and evaluate the economic environment applicable to engineering and technology. **Course Outcome:** After successful completion of the course, students will able to: **CO 1.** Understand and apply basic principles of Psychology **Course Contents** Introduction **UNIT-I 06 Hours** Psychology: A Science and a Perspective; Biology, Culture, and Human Behavior Sensation, Perception and Consciousness UNIT-II **06 Hours** Sensation and Perception: Making Contact with the World around Us; States of Consciousness Learning, Memory and Cognition **UNIT-III 09 Hours** Learning: How We're Changed by Experience; Memory: Of Things Remembered.... and Forgotten; Cognition: Thinking, Deciding, Communicating **Human Development UNIT-IV 06 Hours** Human Development I: The Childhood Years; Human Development II: Adolescence, Adulthood, and Aging Motivation, Emotion, Intelligence and Personality UNIT-V **09 Hours** Motivation and Emotion; Intelligence: Cognitive, Practical, and Emotional; Personality: Uniqueness and Consistency in the Behavior of Individuals **UNIT-VI** Health and Social Psychology **09 Hours** Health, Stress, and Coping; Social Thought and Social Behavior **Text Books:** T1. Psychology: Robert A Baron, Girishwar Misra; Indian Subcontinent Edition, Pearson, 5th edition. **Reference Books:** R1. Essentials of Understanding Psychology: Robert Feldman; McGraw-Hill Education; 11th edition

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV HS2203T– Universal Human Values and Ethics

Credit	Examination Scheme: TH
TH: 02	In Sem. Evaluation: 20 Marks
	Mid Sem. Exam: 30 Marks
	End Sem, Exam: 50 Marks
	Credit TH: 02

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

2. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

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

CO1: The students can understand happiness and prosperity, which are the core aspiration of all human beings.

CO2: The development of a holistic perspective towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and rest of existence

CO3: The students can understand the implication of such holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with nature.

Course Contents Introduction to value education UNIT-I **05 Hours** Understanding value education, Self-exploration as the process for value education, Happiness and Prosperity, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity - Current Scenario, Method to fulfil the basic human aspirations **UNIT-II** Harmony in Human being **10 Hours** Understanding human being as a coexistence of the self and body, Understanding the needs of Self and Body, The Body as an Instrument of the Self, Understanding activities of Self, Understanding Harmony in the Self, Understanding the Harmony in self with body, Programs to fulfil the self-regulation and health UNIT-III Harmony in Family and society **12 Hours** Harmony in family-a basic unit of human interaction, Human--human relationship, Values in relationships, understanding harmony in the society, vision for universal human order **UNIT-IV** Harmony in Nature and existence **06 Hours**

Understanding the harmony in nature, understanding the four orders of nature, realizing existence as coexistence at all levels, holistic perception of harmony in existence

UNIT-V Implications of the Holistic Understanding of Harmony 09 Hours Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Universal

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



Human	Order,	Competence	in	professional	ethics,	Holistic	technologies,	production	systems	and
manager	nent mo	dels: Typical	case	e studies						

Text Books:

T1: Human Values & Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

T2: Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999. T3: Manav Vyavhar Darshan, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 2001.

All

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







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

S. Y. B. Tech (Automation and Robotics) Academic Year – 2024-2025 Semester -III A R2206L : Introduction to Python Programming & Data Science

mazzool, introduction to rython rrogramming & Data Science				
Teaching Scheme:	Credit	Examination Scheme:		
LAB :02 Hours/Week	LAB: 01	ISCE: 30 Marks		
		ESE: 20 Marks		
		Total: 50 Marks		

Course Prerequisites:

Course Objective:

The Objective of this course is to make students learn and understand basics of programming, data structure and algorithms using C programming language, and to apply the knowledge gained to solve computational problems.

Course Outcome:

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

CO1: Develop Python program to demonstrate use of operators and data types.

CO2: Develop Python program using lists, tuples and dictionaries.

CO3: Develop python program using Function, modules and packages.

CO4: Design Classes for given problem.

CO5: Perform file operations to read and write data in files.

Lab Contents

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 50.
- 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

List of Laboratory Assignments/Experiments

1	Syntax basics, Arithmetic/String Operations, Input/Output
2	Control Flow constructs: If-else, Relational and Logical Operators
3	Iteration: While loop, For loop.
4	Collections: Lits, Tuples
5	Collections: Sets, Dictionary
6	Functions and Modules: sys, math, time
7	File Handling: Data streams, Access modes, Read/Write/Seek
8	Exception handling: hierarchy, raise, assert
9	OOP: Classes, Objects
10	GUI programming: TkInter
11	Working with Numpy arrays, Pandas data frames
12	To draw basic plots in Python program using Matplotlib

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



Text Books:

- T1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers,2016
- T2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books:

- R1.Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
- R2.John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press, 2013
- R3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
- R4.Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3",

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



SEMESTER IV Syllabus

AUS

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









S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV AB2207T Sensors and Instrumentation

