SENGUNTHAR ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956
NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU

ESTD 2001

ISO 9001 REGISTERED

CURRICULUM & SYLLABI

B.E. ROBOTICS AND AUTOMATION

(CHOICE BASED CREDIT SYSTEM)

REGULATIONS – 2023

(For the Students Admitted in the Academic Year 2023-2024 onwards)

Estd : 2001

Note: The regulations hereunder are subject to amendments as may be decided by the Academic Council of the Sengunthar Engineering College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the program under the same Regulation as may be decided by the Academic Council.

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REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

B. E. ROBOTICS AND AUTOMATION

VISION

- To be a Renowned Department to offer Robotics and Automation Engineering Education through Industrial Collaborated Teaching Learning Process and to Promote Research with Human values and Ethical standards to address sustainable development of the Automation Industries.

MISSION

- To Prepare the students with adequate knowledge in the field of Robotics and Automation through Industrial Collaborated Teaching Learning Process.
- To Educate and train the students with state of art technologies, industry institute interaction and Promote Research in the field of Robotics and Automation.
- To be committed to fulfill the needs of society in sustainable development of the Automation Industries.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

- ✓ Develop a proficient engineer in Robotics and Automation field to serve the various technological needs of Industry and Society.
- ✓ Develop the engineers to practice the multidisciplinary engineering knowledge in particularly in mechanical, electrical, electronic, control, manufacturing and software for Robotics and Automation systems development.
- ✓ Create engineers continuously to uplift the knowledge, skill, attitude, selflearning, teamwork, value of ethics and able to protect environmental eco-systems.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**Design / development of**	Design solutions for complex engineering problems and design system components or processes that meet the

	solutions	specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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.

PROGRAM SPECIFIC OUTCOME (PSOs)

PSO1	Multi-disciplinary Engineering in Robotics: Analyse the real world needs and design the robot and Automation solutions using the competency in multi domain engineering elements and integrated software tools.
PSO2	Enhancement and upgradation: Analyse conventional functions and process of various engineering elements and propose robots and automation solution for enhanced performance of conventional systems.
PSO3	Robotic system integration and automated Solution and connectivity: Recommend the sensing, interfacing, controlling, actuating, communicating technologies and analysing the data through various subsystems and build the robots.

MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	23HST101 - Professional English - I	-	-	-	-	-	1.40	2.20	1.25	1.80	3.00	-	3.00	-	-	-
		23MAT101 - Matrices and calculus	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
		23HST102 - தமிழர்மரபு/ Heritage of Tamils															
		23PHE101 - Engineering Physics	3	**3**	1	1	-	**-**	-	-	**-**	-	-	**-**	-	**-**	-
		23CYE101 - Chemistry for Engineers	1.6	1.6	2.4	1.25	1.8	1	2	-	-	-	-	1.5	-	-	-
		23GEE101 - Programming in C	2.0	2.33	2.33	1.16	2.00	1.66	1.00	0.83	2.00	0.16	2.83	2.33	1.83	2.16	-
		23EEC101 - Soft Skills															
		23MDC101 - Induction Program (2 Weeks)															
	II	23HST201 - Professional English - II	-	-	-	-	2.00	1.20	1.20	1.00	2.00	3.00	-	3.00	-	-	-
		23MAT201- Statistics and Numerical Methods with MATLAB	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
		23PHT201- Materials Science	2	3	2	1	1.8	1	1	-	-	-	-	-	-	-	-
		23CYT201- Environmental Sciences and Sustainability	1.5	1.8	2.2	1.8	1.5	1.4	2.2	2	1	2	-	1	-	-	-
		23HST102 - □□□□□□□□ □□□□□□□□□□															

		□□□□□ / Tamils and Technology														
		23GEE201 Engineering Graphics	3	2	2	-	2	-	-	-	-	3	-	2	2	2	2
		23EEE202 Basic Electrical and Electronics Engineering	3	2.5	2	1	-	-	-	1	3	3	-	1	3	3	3
		23GEL201 Engineering Practice Laboratory	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
		23EEC201 Foreign Language / Communication Skills															
		23MDC201 Life Skill & Leadership Enhancement Programme															
II	III	23MAT301 Transforms and complex functions	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
		23MET301 Engineering Mechanics	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
		23RMT301 Basics of Robotics	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
		23EEE303 Digital Electronic and Linear Integrated Cirucits	3	3	3	2.2	2	-	-	1	3	1.3	-	1	3	2	1
		23EEE304 Electric Machines and PowerSystem	3	3	3	3	-	-	-	1	3	2	-	3	3	3	3
		23RME301 Manufacturing Process	2	1	1	0	0	1	2	0	0	0	1	1	2	1	2
		23EEC302 Professional Development															
	IV	23RMT401 Automatic Control	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1

		Systems														
		23RMT402 Sensors and Instrumentation	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
		23RMT403 Robot Kinematics	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
		23EEE401 PLC and SCADA	3	3	3	2	3	-	-	1	3	1	-	2	3	1	3
		23MEE402 Strength of Materials	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
		23GEE301 Problem solving using Python Programming	2.33	2.5	1.5	1.83	1.83	-	-	-	-	-	1.5	0.66	2.66	0.5	-
		23MDC401 Value Added Course - I															

CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E - ROBOTICS AND AUTOMATION- FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23HST101	Professional English - I	HS	3	0	0	3	40	60	100
23MAT101	Matrices and Calculus	BS	3	1	0	4	40	60	100
23HST102	□□□□□□□□□□/Heritage of Tamils	HS	1	0	0	1	40	60	100
EMBEDDED COURSE									
23PHE101	Engineering Physics	BS	3	0	2	4	50	50	100
23CYE102	Chemistry for Engineers	BS	3	0	2	4	50	50	100
23GEE101	Programming in C	ES	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC101	Soft Skills	EEC	1	0	0	1	100	-	100
MANDATORY COURSE									
23MDC101	Induction Program (2 Weeks)	MC	-	-	-	-	-	-	-
	TOTAL CREDITS IN SEMESTER - I					21			

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L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

B.E - ROBOTICS AND AUTOMATION- SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23HST201	Professional English - II	HS	3	0	0	3	40	60	100
23MAT201	Statistics and Numerical Methods with MATLAB	BS	3	1	0	4	40	60	100
23PHT201	Materials Science	BS	3	0	0	3	40	60	100
23CYT201	Environmental Sciences and Sustainability	BS	3	0	0	3	40	60	100
23HST202	□□□□□□□□ □□□□□□□□□□□□□□□ / Tamils and Technology	HS	1	0	0	1	40	60	100
EMBEDDED COURSE									
23GEE201	Engineering Graphics	PC	3	0	2	4	50	50	100
23EEE202	Basic Electrical and Electronics Engineering	PC	3	0	2	4	50	50	100
PRACTICALS									
23GEL201	Engineering Practices Laboratory	ES	0	0	4	2	60	40	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC201	Communication Skills /Foreign Language	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
23MDC201	Life Skill & Leadership Enhancement Programme	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER - II			26						

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B.E - ROBOTICS AND AUTOMATION- THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MAT301	Transforms and Complex Functions	BS	3	1	0	4	40	60	100
23MET301	Engineering Mechanics	PC	3	1	0	4	40	60	100
23RMT301	Basics of Robotics	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE303	Digital Electronic and Linear Integrated Cirucits	PC	3	0	2	4	50	50	100
23EEE304	Electric Machines and Power System	PC	3	0	2	4	50	50	100
23RME301	Manufacturing Process	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC301	Professional Development	EEC	0	0	2	1	100	-	100
TOTAL CREDITS IN SEMESTER - III			24						

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TOT : Total

B.E - ROBOTICS AND AUTOMATION- FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23RMT401	Automatic Control Systems	PC	3	0	0	3	40	60	100
23RMT402	Sensors and Instrumentation	PC	3	0	0	3	40	60	100
23RMT403	Robot Kinematics	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE401	PLC and SCADA	PC	3	0	2	4	50	50	100
23MEE402	Strength of Materials	PC	3	0	2	4	50	60	100
23GEE301	Problem solving and Python Programming	ES	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC401	Value Added Course - I	EEC	0	0	4	2	100	-	100
	TOTAL CREDITS IN SEMESTER - IV		23						

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TOT : Total

B.E - ROBOTICS AND AUTOMATION- FIFTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MET501	Design of Machine Elements and Transmission Systems	PC	3	1	0	4	40	60	100
	Professional Elective I	PE	3	0	0	3	40	60	100
	Professional Elective II	PE	3	0	0	3	40	60	100
	Professional Elective III	PE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RME501	CNC Machine	PC	3	0	2	4	50	50	100
23RME502	AI For Robotics	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC501	Value Added Course - II	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
23MDC501	Mandatory Course - I	MC	3	0	0	0	-	-	-
	TOTAL CREDITS IN SEMESTER - V					23			

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PE : Professional Elective
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TOT : Total

B.E - ROBOTICS AND AUTOMATION- SIXTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
	Professional Elective IV	PE	3	0	0	3	40	60	100
	Professional Elective V	PE	3	0	0	3	40	60	100
	Professional Elective VI	PE	3	0	0	3	40	60	100
	Open Elective-I/NCC L1/ L3	OE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RME601	Automation System Design	PC	3	0	2	4	50	50	100
23RME602	Power Electronics and Drives	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23RMJ601	Project Work	EEC	0	0	10	5	40	60	100
MANDATORY COURSE									
23MDC601	Mandatory Course - II	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER - VI			25						

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BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

B.E - ROBOTICS AND AUTOMATION- SEVENTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23HST701	Human Values and Ethics	HS	3	0	0	3	40	60	100
	Elective-Management	GE	3	0	0	3	40	60	100
	Open Elective-II/NCC-II L2/ L4	OE	3	0	0	3	40	60	100
	Open Elective-III	OE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSE									
23RMJ701	Research Paper writing and Publication	EEC	0	0	4	2	100	-	100
TOTAL CREDITS IN SEMESTER - VII			14						

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ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

B.E - ROBOTICS AND AUTOMATION- EIGHTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSE									
23RMJ801	Innovative Product Development	EEC	0	0	14	7	40	60	100
23EEC801	Internship	EEC	0	0	4	2	100	-	100
TOTAL CREDITS IN SEMESTER - VIII			09						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
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P : Practical
C : Credit Point
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ESE : End Semester Examination
TOT : Total

LIST OF HUMANITIES AND SOCIAL SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HST101	Professional English - I	HS	3	0	0	3	40	60	100
23HST102	□□□□□□□□□□/Heritage of Tamils	HS	1	0	0	1	40	60	100
23HST201	Professional English - II	HS	3	0	0	3	40	60	100
23CYT201	Environmental Sciences and Sustainability	HS	3	0	0	3	40	60	100
23HST202	□□□□□□□□ □□□□□□□□□□□□□□□ / Tamils and Technology	HS	1	0	0	1	40	60	100
23HST701	Human Values and Ethics	HS	3	0	0	3	40	60	100

LIST OF BASIC SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MAT101	Matrices and calculus	BS	3	1	0	4	40	60	100
23PHE101	Engineering Physics	BS	3	0	2	4	50	50	100
23CYE101	Chemistry for Engineers	BS	3	0	2	4	50	50	100
23MAT201	Statistics and Numerical Methods with MATLAB	BS	3	1	0	4	40	60	100
23PHT201	Materials Science	BS	3	0	0	3	40	60	100
23MAT301	Transforms and Complex Functions	BS	3	1	0	4	40	60	100

LIST OF ENGINEERING SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23GEE101	Programming in C	ES	3	0	2	4	50	50	100
23GEE201	Engineering Graphics	ES	3	0	2	4	50	50	100
23GEL201	Engineering Practices Laboratory	ES	0	0	4	2	60	40	100
23GEE301	Problem Solving and Python Programming	ES	3	0	2	4	50	50	100

LIST OF PROFESSIONAL CORE

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEE202	Basic Electrical and Electronics Engineering	PC	3	0	2	4	50	50	100
23MET301	Engineering Mechanics	PC	3	1	0	4	40	60	100
23RMT301	Basics of Robotics	PC	3	0	0	3	40	60	100
23EEE303	Digital Electronic and Linear Integrated Cirucits	PC	3	0	2	4	50	50	100
23EEE304	Electric Machines and Power System	PC	3	0	2	4	50	50	100
23RMT301	Manufacturing Process	PC	3	0	2	4	50	50	100
23RMT401	Automatic Control Systems	PC	3	0	0	3	40	60	100
23RMT402	Sensors and Instrumentation	PC	3	0	0	3	40	60	100
23RMT403	Robot Kinematics	PC	3	0	0	3	40	60	100
23EEE403	PLC and SCADA	PC	3	0	2	4	50	50	100
23MEE402	Strength of Materials	PC	3	0	2	4	50	60	100
23MET501	Design of Machine Elements and Transmission Systems	PC	3	1	0	4	40	60	100
23RME501	CNC Machine	PC	3	0	2	4	50	50	100
23RMT502	AI For Robotics	PC	3	0	2	4	50	50	100
23RME601	Automation System Design	PC	3	0	2	4	50	50	100
23RME602	Power Electronics and Drives	PC	3	0	2	4	50	50	100

LIST OF PROFESSIONAL ELECTIVE COURSES

Professional Elective - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23RMP501	Robots and Systems in Smart Manufacturing	PE	3	0	0	3	40	60	100
23RMP502	Drone Technologies	PE	3	0	0	3	40	60	100
23RMP503	Microrobotics	PE	3	0	0	3	40	60	100
23RMP504	Agricultural Robotics and Automation	PE	3	0	0	3	40	60	100
23RMP505	Collaborative Robotics	PE	3	0	0	3	40	60	100
23RMP506	Robot Operating Systems	PE	3	0	0	3	40	60	100

Professional Elective - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23RMP507	Robot and Machine Elements Design	PE	3	0	0	3	40	60	100
23RMP508	Lean Manufacturing	PE	3	0	0	3	40	60	100
23RMP509	Computer Integrated Manufacturing	PE	3	0	0	3	40	60	100
23RMP510	Fundamentals of Nanoscience	PE	3	0	0	3	40	60	100
23RMP511	Additive Manufacturing Technology	PE	3	0	0	3	40	60	100
23RMP512	Computer Aided Inspection and Testing	PE	3	0	0	3	40	60	100

Professional Elective - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23RMP513	Electric and Hybrid Vehicles	PE	3	0	0	3	40	60	100
23RMP514	Embedded System Design	PE	3	0	0	3	40	60	100
23RMP515	Automotive System Modelling andSimulation	PE	3	0	0	3	40	60	100
23RMP516	Field and Service Robotics	PE	3	0	0	3	40	60	100
23RMP517	Advanced Microprocessors and Microcontrollers	PE	3	0	0	3	40	60	100
23RMP518	Smart Mobility and Intelligent Vehicles	PE	3	0	0	3	40	60	100

Professional Elective - IV

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
23RMP601	Applied Signal Processing	PE	3	0	0	3	40	60	100
23RMP602	Machine Learning for Intelligent Systems	PE	3	0	0	3	40	60	100
23RMP603	Systems Modelling and Simulation Methods	PE	3	0	0	3	40	60	100
23RMP604	Optimization Techniques	PE	3	0	0	3	40	60	100
23RMP605	Maintenance and Safety Engineering	PE	3	0	0	3	40	60	100
23RMP606	Micro Electro Mechanical Systems	PE	3	0	0	3	40	60	100

Professional Elective -V

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23RMP607	Computer Architecture and Organisation	PE	3	0	0	3	40	60	100
23RMP608	Virtual Instrumentation	PE	3	0	0	3	40	60	100
23RMP609	Farm Automation	PE	3	0	0	3	40	60	100
23RMP610	Motion Control System	PE	3	0	0	3	40	60	100
23RMP611	Composite and Smart Materials	PE	3	0	0	3	40	60	100
23RMP612	Digital Twin and Industry 5.0	PE	3	0	0	3	40	60	100

Professional Elective - VI

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23RMP613	Process Planning and Cost Estimation	PE	3	0	0	3	40	60	100
23RMP614	Wireless Sensors Networks for Robotics	PE	3	0	0	3	40	60	100
23RMP615	Integrated Product Development	PE	3	0	0	3	40	60	100
23RMP616	Navigation and Communication System	PE	3	0	0	3	40	60	100
23RMP617	Design of UAV systems	PE	3	0	0	3	40	60	100
23RMP618	Aerodynamics of Drones	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

OPEN ELECTIVES - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MEO601	Introduction to Industrial Engineering	OE	3	0	0	3	40	60	100
23ECO602	Fundamentals of Electronic Devices and Circuits	OE	3	0	0	3	40	60	100
23EEO603	Electric Vehicle Technology	OE	3	0	0	3	40	60	100
23EEO604	Renewable Energy System	OE	3	0	0	3	40	60	100
23MEO605	Resource Management Technique	OE	3	0	0	3	40	60	100
23MAO606	Graph Theory	OE	3	0	0	3	40	60	100
23CEO607	Environmental and Social Impact Assessment	OE	3	0	0	3	40	60	100
23PMO608	Pharamaceutical Nanotechnology	OE	3	0	0	3	40	60	100
23RAO609	Foundation of Robotics	OE	3	0	0	3	40	60	100
23CSO610	Introduction to Drone Technologies	OE	3	0	0	3	40	60	100
23MDO611	Biomolecules	OE	3	0	0	3	40	60	100
23CSO612	Cyber Forensics and Ethical Hacking	OE	3	0	0	3	40	60	100