AR2207T – Sensors and Instrumentation						
Teaching Scheme: TH:03 Hours/Week	Credit TH:03	Examination Scl In Sem. Evaluati Mid Sem. Exami End Sem. Exam	neme: TH ion:20 Marks : 30 Marks : 50 Marks			
Course Prerequisites: Basics of sensing elements, bridges and basic electronics Course						
 Course Objective: 1. To introduce the fundamentals of electrical measurements and instrumentation 2. To Understand basic principles of sensing various parameters 3. To Develop mathematical background of sensor design 4. To Learn selection of sensors for typical applications 5. To introduce students with different types ADCs and DACs. 6. To understand different analog and digital modulation methods and understanding of major building 						
Course Outcome: After successful completion CO1:Calibrate and monitor a CO2: Ability to design and a CO3:Demonstrate an unders CO4:To Learn selection of s CO5: Know the complete in ADC and DAC ICs.	Course Outcome: After successful completion of the course, students will able to: CO1:Calibrate and monitor a variety of electronic instruments CO2: Ability to design and conduct experiments for measurement. CO3:Demonstrate an understanding of various types of sensors and transducers CO4:To Learn selection of sensors for typical applications CO5: Know the complete internal structure of ADCs and DACs. Perform the experiments, analysis on					
	Course Contents					
UNIT-I	Introduction		07 Hours			
Basics of measurement–Significance of measurement–Units and Standards–Calibration techniques–Errors in measurement–Generalized measurement system–Sensors and Transducers–Classification of transducer– Static and dynamic characteristics of transducer–Sensor calibration techniques. Criteria for selection of sensors- range, dynamic range, sensitivity, Linearity, response time, band width, accuracy, repeatability & precision, Resolution & threshold, type of output, size and weight, environmental conditions, interfacing.						
UNIT-II Disp	lacement, Force, Pressure and Tempera	ture Sensors	07 Hours			
Position / Displacement sensors - Potentiometric Sensor –Capacitive sensors – Inductive and Magnetic sensors – LVDT, RVDT, Eddy Current, Hall effect, Magneto resistive, Magneto strictive – Ultrasonic – Radar – Strain Gauge – Tactile Sensor – Piezo electric Bellows, Membranes, and Thin Plates–Piezo-resistive Sensors–Vacuum sensor–Thermo-sensitive Sensors–RTD– Thermistors–Thermo electric Contact Sensors–Optical Temperature sensor –Pvrometers.						
UNIT-III	Optical, Vibration and Acoustic Ser	ISORS	07 Hours			
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors, Vibrations sensors – accelerometers etc. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.						
Dr. A. M. Badadhe Dr. Ram Joshi Dr. R. K. Jain						
BOS Chairman (A & R) Dean Academics, RSCOE, Pune Director, RSCOE, Pune						

UNIT-IV	Range, Heading and Advanced Sensors	07 Hours				
Range Sensors – F Heading Sensors – Ionization detector	Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR) – Heading Sensors – GPS, Compass – Humidity sensor – Hygrometer – Radiation Sensors – Scintillation, Ionization detector – Gas Sensors – Bio sensor					
UNIT-V	Vision Based Sensors	07 Hours				
Vision based sense feature extraction, CCD and CMOS C sensor; Block scher	Vision based sensors- Elements of vision sensor, image acquisition, image processing, edge detection, feature extraction, object recognition, pose estimation and visual serving, hierarchy of a vision system, CCD and CMOS Cameras, Monochrome, stereovision, night vision cameras, still vs video cameras, kinect sensor: Block schematic representations					
UNIT-VI	Data Acquisition and Signal Conditioning	07 Hours				
Components of An Software – Data L D/A Converters, Da	alog & Digital DAQ system – Uses of Data Acquisition systems – D oggers – Amplification – Isolation – Filtering – Sample and Hold ci ata Acquisition: Single channel and multi -channel data acquisition	DAQ Hardware & arcuits – A/D and				
T1. Ernest O Do T2. Sawney A I Control", 12 T3. Peter Elgar,	Debelin, "Measurement Systems – Applications and Design", Tata McC K and Puneet Sawney, "A Course in Mechanical Measurements and Ir 2th edition, Dhanpat Rai & Co, New Delhi, 2013. "Sensors for Measurement and Control", Addison-Wesley Longman I	Graw-Hill, 2009 Instrumentation and Ltd, 1998.				
Reference Books: R1.C.Sujatha, W. Dyer,S.A.,SurveyofInstrumentationandMeasurement,JohnWiley&Sons,Canada,2001 R2. Hans Kurt Tönshoff (Editor),Ichiro, "Sensors in Manufacturing"Volume1,Wiley-VCHApril2001. R3.John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999. R4.PatranabisD,"Sensorsand Transducers",2 nd Edition,PHI,NewDelhi,2011. R5.RichardZurawski,"IndustrialCommunication Technology Handbook"2 nd edition,CRCPress,2015 R6. Robert B. Northrop, "Introduction to Instrumentation & Measurements", 3rd Edition, CRC Press, 2014.						
1. https://nptel.ac.in/courses/108105/108105064/ 2. https://archive.nptel.ac.in/courses/108/105/108105064/ 3. https://onlinecourses.nptel.ac.in/noc19 ee44/preview 4. http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/fundamental.html						

A148

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

RID







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV A R2207L – Sensors and Instrumentation Laboratory

AR2207L = Schools and instrumentation Laboratory			
Teaching Scheme:	Credit	Examination Scheme:	
LAB :02 Hours/Week	LAB: 01	ISCE: 30 Marks	
		ESE: 20 Marks	
		Total: 50 Marks	

Course Prerequisites: Basics of sensing elements, bridges and basic electronics Course

Course Objective:

1.To introduce the fundamentals of electrical measurements and instrumentation

2. To Understand basic principles of sensing various parameters

3. To Develop mathematical background of sensor design

4. To Learn selection of sensors for typical applications

5. To introduce students with different types ADCs and DACs.

6. To understand different analog and digital modulation methods and understanding of major building blocks of data communication system.

Course Outcome:

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

CO1:Calibrate and monitor a variety of electronic instruments

CO2: Ability to design and conduct experiments for measurement.

CO3:Demonstrate an understanding of various types of sensors and transducers

CO4:To Learn selection of sensors for typical applications

CO5: Know the complete internal structure of ADCs and DACs. Perform the experiments, analysis on ADC and DAC ICs.

List of Laboratory Assignments/Experiments

1	Testing of Sensor / Transducer (any two types) to calculate: accuracy, precision, span, range, error, resolution etc.
•	

- Experimentation on LVDT/ RVDT to plot its performance characteristics.
- 3 Measurement of Load / Force using Strain Gauge set up
- 4 Measurement of temperature using thermocouples/ thermistors/RTD/Pyrometer etc.
- 5 Testing of Photo conductive / photo voltaic / Photo resistive cell

6 Application of Laser sensor for flow/level/displacement/position etc. measurement

7 Trial on Range Sensors – RF beacons /Ultrasonic Ranging /Reflective beacons /Laser Range Sensor (LIDAR)

8 Performance of any one type of Vision based sensor for suitable application

9 Interfacing of sensor / transducer to DAQ system and monitor the o/p on computer.

Text Books:

T1. Ernest O Doebelin, "Measurement Systems - Applications and Design", Tata McGraw-Hill, 2009

T2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

T3. Peter Elgar, "Sensors for Measurement and Control", Addison-Wesley Longman Ltd, 1998.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



Director, RSCOE, Pune

Reference Books:

R1.C.Sujatha, W. Dyer, S.A., SurveyofInstrumentation and Measurement, John Wiley & Sons, Canada, 2001 R2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume1, Wiley-VCHApril2001. R3.John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

R4.PatranabisD, "Sensorsand Transducers", 2ndEdition, PHI, NewDelhi, 2011.

R5.RichardZurawski,"IndustrialCommunication Technology Handbook"2ndedition,CRCPress,2015 R6. Robert B. Northrop, "Introduction to Instrumentation & Measurements", 3rd Edition, CRC Press, 2014.

On-Line resources:

- 1. https://nptel.ac.in/courses/108108147
- 2. https://archive.nptel.ac.in/courses/108/105/108105064/
- 3. <u>https://onlinecourses.nptel.ac.in/noc19_ee44/preview</u>
- 4. http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/fundamental.html

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV AR2208T – Hydraulics and Pneumatics

	i ilyuluulles ullu i lleul	nunco		
Teaching Scheme:	Credit	Examination Scheme: TH		
TH:03 Hours/Week	TH:03	In Sem. Evaluation:20 Marks		
		Mid Sem. Exam: 30 Marks		
		End Sem. Exam: 50 Marks		
Course Pre requisites: Fluid Mechanic	es, Manufacturing Processes and	Machines, Mechatronics		
Course Objective:				
• To provide student with know	ledge on the application of flui	d power in process Construction and		
manufacturing Industries.				
• To provide students with an	understanding of the fluids	and components utilized in modern		
industrial fluid power system.				
• To develop a measurable degr	ree of competence in the design	n, construction and operation of fluid		
power circuits.	1			
Course Outcome:				
After successful completion of the cou	urse, students will able to:			
CO1: Understand the Fluid power and	operation of different types of	pumps.		
CO2: Summarize the features and fun	ctions of Hydraulic motors, actu	ators and Flow control valves.		
CO3: Understand the Different types of Hydraulic circuits and systems				
CO4: Understand the working of different pneumatic circuits and systems				
CO5: Summarize the various trouble shooting methods and applications of hydraulic and pneumatic				
systems				
	a a			

Course Contents

UNIT-I

FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS

07 Hours

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids -Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT-II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 07 Hours