OPEN ELECTIVES- II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HSO701	English for Competitive Examinations	OE	3	0	0	3	40	60	100
23MGO702	Democracy and Good Governance	OE	3	0	0	3	40	60	100
23MEO703	Fundamentals of Mechatronics	OE	3	0	0	3	40	60	100
23CEO704	Remote Sensing Concepts	OE	3	0	0	3	40	60	100
23MEO704	Nano Technology	OE	3	0	0	3	40	60	100
23MDO705	Ultrasound Principles and its Medical Applications	OE	3	0	0	3	40	60	100
23PMO706	IPR For Pharma Industry	OE	3	0	0	3	40	60	100
23RAO707	Concepts in Mobile Robots	OE	3	0	0	3	40	60	100
23ECO708	Energy Technology	OE	3	0	0	3	40	60	100
23EEO709	Sensors and Actuators	OE	3	0	0	3	40	60	100
23MAO710	Probability and Queuing Theory	OE	3	0	0	3	40	60	100
23CSO711	Introduction to Cyber Security	OE	3	0	0	3	40	60	100
23MEO712	3D Printing and Design	OE	3	0	0	3	40	60	100

OPEN ELECTIVES - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HSO713	Project Report Writing	OE	3	0	0	3	40	60	100
23MAO714	Advanced Numerical Methods	OE	3	0	0	3	40	60	100
23CSO715	Fundamentals of Blockchain Techology	OE	3	0	0	3	40	60	100
23EEO716	Electrical,Electronic and Magnetic Materials	OE	3	0	0	3	40	60	100
23CEO717	Geographical Information System	OE	3	0	0	3	40	60	100
23ECO718	VLSI Design	OE	3	0	0	3	40	60	100
23MDO719	Wearable Technology	OE	3	0	0	3	40	60	100
23MEO720	Additive manufacturing	OE	3	0	0	3	40	60	100
23RAO721	Nanomaterials and Application	OE	3	0	0	3	40	60	100
23MGO722	Cost Management of Engineering Projects	OE	3	0	0	3	40	60	100
23HSO723	Food Safety and Quality Regulations	OE	3	0	0	3	40	60	100
23MDO724	Lifestyle Diseases	OE	3	0	0	3	40	60	100

GENERAL ELECTIVES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23NCCL01	NCC AIRFORCE LEVEL-1	GE	3	0	0	3	40	60	100
23NCCL02	NCC AIRFORCE LEVEL - 2	GE	3	0	0	3	40	60	100
23NCCL03	NCC ARMY LEVEL - 3	GE	3	0	0	3	40	60	100
23NCCL04	NCC ARMY LEVEL - 4	GE	3	0	0	3	40	60	100

ELECTIVE - MANAGEMENT

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MGT701	Principles of Management	GE	3	0	0	3	40	60	100
23MGT702	Total Quality Management	GE	3	0	0	3	40	60	100
23MGT703	Engineering Economics and Financial Accounting	GE	3	0	0	3	40	60	100
23MGT704	Human Resource Management	GE	3	0	0	3	40	60	100
23MGT705	Knowledge Management	GE	3	0	0	3	40	60	100
23MGT706	Industrial Management	GE	3	0	0	3	40	60	100
23MGT707	Hospital Management	GE	3	0	0	3	40	60	100
23MGT708	e-Waste Management	GE	3	0	0	3	40	60	100

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEC101	Soft Skills	EEC	1	0	0	1	100	-	100
23EEC201	Communication Skills/Foreign Language	EEC	0	0	4	2	100	-	100
23EEC301	Professional Development	EEC	0	0	2	1	100	-	100
23EEC401	Value Added Course-I	EEC	0	0	4	2	100	-	100
23EEC501	Value Added Course-II	EEC	0	0	4	2	100	-	100
23RMJ601	Project Work	EEC	0	0	10	5	40	60	100
23RMJ701	Research Paper Writing / Publication	EEC	0	0	4	2	100	-	100
23RMJ801	Innovative Product Development	EEC	0	0	14	7	40	60	100
23EEC801	Internship	EEC	0	0	4	2	100	-	100

LIST OF MANDATORY COURSES

MANDATORY COURSES - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MDC501	Introduction to Women and Gender Studies	MC	3	0	0	0	-	-	-
23MDC502	Elements of Literature	MC	3	0	0	0	-	-	-
23MDC503	Film Appreciation	MC	3	0	0	0	-	-	-
23MDC504	Disaster Risk Reduction and Management	MC	3	0	0	0	-	-	-
23MDC505	Constitution of India	MC	3	0	0	0	-	-	-

MANDATORY COURSES - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MDC601	Well Being with Traditional Practices- Yoga, Ayurveda and Siddha	MC	3	0	0	0	-	-	-
23MDC602	History of Science and Technology in India	MC	3	0	0	0	-	-	-
23MDC603	Political and Economical Thought for a Human Society	MC	3	0	0	0	-	-	-
23MDC604	State,Nation Building and Politics in India	MC	3	0	0	0	-	-	-
23MDC605	Industial Safety	MC	3	0	0	0	-	-	-

CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

CREDIT SUMMARY

DEPARTMENT OF ROBOTICS AND AUTOMATION

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	4	4	-	-	-	-	3	-	11
BS	12	10	4	-	-	-	-	-	26
ES	4	2	-	4	-	-	-	-	10
GE	-	-	-	-	-	-	3	-	3
PC	-	8	19	17	12	8	-	-	64
PE	-	-	-	-	9	9	-	-	18
OE	-	-	-	-	-	3	6	-	9
EEC	1	2	1	2	2	5	2	9	24
MC	-	-	-	-	-	-	-	-	-
Total	21	26	24	23	23	25	14	9	165

CURRICULUM AND SYLLABI
FOR B.E. / B.Tech. DEGREE PROGRAMMES
(For the Students Admitted in the Academic Year 2023-2024 onwards)
SEMESTER I

23HST101 PROFESSIONAL ENGLISH – I L T P C
(Common to all B.E. & B.Tech. Branches) 3 0 0 3

OBJECTIVES

- To develop learning English language through grammar.
- To use grammar efficiently for demonstrating all the four language skills (LSRW).
- To write business letters, dialogue writing, paragraph and essay writing.
- To speak effectively about self introduction and real time situation.
- To build the reading skills through reading comprehension and note taking

UNIT I VOCABULARY 8

Synonyms and Antonyms - Word Formation - Sentence Types (declarative, imperative, interrogative & exclamatory) - Single Word Substitutes - Use of Abbreviations and Acronyms- Homonyms and Homophones - Collocation - British and American Vocabulary.

UNIT II GRAMMAR 10

Parts of speech - Be, Have and Do verbs - Punctuation - Tenses - Numerical Adjectives - modal verbs - Single line Definition - Direct and Indirect Speech - Gerunds and Infinitives - Same Word Used as Different Parts of Speech.

UNIT III WRITING 9

Letter Writing - Business communications - quotations, placing orders, complaints, replies to queries from business customers - Dialogue Writing – Paragraph Writing (descriptive, narrative, expository & persuasive) - Essay Writing - Writing Instructions.

UNIT IV SPEAKING 9

Self-introduction - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes - Tongue twisters

UNIT V READING SKILLS 9

Reading Comprehension – Reading techniques, pre-reading, post-reading, comprehension questions (multiple choice questions or short questions) - Short Comprehension Passages, practice skimming - Scanning and Predicting - Reading the passage and taking (Note making) Notes - Scan and understand main contents of the passage.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Use a wide range of vocabulary in oral and written communication

- Frame grammatically correct sentences.
- Write letters, frame paragraphs and Essays, develop conversation.
- Develop speaking skills for self-Introduction, delivering speeches and Technical Presentation
- Read and comprehend the passage, technical content and take notes

TEXT BOOKS

1. Board of Editors. Using English A Course book for Under graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012.
2. Title: Developing Communication Skills. Publisher: MacMillan. Author: Krishna Mohan, Meera Banerji. Edition: Paperback 2019.

E-RESOURCES

1. http://www.usingenglish.com
2. https://www.khanacademy.org/humanities/grammar

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	3	1	2	3	-	3	-	-	-
2	-	-	-	-	-	1	2	-	1	3	-	3	-	-	-
3	-	-	-	-	-	3	3	2	3	3	-	3	-	-	-
4	-	-	-	-	-	1	2	1	2	3	-	3	-	-	-
5	-	-	-	-	-	1	1	1	1	3	-	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	-	-	-	1.40	2.20	1.25	1.80	3.00	-	3.00	-	-	-

1.Low 2-Medium 3-High '-' – No Correlation

23MAT101 **MATRICES AND CALCULUS** **L T P C**

(Common to all B.E./ B.Tech. Branches) **3 1 0 4**

OBJECTIVES

- To develop the use of matrix algebra techniques those are needed by engineers for practical applications.
- To familiarize the students with differential and integral calculus.
- To describe the student with functions of several variables.
- To acquire the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To acquaint the student with the concepts of vector calculus that is needed for problems in engineering disciplines.