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT-III

HYDRAULIC CIRCUITS AND SYSTEMS

07 Hours

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

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



UNIT-IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	07 Hours			
Properties of air	– Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, M	uffler, Air control			
Valves, Quick Ex	xhaust Valves, Pneumatic actuators, Design of Pneumatic circuit - C	Cascade method –			
Electro Pneumat	ic System – Elements – Ladder diagram – Problems, Introduction	n to fluidics and			
pneumatic logic c	ircuits.				
UNIT-V	TROUBLE SHOOTING AND APPLICATIONS	07 Hours			
Installation, Selec	tion, Maintenance, Trouble Shooting and Remedies in Hydraulic and P	neumatic systems,			
Design of hydra	ulic circuits for Drilling, Planning, Shaping, Surface grinding, P	ress and Forklift			
applications. Des	ign of Pneumatic circuits for Pick and Place applications and tool	handling in CNC			
Machine tools – I	ow cost Automation – Hydraulic and Pneumatic power packs.				
Text Book:					
1. Anthony Espo	sito, —Fluid Power with Application, Pearson Education (Singapore	e) Pvt. Ltd, Delhi,			
India, 2003.					
2. Majumdar S.R.	, —Oil Hydraulics Systems- Principles and Maintenancel, Tata McGrav	w-H1ll, 2001.			
Reference Books:					
1. Anthony Lal, –	-Oil hydraulics in the service of industry, Allied publishers, 1982.				
2. Dudelyt, A. Pe	ase and John T. Pippenger, —Basic Fluid Powerl, Prentice Hall, 1987.				
3. Majumdar S.R., —Pneumatic systems – Principles and maintenancel, Tata McGraw Hill, 1995					
4. Michael J, Prinches and Ashby J. G, —Power Hydraulics, Prentice Hall, 1989.					
5. Shanmugasundaram.K, —Hydraulic and Pneumatic controls, Chand & Co, 2006.					
On-Line resources:					
1. <u>Oil Hydraulics and Pneumatics - Course (nptel.ac.in)</u>					
2. <u>NPTEL :: Mechanical Engineering - Fundamentals of Industrial Oil Hydraulics and Pneumatics</u>					

A148

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

RU







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV AR22081 – Hydraulics and Pneumatics Laboratory

	ij di danco dila i neamatico	Laboratory
Teaching Scheme:	Credit	Examination Scheme:
LAB :02 Hours/Week	LAB: 01	ISCE: 30 Marks
		ESE: 20 Marks
		Total: 50 Marks

Course Pre requisites: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics Course Objective:

- To provide student with knowledge on the application of fluid power in process Construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

Course Outcome:

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

CO1: Understand the Fluid power and operation of different types of pumps.

CO2: Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.

CO3: Understand the Different types of Hydraulic circuits and systems

CO4: Understand the working of different pneumatic circuits and systems

CO5: Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems

Lab Contents

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 50.
- 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

	r mar provident en annual en a			
	List of Laboratory Assignments/Experiments			
1	Design and making of simple pneumatic and hydraulic circuits using basic components.			
2	Simulating Cylinder: Sequencing, Reciprocating, synchronizing and Speed control Hydraulic Circuit			
3	Develop systems for automatic reciprocating actuator using electro – pneumatic elements			
4	Construction and testing of a hydraulic actuator circuit for any suitable application.			
5	Built a Electro-hydraulic circuit for suitable application.			
6	Design and Simulation of hydraulic circuits using simulation software			
7	Design and Simulation of pneumatic circuits using simulation software			

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



8 Design Report of Hydraulic / Pneumatic System for any industrial application.

Text Book:

1. Anthony Esposito, —Fluid Power with Application^{II}, Pearson Education (Singapore) Pvt. Ltd, Delhi, India, 2003.

2. Majumdar S.R., —Oil Hydraulics Systems- Principles and Maintenancel, Tata McGraw-Hill, 2001.

Reference Books:

1. Anthony Lal, —Oil hydraulics in the service of industry^{||}, Allied publishers, 1982.

- 2. Dudelyt, A. Pease and John T. Pippenger, -Basic Fluid Powerl, Prentice Hall, 1987.
- 3. Majumdar S.R., —Pneumatic systems Principles and maintenancell, Tata McGraw Hill, 1995
- 4. Michael J, Prinches and Ashby J. G, -Power Hydraulics, Prentice Hall, 1989.
- 5. Shanmugasundaram.K, -Hydraulic and Pneumatic controls, Chand & Co, 2006.