UNIT I MATRICES **9+3**

Eigen values and Eigen vectors – Properties of Eigen values – Cayley-Hamilton theorem – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of quadratic form.

UNIT II DIFFERENTIAL AND INTEGRAL CALCULUS **9+3**

Differentiation rules: Derivatives of polynomials and exponential functions – The product and quotient Rules – Derivatives of trigonometric functions – The Chain rule – Implicit differentiation – Applications of differentiation: Maximum and Minimum Values – Techniques of integration: Integration by parts – Trigonometric integrals – Integration of rational functions by partial fractions.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial derivatives – Homogeneous functions – Euler's theorem – Total derivative – Jacobians – Taylor's theorem for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double integrals.

UNIT V VECTOR CALCULUS **9+3**

Scalar and vector point functions – Gradient – Divergence and curl – Line integral – Surface integral – Green's theorem in a plane – Volume integral – Divergence theorem – Irrotational and Solenoidal fields.

OUTCOMES

Upon completion of the course, Students will be able to:

- Classify the matrix algebra methods for solving practical problems.

- Discover differential calculus tools in solving various application problems and compare different methods of integration in solving practical problems.
- Develop differential calculus ideas on several variable functions.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.
- Solve engineering problems using the concept of vector calculus.

LIST OF TUTORIALS

1. Computation of Eigen values and Eigenvectors.
2. Calculate differentiation and integration of simple functions.
3. Determining Maxima and minima of functions for two variables.
4. Evaluating double and triple integrals.
5. Computing Gradient, divergence and curl of point functions.

TOTAL:45+15 =60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, New Delhi, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES

1. Bali N.P, Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Kanti B. Dutta., "Mathematical Methods of Science and Engineering – Aided with MATLAB", Cengage Learning, New Delhi, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/111105121 (Differential Calculus and Integral Calculus)
2. https://nptel.ac.in/courses/111107112 (matrix analysis)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
2	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
3	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
4	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
5	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23HST102 **HERITAGE OF TAMILS** **L T P C**
1 0 0 1

UNIT I LANGUAGEAND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils..

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu,Oyillattam,Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15PERIODS

TEXT BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

REFERENCE BOOKS

1. Heritage of Tamils,Publishedby:Yes Dee Publishing Pvt Ltd,Chennai
2. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23HST102 **தமிழர் மரபு** **L T P C**
1 0 0 1

UNIT I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழி குடும்பங்கள்- திராவிட மொழிகள் -தமிழ் ஒரு செம்மொழி -தமிழ் செவ்விலக்கியங்கள்- சங்க இலக்கியத்தில் சமய சார்பற்ற தன்மை- சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மை கருத்துக்கள் -தமிழ் காப்பியங்கள்- தமிழகத்தில் பௌத்த சமயங்களின் தாக்கம் -பக்தி இலக்கியம் ஆழ்வார்கள் மற்றும் நாயன்மார்கள்- சிற்றிலக்கியங்கள் -தமிழில் நவீன இலயக்யத்தின் வளர்ச்சி -தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

UNIT II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை- சிற்பக்கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை -ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினை பொருட்கள் ,பொம்மைகள் -தேர் செய்யும் கலை-சுடுமண் சிற்பங்கள் -நாட்டுப்புற தெய்வங்கள்- குமரி முனையில் திருவள்ளுவர் சிலை-இசை கருவிகள் -மிருதங்கம் ,பறை ,வீணை,யாழ், நாதஸ்வரம் ,தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

UNIT III நாட்டுப்புற கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து,கரகாட்டம் ,வில்லுப்பாட்டு, கணியான் கூத்து ,ஒயிலாட்டம், தோல்பாவை கூத்து,சிலம்பாட்டம், வளரி ,புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

UNIT IV தமிழர்களின் திணைகோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும் , விலங்குகளும் -தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறகோட்பாடுகள்-தமிழர்கள் போற்றிய அறக்கோட்பாடு -சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவு,கல்வியும்- சங்க கால நகரங்களும் துறை முகங்களும் -சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி -கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி

UNIT V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு- இந்தியாவின் பிறபகுதிகளில் தமிழ்பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில்,

சித்தமருத்துவத்தின் பங்கு- கல்வெட்டுகள், கையெழுத்துப்படிகள் -தமிழ் புத்தகங்களின் வரலாறு

TOTAL: 15PERIODS

TEXT BOOKS

1. தமிழக வரலாறு -மக்களும் பண்பாடும் -கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினி தமிழ் -முனைவர் இல சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி -வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4 .பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

REFERENCE BOOKS

1. தமிழர் மரபு -முனைவர் ஆ பூபாலன் (வி ஆர்பி பி பப்ளிஷர்ஸ்)

23PHE101 **ENGINEERING PHYSICS** **L T P C**

(Common to Civil, Mechanical, R & A and Pharm.Tech) **3 0 2 4**

OBJECTIVES

- To study the structure of crystalline materials using crystallographic knowledge.
- To learn elasticity, placticity, stress, strain behavior of materials for industrial applications.
- To generalize the fundamentals of ultrasonics and sound waves, as well as their applications.
- To explore the complex physical phenomenon using the fundamental principles of quantum mechanics and Schrödinger's wave equation.
- To exhibit different materials heat transmission modes and fundamentals of thermal conduction in solid and its applications.
- To understand the Engineering Physics that can be applied to optics, acoustics and ultrasonic's, matter characteristics and to determine thermal properties.

UNIT I CRYSTAL PHYSICS 9

Lattice and Unit cell – Crystal Systems and Bravais lattice – Lattice planes – Miller Indices – d - Spacing in Cubic lattice – Calculation of Number of Atoms per Unit Cell – Atomic radius ,Coordination Number, Packing factor for SC, BCC, FCC and HCP structures – Crystal Growth Techniques – Melt Growth Techniques (Bridgman and Czochralski).- Silicon chip Production Process.

UNIT II MECHANICAL PROPERTIES OF SOLIDS & FLUIDS 9

Elasticity – Stress-Strain Diagram and its Uses - Factors Affecting Elastic Modulus – Torsional Stress and Deformations – Twisting Couple - Torsion Pendulum: Theory and Experiment - Bending of beams - Bending Moment – Cantilever: Theory and Experiment – Non-Uniform Bending: Theory and Experiment - I-Shaped Girders.

UNIT III ACOUSTICS & ULTRASONICS 9

ACOUSTICS : Classification of Sound – Decibel - Weber Fechner Law- Reverberation-Sabine's formula (Qualitative) - Factors affecting Acoustics of Buildings and their Remedies.

ULTRASONICS: Properties -Production of Ultrasonics - Magnetostriction and Piezoelectric methods - Non Destructive Testing – Pulse echo system, through Transmission and Reflection modes - Medical applications – Sonogram.

UNIT IV QUANTUM PHYSICS 9

Black Body Radiation – Planck's Theory (derivation) – Electron Diffraction – Wave function and its Physical significance – Schrödinger's Wave Equation: Time independent and time dependent equations – Particle in a One-Dimensional box - Scanning Electron Microscope - Transmission Electron Microscope - Quantum Tunneling – Scanning Tunneling Electron Microscope.

UNIT V THERMAL PHYSICS **9**

Transfer of Heat Energy – Thermal expansion of Solids and Liquids – Expansion joints - Bimetallic strips - Thermal Conduction, Convection and Radiation – Heat conductions in Solids – Thermal Conductivity – Lee's disc method: Theory and Experiment - Conduction through Compound Media (series and parallel) – Geothermal Energy - Geothermal power - Thermal battery - Thermal Energy Storage.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course to:

- Familiarize the structure of crystalline solids by applying knowledge of crystallography.
- Analyze theories of failure and yield criteria as an elements of properties of matter.
- Understand different materials characterization techniques.
- Apply the basic principles of quantum mechanics and Schrödinger's wave equation to study the complex physical phenomenon.
- Build knowledge about thermal conductivity and its applications.
- Experimentally combine the concepts of thermal, optical, acoustic, and elasticity for use in engineering applications

TEXT BOOKS

1. P.Mani, "A Text book of Engineering Physics" Dhanam Publications, 2018.
2. Rajendran V. "Engineering Physics". TaTa McGraw Hill Publications, 2016
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGrawHill, 2017.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials" Narosa Publishing House, 2009
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015

E-RESOURSES

1. https://archive.nptel.ac.in/courses/122/107/122107035/
2. https://archive.nptel.ac.in/courses/115/101/115101107/

LIST OF EXPERIMENTS

(**Common to Civil, Mechanical, Robotics & Automation & Pharmaceutical Technology**)

(Eight experiments are to be conducted in Lab)

1. Determination of wavelength of laser.
2. Determination of particle Size lycopodium powder using laser.
3. Determination of wavelength of mercury spectrum- Spectrometer.
4. Determination of Young's modulus - Uniform bending.
5. Torsional Pendulum: Determination of moment of inertia and rigidity modulus.
6. Determination of velocity of ultrasonic in liquid.
7. Determination of Viscosity of a liquid –Poiseulle's Method.
8. Determination of thermal conductivity of bad conductor using Lee's Disc Apparatus.
9. Determination of Specific resistance of a given wire using Carey's Foster's Bridge (Virtual).
10. Radiation with Temperature Change Using Stefan's Law. (Virtual)

TOTAL: 15 PERIODS

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
6	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23CYE102	CHEMISTRY FOR ENGINEERS (Common to CIVIL, MECH, R&A)	L T P C 3 0 2 4

OBJECTIVES

- To classify the impurities of water and know the treatment and the conditioning methods for domestic and industrial uses.
- To familiarize the types of fuels, calorific value calculations and characteristics of solid, liquid and gaseous fuels.
- To impart knowledge onprinciples and instrumentation of spectroscopy and chromatography.
- To provide students with an understanding of different types of energy sources, energy storage devices, and the principles of energy conversion.
- To be familiar with the types of corrosion and control measures and working of batteries.
- To inculcate practical skills in the determination of water quality parameters and instrumental analysis.

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics – Hardness – Estimation of hardness by EDTA method – Alkalinity and its estimation - Boiler feed water – Requirements –Boiler troubles (Scale and Sludge) – Internal conditioning (colloidal – Phosphate – Calgon and carbonate conditioning methods) – External conditioning – Zeolite process, Demineralization process – Desalination of brackish water by reverse osmosis-Nano filtration - Municipality water treatment - Break point chlorination.

UNIT II FUELS AND COMBUSTION 9

Fuels: Introduction - Classification of fuels - Coal - Analysis of coal (proximate and ultimate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum – Manufacture of synthetic petrol (Bergius process) - Knocking - Octane number - Diesel oil - Cetane number –Natural gas - Compressed Natural Gas (CNG) –Liquefied Petroleum Gases (LPG) - Power Alcohol and Biodiesel. Combustion of fuels: Introduction - Calorific value - Higher and lower calorific values- Theoretical Calculation of calorific value - Ignition temperature - Spontaneous ignition temperature – Explosive range - Flue gas analysis (ORSAT Method).

UNIT III ANALYTICAL CHEMISTRY 9

Spectroscopy: Electromagnetic spectrum-Absorption of radiation –Electronic, Vibrational and rotational transitions. UV-Visible and IR Spectroscopy-Principles, instrumentation (Block Diagram Only).-Chromatography- General principles - classification - Chromatographic behavior of solutes-Quantitative determination - Gas chromatography - Liquid chromatography – High Pressure Liquid Chromatography –Applications.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear Fission – Controlled nuclear fission – Nuclear fusion – Differences between nuclear fission and fusion – Nuclear chain reactions – Nuclear energy – Light water nuclear power plant – Breeder reactor – Solar energy conversion – Solar cells - Wind energy. Batteries - Types of batteries – Primary battery (dry cell) Secondary battery (lead acid battery, lithium-ion-battery) Fuel Cells - H_2 -O_2 fuel cell – Supercapacitors.

UNIT V ELECTROCHEMISTRY, CORROSION AND ITS CONTROL 9

Introduction-Electrochemical cells applications of electrochemical series-Reference electrode-Standard calomel electrode, ion selective electrode-Glass electrode-Potentiometric titration, Redox titration, Conductometric titration-Strong acid vs Strong base. Corrosion – Types – Chemical Corrosion – Electrochemical Corrosion (galvanic and differential aeration) - Factors influencing corrosion – Material selection and design aspects-Control methods of corrosion – sacrificial anodic and impressed current cathodic protection.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to

- Infer the quality of water and Identify the method of removal of impurities from water for domestic and industrial purpose.
- Illustrate the quality of fuels from its characteristics, to design and develop new combustion systems that are sustainable, efficient, and environmentally friendly.
- Analyze about the interactions of light with matter and the use of analytical techniques to analyze and characterize molecules.
- Recognize different forms of Energy resources and apply them for suitable application in Energy sectors.
- Analyze the causes of corrosion and discuss the control measures and discuss the functions of batteries.
- Determine the water quality parameters and perform quantitative chemical analysis by pH metery, flame photometry, conductometry and potentiometry.

TEXT BOOKS

1. Jain P.C and Monika Jain, "Engineering Chemistry", Dhanpet Rai Publishing Company (P) Ltd.,New Delhi, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India Pvt Ltd, New Delhi, 2013.
3. R.Gopalan, "Analytical Chemistry" Sultan Chand & Sons,3th Edition,2017.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company Ltd, New Delhi, 2015.

2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. ShobhaRamakrishnan, BananiMukhopadhyay,"Essentials of Analytical Chemistry"Pearson Education India,2018.

E-RESOURCES

1. https://nptel.ac.in/courses/104105084
2. http://library.iitbbs.ac.in/open-access-e-resources.php

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of sodium and potassium present in water using flame photometer.
7. Conductometric Precipitation Titration using $BaCl_2$ and Na_2SO_4.
8. Conductometric titration of strong acid vs strong base.
9. Estimation of Ferrous ions by Potentiometric Titration.
10. Estimation of copper content in the brass by Iodometry.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	-	1	-	3	-	-	-	-	2	-	-	-
2	1		2	-	1	-	-	-	-	-	-		-	-	-
3	2	2	3	1	1	1	-	-	-	-	-	1	-	-	-
4	1	1	2	1		-	-	-	-	-	-	-	-	-	-
5	2	1	2	1	3	-	1	-	-	-	-	-	-	-	-
6	2	3	-	-	3	-	-	-	-	-	-	-	-	-	-
AVG	1.6	1.6	2.4	1.25	1.8	1	2	-	-	-	-	1.5	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

23GEE101	PROGRAMMING IN C	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

- To understand the constructs of C Language.
- To study arrays and strings for developing C programs
- To know the functions and pointers application in C programs
- To understand the concepts of structures and Union.
- To understand input/output and file handling in C.
- To develop programs and applications using C.

UNIT I BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms – Structure of C program – C programming: Data Types– variables–Storage classes – Constants – Enumeration Constants – Keywords – Operators: Precedence and Associativity – Expressions –Input/Output statements, Assignment statements – Decision making statements – Switch statement – Looping statements – Pre-processor directives – Compilation process.

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program**:** Computing Mean, Median and Mode – Two dimensional arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) – String operations: length, compare, concatenate, copy –Sorting – Selection sort, Insertion sort, Merge sort, quick sort – Searching – linear and binary search.

UNIT III FUNCTIONS AND POINTERS **9**

Introduction to functions: Function prototype, function call, Built–in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions – Pointers – Pointer operators – Arrays and pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference.

UNIT IV STRUCTURES AND UNION **9**

Structure – Example Programs – Nested structures – Pointer in Structures – Array of structures -Example Program using structures and pointers – Self referential structures – Dynamic memory allocation.Union- Storage classes

UNIT V FILE PROCESSING **9**

Files – Operations of File – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments.

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Programs using I/O statements, expressions and decision–making constructs.
2. Write a program to find whether the given year is leap year or Not.
3. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
4. Check whether a given number is Armstrong number or not?
5. Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions.
    a) 5 if it is a perfect cube.
    b) 4 if it is a multiple of 4 and divisible by 6.
    c) 3 if it is a prime number.
6. Populate an array with height of persons and find how many persons are above the average height.
7. From a given paragraph perform the following using built–in functions:(i)Find the total number of words.(ii)Capitalize the first word of each sentence.(iii)Replace a given word with another word.
8. Solve towers of Hanoi using recursion.
9. Locate and Display the Contents of an Array using Pointers.
10. Generate salary slip of employees using structures and pointers.
11. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 +15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to,

- Build C programs for simple applications using basic constructs
- Develop C programs using arrays and strings.
- Construct C programs using functions, recursion and pointers
- Implement applications in C using structures.
- Develop applications in C using file processing.
- Develop applications using C programming constructs

TEXT BOOKS

1. E.Balagurusamy,"Programming in ANSI C", Tata McGraw Hill, Eigth Edition, 2019.
2. Kernighan, B.W and Ritchie,D.M,"The C Programming language", Second Edition, Pearson Education, 2016.

REFERENCES

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Juneja, B. L and Anita Seth, "Programming in C", CENGAGE Learning India pvt.Ltd., 2011.