On-Line resources:

- 1. Oil Hydraulics and Pneumatics Course (nptel.ac.in)
- 2. <u>NPTEL :: Mechanical Engineering Fundamentals of Industrial Oil Hydraulics and Pneumatics</u>

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









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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV

AR22091 – Automatic Control System					
Teaching Scheme: TH:03 Hours/Week		Credit TH:03	CreditExamination Scheme: THTH:03In Sem. Evaluation:20 MarksMid Sem. Exam: 30 MarksEnd Sem. Exam: 50 Marks		
Course Pre requi	sites: Bas	ic electrical systems and basic transforms su	ich as Laplace and	Z transforms	
Course Objective	This cou	urse provides an introduction to the elements	s of control system	ns and their	
modeling using va	rious tech	niques. The objective of this course is to an	alyze (Introduce) t	he systems in	
time and frequency	y domain	which predict the stability of control system	iS.		
Course Outcome: After successful co CO1: Model a phy diagrams and Sign CO2: Analyze a li CO3: Model and a CO4: Visualize th	mpletion ysical and al flow gr near contranalyze th e concept	of the course, students will able to: electrical system and visualize its input-ou raph. rol system in time and frequency domain us e control system using state space analysis. of PID controllers and analyze digital contr	tput relationships ing graphical meth ol system using tra	by means of block ods. ansfer function.	
		Course Contents			
UNIT-I		INTRODUCTION		07Hours	
Introduction to control system-Basic elements of control system- Open and Closed loop control systems- Differential equation representation of physical systems-Transfer function, Force – Voltage, Force – Current analogy					
UNIT-II		MATHEMATICAL MODELI	NG	07 Hours	
Mathematical mod system -Block diag	leling of e gram redu	electrical and mechanical systems (Translation techniques- Signal flow graph, Masso	onal and Rotationa n's Gain Formula	l) Analogous	
UNIT-III		TIME DOMAIN ANALYSI	S	07 Hours	
Time response analysis-Analysis of transient and steady state behavior of control systems- Standard test signals –Time response of First order system- step, ramp and impulse response analysis-Second order system – step response analysis- steady state error- generalized error co-efficient–Response with P, PI, PD and PID controllers					
UNIT-IV		STABILITY ANALYSIS AND ROOTL	OCUS	07 Hours	
Concepts of stability-Location of poles on s-plane for stability-Routh-Hurwitz stability criterion- Root locus Techniques					
UNIT-V		FREQUENCYDOMAINANAL	YSIS	07 Hours	
Frequency response-Frequency domain specifications- Correlation between time domain and frequency domain specifications-Bode plot- Stability analysis using Bode plot- transfer function from Bode plot, Nyquist stability criterion & Plot					
Dr. A. M. Badadhe Dr. Ram Joshi Dr. R. K. Jain					

BOS Chairman (A & R)

Dean Academics, RSCOE, Pune



UNIT-VI

STATE SPACE ANALYSIS

07 Hours

State space model of a control system-State space representation using physical, phase and canonical variables-diagonal canonical form-Jordan canonical form, State transition matrix, state observer, eigen values and eigen vectors

Text Books:

T1. Benjamin C. Kuo, "Automatic Control Engineering", 7th Edition Prentice Hall of India Pvt. Ltd. T2.I. J. Nagrath, M. Gopal, Control Systems Engineering, Fifth Edition, New Age International, New Delhi,2011.

Reference Books:

- R1.R. Ananda Natarajan, P. Ramesh Babu, Control Systems Engineering, Second edition, SciTech Publications, 2005.
- R2. Benjamin C. Kuo, Automatic Control Systems^{II}, Seventh Edition, PHI Learning, New Delhi, 1997
- R3. Katsuhiko Ogata, Discrete Time Control Systems, Second Edition, PHI Learning, New

On-Line Resources:

- 1. <u>https://onlinecourses.nptel.ac.in/noc21_me13/preview</u>
- 2. https://nptel.ac.in/courses/108101037
- 3. <u>https://onlinecourses.nptel.ac.in/noc20_me39/preview</u>

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV R2209L – Automatic Control System Laborat

	AK2209L – Automatic Control System Laboratory								
Teaching	g Scheme:	Credit	Examination Scheme:						
LAB :02	Hours/Week	LAB: 01	ISCE: 30 Marks						
			ESE: 20 Marks						
			Total: 50 Marks						
Course F	Pre requisites: Bas	ic electrical systems and basic transforms s	uch as Laplace and Z transforms						
Course (Dbjective: This cou	irse provides an introduction to the element	ts of control systems and their						
modeling	s using various tech	niques. The objective of this course is to ar	alyze (Introduce) the systems in						
time and	frequency domain	which predict the stability of control system	ns.						
Course (Dutcome:								
After suc	cessful completion	of the course, students will able to:							
CO1: Mo	odel a physical and	electrical system and visualize its input-ou	itput relationships by means of block						
diagrams	and Signal flow gr	aph.							
CO2: An	alyze a linear cont	rol system in time and frequency domain us	sing graphical methods.						
CO3: Mo	odel and analyze th	e control system using state space analysis.							
CO4: V1	sualize the concept	of PID controllers and analyze digital cont	rol system using transfer function.						
		Lab Contents							
		Guidelines for Assessment							
Practica	al/Oral examination	n based on the practical's performed in	the lab. The Performance will be						
assessed	d jointly by interna	l and external examiners.							
•	Total marks assign	ed are 50.							
-	Continuous assessi	nent will be carried out based on attendance	e, lab performance, and timely						
	submission of lab f	ile							
Final pr	ractical examination	a for specific practical and oral examination	will be conducted						
	List of Labo	ratory Assignments/Experiments (Any ei	ght to be performed)						
1	Simulation of a ty	pical second order system and determination	on of step response and evaluation of t						
	domain specificat	ions.							
2	Evaluation of effe	ect of pole location on stability							
3	Transfer function	of any physical systems (AC Servomotor/	Two Tank System/Temperature control						
	Level control)								
4	Study and testing	of D.C. Motor Position control System.							
5	Control of level/F	ressure/Temperature using PID controller.							
6	To obtain Nyquis	t plot for a given transfer function of the sy	stem using MATLAB.						
7	To obtain Bode p	lot for a given transfer function of the syste	m using MATLAB.						
8	To plot the root lo	ocus for a given transfer function of the sys	tem using MATLAB						
9	To investigate the	effect of P, PI and PID controller on time	response of second order system.						
10	Experimental stud	ly of time response characteristics of R-L-G	C second order system: Validation						