E – RESOURCES

1. https://nptel.ac.in/courses/106/105/106105085/ (Introduction to C Programming)
2. https://nptel.ac.in/courses/106/106/106106210/ (Stack Operations)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	2	1	1	1	2	-	3	2	1	2	-
2	2	2	2	1	2	1	1	1	2	-	3	3	2	2	-
3	2	3	2	1	2	1	1	1	2	-	3	2	2	2	-
4	3	2	2	1	3	1	1	1	2	-	3	3	2	2	-
5	2	3	3	1	2	1	2	1	2	-	3	2	2	3	-
6	2	2	3	2	1	2	-	-	2	1	2	2	2	2	-
AVG	2.00	2.33	2.33	1.16	2.00	1.66	1.00	0.83	2.00	0.16	2.83	2.33	1.83	2.16	-

1 - low, 2 - medium, 3 - high, '-"- no correlation

SEMESTER II

23HST201	**PROFESSIONAL ENGLISH II**	**L T P C**
	(Common to all B.E. & B.Tech. Branches)	**3 0 0 3**

OBJECTIVES

- To use grammatical components effectively in written communication.
- To read and understand on comprehend technical writing.
- To develop skills for writing email, business letters, Job Application Letter and Resume.
- To write checklist, recommendation, transcoding graphics and letter.
- To speak fluently in real contexts.

UNIT I GRAMMAR **9**

Articles - Prepositions - Compound words - Conditionals - Subject verb agreement - Active and Passive voice - Impersonal Passive Voice.

UNIT II LISTENING & READING **9**

Syllabification – Reading Vocabulary - Reading Newspapers - Listening to Youtube Documentaries - Listening to Podcast - Listening to Motivational Movies.

UNIT III BUSINESS WRITING **9**

E-mail writing - fixing an appointment, cancelling appointment, conference details, training programme details, paper submission for seminars and conferences - Job Application Letter and Résumé.

UNIT IV WRITING **9**

Checklist - Writing Recommendations - Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables - Formal Letter Writing - inviting dignitaries and declining invitations.

UNIT V SPEAKING **9**

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Suggesting - Comparing and Contrasting – Expressing - Finding out facts, attitudes and opinions - Situational Role-play.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Use grammar to frame sentences and write sentences in passive forms
- Read vocabulary, newspaper and improve listening skills
- Draft emails, write business letters, construct resume with job application letter.
- Frame checklist, write recommendation and Transcoding graphical representation.
- Develop speaking skill for taking part in Collaborative task and Situational Role-play.

TEXT BOOKS

1.Title: Technical English II Author: S. Sumant Maven Learning.

2.Communicative English by KN Shoba ,Lourdes Joavani Rayen Publised by Cambridge university 2017.

REFERENCES

1.Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, "Resonance English for Engineers and Technologists", Cambridge University Press, first Edition, Foundation Books,New Delhi, 2013.

2.Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.

3.Norman Whitby, Business Benchmark- Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2006.

E-RESOURCES

1.https://www.fluentu.com/Blog/english/english-small-talk/

2.https://www.britishcouncil.com

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-
2	-	-	-	-	2	1	1	1	2	3	-	3	-	-	-
3	-	-	-	-	2	1	2	1	2	3	-	3	-	-	-
4	-	-	-	-	-	1	1	1	1	3	-	3	-	-	-
5	-	-	-	-	-	2	1	1	3	3	-	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	-	-	2.0	1.2	1.2	1.0	2.0	3.0	-	3.0	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

23MAT201 STATISTICS AND NUMERICAL METHODS WITH MATLAB L T P C
(Common to all B.E./ B.Tech. Branches) **3 1 0 4**

OBJECTIVES

- To provide the necessary basic concepts in testing of hypothesis for small and large samples which plays an important role in real life problems.
- To acquaint the knowledge of classifications of design of experiments.
- To extend the basic concepts of solving algebraic and transcendental equations.
- To apply the numerical techniques of interpolation and integration.
- To produce the knowledge of various techniques in solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distribution – Testing of significance for single proportion, single mean and difference of means – Test of significance for small samples by 't' test – Snedecor's F- test of significance – Chi-square test : Chi-square test of goodness of fit – Independent of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

Basic principles of experimental design – Completely randomised design – Analysis of vaiance for one way classification – Randomised block design – Analysis of variation for two factor experiments variations – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations by Newton Raphson method – Solution of simultaneous algebraic equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods – Matrix Inversion by Gauss Jordan method – Eigen values of a matrix by Power method.

UNIT IV INTERPOLATION AND NUMERICAL INTEGRATION 9+3

Interpolation: Newton's forward and backward interpolation formulae – Lagrange's interpolation formula – Newton's divided difference formula – Numerical integration by Trapezoidal and Simpson's 1/3 rule –Numerical double integration by Trapezoidal rule.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Euler's method – Modified Euler's method – Fourth order Runge - Kutta method for solving first order equations – Taylor's series method – Predictor-corrector methods: Milne's method – Adams-Bash forth method.

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the concept of testing of hypothesis for small and large samples in real life problems.

- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Summarize the numerical techniques of interpolation in various intervals and apply the numerical techniques of integration for engineering problems.
- Produce various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial conditions by using certain techniques with engineering applications.

LIST OF TUTORIALS

1. Solving one sample and paired sample't' test.
2. Determination of roots of a polynomial.
3. Solution of linear system of equations by Gauss Seidel methods.
4. Evaluation of line integrals by Trapezoidal rule.
5. Solution of ordinary differential equations by Euler's method.

TOTAL: 45+15 PERIODS

TEXT BOOKS

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, enth Edition, New Delhi, 2015.
2. Dr.Kandasamy. P, Dr.Thilagavathy . K and Dr. Gunavathy .K., "Statistics and Numerical Methods", S. Chand and Company Ltd., NewDelhi, 2010.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 12th Edition, New Delhi, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105041/ (Statistics)
2. https://nptel.ac.in/courses/111/107/111107105/ (Numerical Methods)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
2	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
3	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
4	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
5	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	3	1	1	2	-	-	-	1	-	2	3	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23PHT201 **MATERIALS SCIENCE** **L T P C**

(Common to Civil, Mechanical, R & A and Pharm.Tech) **3 0 0 3**

OBJECTIVES

- To learn the principles of cryogenics and superconductivity and applications.
- To be familiar with the application of physics concepts to microscopic and NDT Testing.
- To explore different kind of nano materials and synthesis of nano materials, applications.
- To gain the knowledge of advanced and smart materials for various engineering applications.
- To study different composite materials and synthesize methods.

UNIT I CRYOGENICS **9**

Introduction to Cryogenics - Properties of Cryogenic Fluids- Gas-Liquefaction of Gases and Refrigeration Systems – Cryocoolers -Cryogenic Insulations - Superconductivity: Properties – Type I and Type II Superconductors – BCS theory of Superconductivity - High Tc superconductors – General applications of Superconductors –Cryotron and Magnetic levitation.

UNIT II MATERIALS CHARACTERIZATION **9**

Introduction to materials and Techniques-X-Ray Diffraction (XRD) – Atomic Force Microscopy (AFM)- Fourier Transform Infrared Spectroscopy (FTIR)- UV-Vis Spectroscopy- Non-Destructive Testing (NDT) : Liquid Penetrant Test, Magnetic Detection, Electromagnetic Testing, Ultrasonic Test, Thermal Infrared Testing and Spark Test.

UNIT III NANOMATERIALS & NANODEVICES **9**

Emergence of Nano science - Role of Particle Size - Quantum Structures: Quantum Well, Quantum Wire and Quantum Dot- Properties at Nano Scale (Optical, Electronic and Magnetic) - Synthesis of Nanomaterials: Physical Vapour Deposition (PVD) - Pulsed Laser Deposition (PLD) - Carbon Nanotubes - Micro Electro Mechanical Systems (MEMS) - Nano Electro Mechanical Systems (NEMS).

UNIT IV SMART MATERIALS **9**

Intelligent / Smart materials – Functional materials – Polyfunctional Materials – Structural Materials, Electrical Materials, Bio-Compatible Materials - Metallic Glasses: Types, Glass forming ability of Alloys, Melt spinning process, Applications - Shape Memory Alloys: Phases, Shape Memory Effect, Pseudo elastic effect, NiTi alloy, and applications.

UNIT V COMPOSITE MATERIALS **9**

Definitions, Composites, Reinforcements and Matrices, Types of Reinforcements, Types of Matrices, Types of Composites, Carbon Fibre Composites, Properties of Composites in Comparison with Standard Materials, Applications of Metal, Ceramic and Polymer matrix

composites. Hand and spray lay - Up, Injection molding, Resin injection, Filament winding, Pultrusion, Centrifugal casting and Prepregs.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to;

- Learn the potential applications of superconductors.
- Acquire knowledge on various materials characterization techniques.
- Understand the fundamentals of nano materials and various synthesize methods.
- Build knowledge about smart materials and their applications.
- Create methodologies and develop the principles of composite materials.