AUS

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



	using simulation								
11	Using simulation. Experimental determination of DC serve motor parameters for mathematical modeling, transfer								
11	function and characteristics								
12	Simulation of state transition matrix by various methods using MATLAB.								
Text Bo									
T1. Be	eniamin C. Kuo, "Automatic Control Engineering", 7th Edition Prentice Hall of India Pvt. Ltd.								
T2.I. J	Nagrath, M. Gopal, Control Systems Engineering, Fifth Edition, New Age International, New								
Delhi,2011.									
Referen	ce Books:								
R1.R	L. Ananda Natarajan, P. Ramesh Babu, Control Systems Engineering, Second edition, SciTech								
ץ חרת	ublications, 2005.								
R2. D R3 K	atsubiko Ogata Discrete Time Control Systems Second Edition PHI Learning, New Denn, 1997								
On-Line	Resources:								
1. <u>h</u>	ttps://onlinecourses.nptel.ac.in/noc21_me13/preview_								
2. <u>h</u>	ttps://nptel.ac.in/courses/108101037								
3. <u>h</u>	ttps://onlinecourses.nptel.ac.in/noc20_me39/preview_								

Dr. A. M. Badadhe

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

RIDUIT







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

S. Y. B. Tech. (Automation and Robotics) Academic Year - 2024-2025 Semester -IV AR2210L – Product Development & Modeling Laboratory

	I Toudet De		
Teaching Scheme:		Credit	Examination Scheme:
LAB :02 Hours/Week		LAB: 01	ISCE: 30 Marks
			ESE: 20 Marks
			Total: 50 Marks

Course Prerequisites: Engineering Graphics

Lab Contents

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 50.
- 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

List of Laboratory Assignments/Experiments

- Introduction to product design to create new ideas. 1
- Development of ideas through a process that leads to new products. 2
- 3 Create scale model of new product using Rapid Prototyping.
- 4 Introduction to Modeling software like CATIA, CREO, NX.
- 5 Develop 3D models of all parts in details by applying advanced tools-I.
- Develop 3D models of all parts in details by applying advanced tools-II. 6
- 7 Create assembly using all parts with appropriate constraints.
- Creating Production Drawing and animation for assembly (minimum 5 parts). 8 9
 - Assignment
 - i. Assignment based on Industrial drawing
 - Assignment based on Innovative creation like future base design. ii.

Reference Books:

- R1.N. D. Bhatt and V.M. Panchal, Machine Drawing, Charoter Publications
- R2. ASME Y14.5 2009

R3. Ibrahim Zeid, Mastering CADCAM, McGraw-Hill

R4. Help manuals and tutorials of referred software

Online Resources:

https://nptel.ac.in/courses/112/104/112104230/

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV

ES2206T – Introduction to Environmental Science and Engineering

Teaching Scheme:	Credit	Examination Scheme: TH
TH:02 Hours/Week	TH:01	In Sem. Evaluation:20 Marks
		Mid Sem. Exam: 30 Marks
		End Sem. Exam: 50 Marks

Course Prerequisites: The student should have completed four semesters of UG Engineering

Course Objective:

- To understand renewable, non-renewable energy, alternate energy, nonconventional energy resources.
- To understand concept of sustainable development.
- To understand causes and different methods for controlling air pollution.
- To understand importance of usage of biodegradable & ecofriendly polymers or plastics in everyday life.
- To understand importance OF Climate change, impacts, adaption and Mitigation
- To understand importance disaster management.

Course Outcome:

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

CO1: Explain renewable, non-renewable energy sources and alternate energy sources.

CO2: Formulate action plans for sustainable development.

CO3: Suggest different methods for controlling air pollution.

CO4: Utilize biodegradable and ecofriendly polymers or plastics.

CO5: Explain reasons for climate, its impact and mitigation measures for climate change.

CO6: Demonstrate importance of disaster management.

Course Contents

UNIT-I Energy Resources 08 Hours

Sources of energy and their classification: Renewable and non-renewable energy sources, Use of alternate energy sources: Power alcohol and Biodiesel Hydrogen as a future fuel. Utilization of solar in space heating and water heating. Conversion of solar energy into electricity. Biomass energy resources. Fuel cell (H₂-O₂) and Polymer Electrolyte Membrane Fuel Cell (PEM).

UNIT-II

Introduction to Sustainable Development

07 Hours

Need and concept of sustainability. Social, environmental and economic sustainability concept. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs. Introduction to environmental impact analysis(EIA)- Historical background, Elements of EIA process. Participants in EIA process. Design of EIA. Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Eco labeling /Eco mark scheme Environmental Audit for sustainable development. Eco labeling of Environment Friendly –Products.

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



UNIT-IIIAir Pollution Science and Engineering07 HoursComposition and structure of atmosphere. Classification of air pollutants and their effects, acid rain,
photochemical smog and particulates. Sources, Characteristics and biochemical effects of some important
air pollutants. Effects of air pollutants on man and his environment. Air quality standards and monitoring.
Atmospheric sampling and analysis. Methods and equipment used to control gase-us pollutants and
industrial effluents. Air quality management; Indoor air pollution.07 Hours

UNIT-IV		Green Tech	nology and	Ecofri	endly	Polymers		0	7 Hours
Twelve Princip	les of Green	n Chemistry,	zero waste	techno	logy,	environme	ntal degrada	tion of	of polymers.
Biodegradable	Polymers.	Bioplastics:	Polylactic	acid,	Poly	hydroxy	butyratevale	erate	(BIOPOL),
Polycaprolacton	e. Concept	of bioremedia	tion.						

UNIT-V	Climate Change: Impacts	, Adaptation and Mitigation	07 Hours
--------	--------------------------------	-----------------------------	----------

Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs);Climate justice.

UNIT-VI

Disaster management

07 Hours

Basic Concepts of Disaster Management: Introduction, necessity of studying Disaster Management (DM); Types of disasters. Vulnerability. Disaster Risk, Assessing Disaster Risk and ways of minimizing disaster risk. Disaster Risk Management (DRM) plan. Natural Hazards Risk management, Climate Disasters & amp; Agriculture. Industrial hazard Risk Management.

Text Books:

T1. A Text book of Environmental Chemistry and Pollution Control – S. S. Dara

Reference Books:

R1. Environmental Pollution: Monitoring and Control-S.M. Khopkar

R2. Sustainability Engineering concepts, design and case studies-Allen ,D.T and Shonnard D.R

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV HS2206L – Soft Skills

Teaching Scheme:	Credit	Examination Scheme:
LAB :02 Hours/Week	LAB: 01	ISCE: 30 Marks
		ESE: 20 Marks
		Total: 50 Marks
Cuidolinos for Asso	semant/Cuidalinas for Lab	TW Assossment

Guidelines for Assessment/Guidelines for Lab /TW 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 50.
- 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

	List of Laboratory Assignments/Experiments						
1	Skill training, Employability training, Pre-job trainings.						
2	Introduce yourself with SWOT analysis						
3	Life Skill Management.						
4	Development of leadership qualities and Public speaking skills.						
5	Group discussion on environment protection.						
6	Confidence Management.						
7	A group discussion on importance of personality development.						
8	Assignment on Goal Setting and Time Management.						
9	Assignment on Team building and assigning work distribution.						
10	Assignment on computer ethics (Social impact of computers)						
11	Assignment On the Job Training (OJT) and apprenticeships shall form an integral						
	part of a skills based program.						

Reference Books:

R1.Campbell, J., Baikaloff, N., & Power, C. (2006). Towards a global community: Educating for tomorrow's world. Dordrecht: Springer

R2.Boston Consulting Group (2010), Winning in Emerging Market Cities: A Guide to the World's Largest Growth Opportunity, Boston Consulting Group, Boston

R3.M. Govindarajan, S. Natarajan, V.S. Senthil Kumar, "Professional Ethics and Human Values", PHI Learning Press

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







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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV HS2205T– Economics