TEXT BOOKS

1. P.Mani, "A Text book of Engineering Physics " Dhanam Publications, 2018
2. Rajendran V. "Engineering Physics". TaTa McGraw Hill Publications, 2012.
3. Sam Zhang, Lin Ki, Ashok Kumar, "Materials Characterization Techniques", CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials" Narosa Publishing House, 2009.
3. P. SanthanaRagavan and P. Ramasamy, "Crystal Growth Processes and Methods", KRU Publications, Kumbakonam, 2017

E-RESOURCES

1. https://nptel.ac.in/courses/112108150/
2. https://swayam.gov.in/nd1_noc19_mm13/preview

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	1	2	1	1	-	-	-	-	-	-	-	-
2	2	3	2	1	2	1	1	-	-	-	-	-	-	-	-
3	2	3	2	1	2	1	1	-	-	-	-	-	-	-	-
4	2	3	2	1	1	1	1	-	-	-	-	-	-	-	-
5	2	3	2	1	2	1	1	-	-	-	-	-	-	-	-
AVG	2	3	2	1	1.8	1	1	-	-	-	-	-	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23CYT201 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY L T P C
(Common to All B.E /B.TechBranches) **3 0 0 3**

OBJECTIVES

- To understand the importance of the environment, ecosystem, biodiversity and its conservation.
- To impart knowledge on various kinds of pollutions, solid waste management and precautionary measures for disasters.
- To be familiar with the social issues and identify the possible way to improve the quality of the environment.
- To analyze the problems of overpopulation and understand the value education.
- To familiarize the concept of sustainability and implement sustainable practices in various fields.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – Need for public awareness - Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, rivers, oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Biogeographically classification of India – Value of biodiversity – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity – Endangered and endemic species of India – Conservation of biodiversity: In-Situ and Ex-Situ conservation of biodiversity.

Activity: Biodiversity in and around the campus and report submission.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes - E-waste – Role of an individual in prevention of pollution - Pollution case studies – Disaster management: floods, earthquake and cyclone.

Activity: Local pollution case study and report submission.

UNIT III SOCIAL ISSUES AND THE ENVIRONMENT9

Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies - Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Green Chemistry and principles - Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – Public awareness.

Activity: Creating environmental awareness.

UNIT IV HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.

Activity: Visit to local primary health center.

UNIT V SUSTAINABLE MANAGEMENT 9

Sustainability-Concept, needs and challenges-economic, social and aspects of sustainability-From unsustainability to sustainability-Millennium development goals, and protocols-Sustainable Development Goals-Targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-Case studies. Zero waste and R concept, Material Life cycle assessment, Environmental Impact Assessment, Sustainable habitat: Energy efficiency, Sustainable transports.

Activity: Field trips to local organizations or facilities with sustainable practices in place.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to

- Acquire knowledge on public awareness & about the environment, ecosystem and biodiversity.
- Find solutions for pollutions and waste management to improve the quality of environment.
- Identify the causes of social issues and apply the concept of green chemistry to maintaining a clean environment.
- Analyze the effects of human population and issues related to the environment and human health.
- Understand the different goals of sustainable development and apply them for suitable technological advancement and societal development.

TEXT BOOKS

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
3. Allen, D. T. and Shonnard, D. R., "Sustainability Engineering: Concepts, Design and Case Studies", First edition, Prentice Hall, 2015.

REFERENCES

1. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt Ltd, Hydrabad, 2015.

2. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi, 2007.
3. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

E-RESOURCES

1. https://nptel.ac.in/courses/122102006/
2. https://swayam.gov.in/nd1_noc19_ge22/preview

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	1	3	2	-	1	3	-	1	-	-	1	-	-	-
2	2	2	2	2	2	2	1	-	-	-	-	-	-	-	-
3	-	2	2	2	1	1	3	-	-	-	-	-	-	-	-
4	1	2	2	1	1	2	3	3	-	-	-	-	-	-	-
5	-	2	2	2	2	1	1	1	-	2	-	-	-	-	-
AVG	1.5	1.8	2.2	1.8	1.5	1.4	2.2	2	1	2	-	1	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23HST202 **TAMILS AND TECHNOLOGY** **L T P C**
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

TOTAL: 15PERIODS

TEXT BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

REFERENCE BOOKS

1. Heritage of Tamils, Published by:Yes Dee Publishing Pvt Ltd, Chennai
2. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23HST202 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

அலகு I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்**: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III **உற்பத்தித் தொழில் நுட்பம்**: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15PERIODS

TEXT BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCE BOOKS

1. தமிழர் மரபு -முனைவர் ஆ பூபாலன் (வி ஆர்பி பி பப்ளிஷர்ஸ்)

23GEE201	ENGINEERING GRAPHICS	L T P C
	(Common to all Programmes)	3 0 2 4

OBJECTIVES

- To acquire the knowledge of various curves.
- To learn projections of points, lines, planes viewed in different positions.
- To impart the graphic skills for converting pictorial views of solids in to orthographic views and perspective projections.
- To learn the principles of projection of simple solids.
- To gain the knowledge about the section of solids and development of surfaces of the given solids.

UNIT I PLANE CURVES (Manual drafting) 9+3

Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per BIS conventions. **(Not for Examination)**

Construction of ellipse – Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES (Manual drafting) 9+3

Projection of points – Projection of straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to one reference planes.

UNIT III ORTHOGRAPHIC AND PERSPECTIVE PROJECTIONS (Manual drafting) 9+3

Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids, cones and cylinders by visual ray method.

UNIT IV PROJECTION OF SOLIDS (CAD software) 9+3

Projections of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT V SECTION OF SIMPLE SOLIDS AND DEVELOPMENT OF SURFACES (CAD software) 9+3

Sectioning of simple solids like prisms – pyramids, cylinder and cone - Inclined to one reference plane. Development of lateral surfaces of simple and truncated solids: Prisms, Pyramids, Cylinders and Cones.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Predict the construction of various curves.
- Analyze the principles of projection of various planes by different angle to project points, lines and plane surfaces.

- Draw the projection of three dimensional into two dimensional objects and perspective projections**.**
- Draw the principles of projection of simple solids by change of position method.
- Construct the sectional views of components and develop the component surface.

TEXT BOOKS

1.Venugopal K. and Prabhu Raja V., - "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018.
2.Natarajan K.V., "Engineering Graphics", 32nd Edition, Dhanalakshmi Publishers, 2019.
3.Bhatt N.D., "Engineering Drawing", 53rd Edition Charotar Publishing House Pvt. Ltd., 2014.

REFERENCES

1.K.R. Gopalakrishna, "Engineering Drawing Volume 1 & 2", 55th Edition, Subhas Publications, Bangalore, 2017.
2.T.Jeyapoovan., "Engineering Graphics using Auto CAD" 3rd Edition, vikas publishing house Pvt Ltd, New Delhi, 2017.
3.Dhananjay A. Jolhe, Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Company Limited, 2008.

E- RESOURCES

1.https://nptel.ac.in/courses/112/103/112103019/ - (Geometric Constructions)
2.https://nptel.ac.in/courses/105/104/105104148/ - (Projections)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2
2	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2
3	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2
4	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2
5	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	-	2	2	-	-	-	2	-	2	2	2	2

1-Low 2-Medium 3-High '-' – No Correlation

23EEE202 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
(Common to AIDS, CSE, CSE-CS, IT, R&A, PT) 3 0 2 4

OBJECTIVES

- To understand electric circuit laws, single and three phase circuits, wiring and measuring instruments.
- To know working principles of electrical machines.
- To realize the working principle of various electronic devices and applications.
- To apply the principles of digital electronics in digital world.
- To familiarize the use of various measuring instruments.
- To provide practical knowledge on electrical and electronics engineering.

UNIT I ELECTRICAL CIRCUITS 9

DC circuits: Circuit components: Conductor, Resistor, Inductor, Capacitor - Ohm's Law - Kirchhoff's Laws - Independent and Dependent sources - Nodal analysis, Mesh analysis with Independent sources only (Steady state) – Thevenin's theorem – Maximum Power Transfer theorem.

Introduction to AC circuits and parameters: Waveforms, Average value, RMS value, Instantaneous power, real power, reactive power and apparent power, power factor - Steady state analysis of RL, RC & RLC circuits.

UNIT II ELECTRICAL MACHINES 9

DC Generators: Construction and working principle, EMF equation, Types and applications – DC Motors: Working principle, Types and applications - Construction, Working principle and applications: Single phase transformer, Three phase alternator and Three phase induction motor – BLDC Stepper Motor – PMSM.

UNIT III ANALOG ELECTRONICS 9

PN junction diodes and its applications - Zener diode: structure, operation, Zener diode as regulator – Biasing of BJT - JFET, SCR, MOSFET, IGBT - Types, VI characteristics.

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, Combinational logic - Representation of logic functions - SOP and POS forms, K-map representations - Minimization using K maps - Half adder, Full adder – Multiplexer, Demultiplexer.

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Operating principle and Types of Moving coil and Moving iron meters - Measurement of power and Energy meter - Data acquisition.