HS2205T– Economics									
Teaching Scheme: TH:02 Hours/Week	ing Scheme: Credit Examination Scheme: TH Hours/Week TH:02 In Sem. Evaluation:20 Marks Mid Sem. Exam: 30 Marks End Sem. Exam: 50 Marks								
Course Prerequisite	Course Prerequisites: The student should have completed four semesters of UG Engineering								
Course Objective:	Course Objective:								
The Objective of this course is to make students learn and understand basic concepts and principles of									
Economics applicab	le to the engi	ineering profession and its enviro	onment, and to appl	y the knowledge					
gained to analyze,	create and	evaluate the economic environm	nent applicable to	engineering and					
technology.									
Course Outcome:									
After successful con	pletion of the	course, students will able to:							
CO1: Understand an	id apply basic	principles of Microeconomics							
CO2: Understand an	id apply basic	principles of Macroeconomics							
CO3: Gain basic kno	owledge on In	dian Economy							
		Course Contents							
UNIT-I		Microeconomics		14 Hours					
Introduction to markets and prices; Producers, consumers and competitive markets; Market structure and									
competitive strategy									
UNIT-II		Macroeconomics		14 Hours					
Goods and financial	markets, labo	or markets, Unemployment, Inflati	on, Economic grow	th, Technological					
progress and growth									
UNIT-III		Indian Economy		14 Hours					
Planning and econor	nic developme	ent; Agriculture in the national eco	nomy; Indian Indust	ries					
Text Books:			•						
T1. Microeconon	nics: Robert P	indyck, Daniel Rubinfeld; Pearson	Education India; 8t	h Edition.					
T2. Macroeconomics: Olivier Blanchard, David H. Johnson: Pearson: 6th edition.									
12. Macroeconomics: Ulivier Blanchard, David H. Johnson; Pearson; oth edition. T3 Datt and Sundharam's Indian Economy: Gauray Datt Ashwani Mahajan: S. Chand & Contract									
T3. Datt and Sun	T3. Datt and Sundharam's Indian Economy: Gaurav Datt, Ashwani Mahajan; S. Chand & Co.; 72nd edition								
T3. Datt and Sun edition.	dharam's Indi	an Economy: Gaurav Datt, Asnwa	ni Manajan; S. Char	nd & Co.; 72nd					
T3. Datt and Sun edition. Reference Books:	dharam's Indi	an Economy: Gaurav Datt, Ashwa	ni Manajan; S. Char	id & Co.; 72nd					
T3. Datt and Sun edition. Reference Books: R1. Microeconom	nics: Samuelso	on, Nordhaus; McGraw Hill Educa	tion; 19th edition.	ld & Co.; 72nd					

R3. Indian Economy: V.K. Puri, S.K. Misra, Bharat Garg; Himalaya Publishing House; 40th edition.

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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





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

S. Y. B. Tech. (Automation and Robotics) Academic Year – 2024-2025 Semester -IV AR2211L – Co-Curricular Course - 2

Teaching Scheme:	Credit	Examination Scheme:	
LAB :02 Hours/Week	LAB: 01	ISCE: 50 Marks	
		Total: 50 Marks	

Course Objectives:

One of the fundamental principles of New Education Policy 2020 (NEP 2020) is no hard separations between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning; (Page No 5 of NEP 2020 document). Further National Credit Framework (NCrF) recognizes no hard separation between different areas of learning, i.e. arts and sciences, vocational and academic streams, curricular and extra-curricular for the purpose of assignment of credits and credit levels. Hence, credits are assigned to sports and games, and various club activity.

Course Outcomes:

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

Guidelines for Assessment

- RSCOE shall organize various competitions through its various clubs (governed by either by Student Affairs or Department) during the semester and academic year.
- All UG students shall choose at least ONE activity/event from the group of Co-curricular and Extra-curricular activities happening on campus or off campus during the semester. The student shall take active part in the activity, take part in competitions and earn grade points
- On registering for a particular activity, the performance of a student shall be continuously monitored by the Faculty-in-charge.

RSCOE shall have club activities into three categories.

- 1. Art Club
- 2. Technical Club
- 3. Sports and Games
- 4. SWAYAM
- Art club include various clubs related to liberal arts, music, performing art etc.
- Technical club include chapters of professional societies like SAE, ASRAE, ISHRAE, CSI, RSI, IEEE, ISTE, IET, Department Associations, Supra, BAE, Robocon club etc.
- National Service Scheme (NSS) and Similar activities such as Unnat Bharat, Social Work, Blood donation etc.
- SWAYAM portal offers some self-paced courses related with YOGA such as Physical Activity (YOGA) (योग) or approved by Dean concern.
- Participation in competitions, winning prizes, representing institute on state, national and international level etc shall get weightage as mentioned in the Table

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

Dr. Ram Joshi Dean Academics, RSCOE, Pune



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

			Marks*	Grade	Letter			
•	 Art clubs Technical Clubs Sports Any other competition/ activity defined by institute/ department. 	NSS/NCC/Unnat Bharat Abhiyan	Participation in events outside of the institutes	SWAYAM Courses (only 4 week course approved Dean concern)	Leadership & Management of clubs/activities/ Student Professional Societies/ Institute Festival & Technical Events etc		point	Grade
: level	First Price winner, Second Prize Winner, Third Price winner	Best NSS/NCC Volunteer Awardee (State / National level) / Participation in Republic Day Parade Camp / International Youth Exchange Programme, supported by certification	First Price winner, Second Prize Winner, Third Price winner	As reflected in grade sheet	Top level management	30-28	10	0
ievement	Active Participation (High)	Active Participation (High)	Selection in such events supported by certification		Middle levele management	25-27 22-24	9 8	A+ A
Ach	Active Participation (Medium)	Active Participation (Medium)			Lower-level management	19-21	7	B+
	Active Participation (low)	Active Participation (low)				13-15	5	c
	Not participate	Not participate				12	4	P

*Various clubs have different marking system, however, it can be scaled down to 30 and assign credit accordingly.

A1118

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