LIST OF EXPERIMENTS

1. Verification of KVL & KCL.
2. Load test on DC shunt motor.
3. Characteristics of PN and zener diodes

4. Characteristics of BJT.
5. Half wave and full wave rectifiers
6. Verifications of Half adder and Full adder.
7. Measurement of power and Energy meter.

TOTAL : 45+15 PERIODS

OUTCOMES

Upon completion of the course, Students will be able:

- To understand electric circuits and choose appropriate instruments for electrical measurement for a specific application.
- To understand the concept of different types of DC and AC machines.
- To identify the diode's usage as a rectifier, and Zener diode's usage as an voltage regulator and discuss the basic characteristics of BJT.
- To employ Boolean algebra to implement the combinational logic circuits.
- To understand the operating principles of measuring instruments and choose suitable instrument for measuring the parameters.
- To understand and analyse practical electrical and electronics engineering.

TEXT BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020.
2. S. K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, 2nd Edition, 2017.

REFERENCES

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/108108076 - (Basics of Electrical Technology).
2. https://www.digimat.in/nptel/courses/video/108105112/L01.html - (Fundamentals of Electrical Engineering).

Mapping of Cos-Pos & PSOs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	-	-	-	1	-	-	-	1	3	-	3
2	3	1	-	1	-	-	-	1	-	-	-	1	3	-	3
3	3	-	-	1	-	-	-	1	-	-	-	1	3	-	3
4	3	3	2	1	-	-	-	1	-	-	-	1	3	-	3
5	3	-	-	-	-	-	-	1	-	-	-	1	3	-	3
6	3	3	2	-	-	-	-	1	3	3	-	1	3	3	3
AVG	3	2.5	2	1	-	-	-	1	3	3	-	1	3	3	3

1-Low 2-Medium 3-High '-' – No Correlation.

23GEL201 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan, laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

WOOD WORK STUDY:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch boardwiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type usingDiac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone..
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

TOTAL: 60 PERIODS

OUTCOMES

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

- Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
- Wire various electrical joints in common household electrical wire work.
- Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

- Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
6	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
AVG	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

1-Low 2-Medium 3-High '-' – No Correlation

23EEC201 COMMUNICATION SKILLS L T P C
(Common to all B.E. & B.Tech. branches) 0 0 4 2

OBJECTIVES

- To use vocabularies appropriately in a sentence and various situations.
- To improve communicative competence through listening.
- To make effective presentations and group discussions.
- To read and recognize different context.
- To write paragraph, essay and special addresses.

Unit I VOCABULARY 6

Vocabulary building – Articulate ideas and thoughts; usage of palindromes, greetings, wishes, festival related words - Vocabulary Words with Sentences. - Idiomatic Expressions.

Unit II LISTENING 6

Listening Skill- Its importance – Purpose - Process - Types- Barriers - Effective Listening strategies- Listening to telephonic conversations – Watching Inspiring Speech videos on Youtube - Listening native speaker's videos for pronunciation - Listening to broadcast, messages, announcements - Listening to Instagram Videos.

Unit III SPEAKING 6

JAM Talk - Role play - Debate - Conversational skills (formal and informal) - Conversation practice - Group Discussion and Interview Skills – Introducing oneself and others – Goal Settings - Immediate, Long term and short term.

Unit IV READING 6

Reading for the Main idea- Finding Specific Information - Reading for Detail - Read and recognize different text types ranging from newspaper, articles, magazines, books and Reading autobiographies.

Unit V WRITING 6

Paragraph Writing - Essay writing - Creative writing - Special Address on Specific topic - Welcome Address, vote of Thanks.

TOTAL: 30 PERIODS

Mandatory activities: Presentation, Group Discussion, Mock Interview

OUTCOMES

Upon completion of the course, the students will be able to:

- Improve vocabulary and express the same contextually.
- Listen and comprehend the general and technical text.
- Speak effectively in presentation, debate and group discussions.
- Read and understand the concept from newspapers, articles, magazines and books.

- Draft special addresses, welcome address, vote of thanks and write paragraph and essay.

TEXT BOOKS

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011.
2. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford, 2011.

REFERENCES

1. Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan, 2014.
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press,1992.
4. Asraf rezvi. Effective Technical Communication. India: McGraw-Hill Education Private Limited, 2005.

EXTENSIVE READING

1. Dr. A. P. J. Abdul Kalam " Wings of Fire "

E-RESOURCES

1. https://youglish.com
2. https://newsinlevels.com
3. https://britishcouncil.org
4. https://writeandimprove.com

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	1	1	1	3	-	3	-	-	-
2	-	-	-	-	-	1	-	-	1	3	-	3	-	-	-
3	-	-	-	-	-	1	2	2	3	3	-	3	-	-	-
4	-	-	-	-	-	2	2	-	3	3	-	3	-	-	-
5	-	-	-	-	-	1	1	-	1	3	-	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	-	-	-	1.20	1.50	1.50	1.80	3.00	-	3.00	-	-	-

1. Low 2-Medium 3-High '-' – No Correlation

SEMESTER III

23MAT301	**TRANSFORMS AND COMPLEX FUNCTIONS**	**L T P C**
	[Common to Civil, EEE, Mech, R&A and PT]	**3 1 0 4**

OBJECTIVES

- To explain Fourier transforms techniques used in wide variety of situations.
- To utilize the effective mathematical tools to develop Z transform techniques for discrete time systems.
- To apply the Fourier series analysis to many applications in engineering to solve boundary value problems.
- To develop the fundamental concepts in analytic functions, conformal mapping and bilinear transformations.
- To extend the standard techniques of complex integration.

UNIT I FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem – Fourier transform – Fourier sine and cosine transforms – Properties of Fourier transform – Convolution theorem for Fourier transform – Parseval's identity for Fourier transform

UNIT II Z-TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z-transforms: Some standard Z-transforms – Elementary properties – Some useful Z-transforms and inverse Z- transforms – Convolution theorem – Evaluation of Inverse Z-transforms by partial fraction method – Application to difference equations.

UNIT III FOURIER SERIES **9+3**

Euler's formulae – Conditions for a Fourier expansion – Functions having points of discontinuity – Odd and even function – Half range series – Parseval's formula – Practical Harmonic analysis.

UNIT IV ANALYTIC FUNCTIONS **9+3**

Cauchy-Riemann equations – Analytic functions – Properties of analytic functions – Harmonic functions – Orthogonal system – Construction of analytic functions – Bilinear transformation – Conformal transformation by w = 1/z.

UNIT V COMPLEX INTEGRATION **9+3**

Cauchy's theorem – Cauchy's integral formula –Taylor's and Laurent's series – Residues: Residue theorem – Calculation of residues – Evaluation of real definite integrals: Integration around the unit circle.

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze some of the physical problems of engineering by Fourier transforms.
- Apply Z transforms techniques in solving difference equation.

- Solve differential equations using Fourier series analysis.
- Develop the concept of analytic functions, conformal mapping and bilinear transformations.
- Evaluate integrals using Cauchy's integral formula and residue theorem.

LIST OF TUTORIALS

1. Calculate Fourier transform of simple functions.
2. Solve difference equations by Z transforms.
3. Computation of Fourier series coefficient.
4. Determination of Bilinear transformation for the given set of points.
5. Calculate complex line integration.

TOTAL: 45+15=60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10thEdition, John Wiley, India, 2016.

REFERENCES

1. N.P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", 9thEdition, Laxmi Publications Pvt. Ltd, 2014.
2. Dr.Kandasamy. P, Dr.Thilagavathy . K and Dr. Gunavathy .K., "Engineering Mathematics – Volume III", S. Chand and Company Ltd., NewDelhi, 2010.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/111/102/111102129/# (Transforms)
2. https://archive.nptel.ac.in/courses/111/105/111105134/ (Complex functions)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
2	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
3	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
4	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
5	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23MET302 ENGINEERING MECHANICS L T P C

(Common to Civil, Mechanical Engineering and Robotics and Automaton) **3 1 0 4**

OBJECTIVES

- To understand the definition of particle, body, force and their equilibrium conditions.
- To understand the concept of equilibrium of rigid bodies.
- To learn the basic concepts of friction.
- To learn about the center of gravity and moment of inertia of surfaces.
- To develop basic dynamics concepts – force, momentum, and impact of elastic bodies.

UNIT I FUNDAMENTAL CONCEPTS OF MECHANICS 9+3

Introduction to mechanics – Scalars & vectors - Unit conversion – Laws of Mechanics (Parallelogram law, Lami's theorem and Triangular law of forces) – Types of forces acting on a body - Resolution and composition of force – Free body diagram – Equilibrium of a particle - Equivalent system of forces and computation of resultant forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Introduction - Varignon's theorem - Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Resolution of a given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III FRICTION 9+3

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – Angle of Repose – Equilibrium of bodies on inclined plane - Belt friction – Ladder friction – Wedge friction – Rolling resistance.

UNIT IV CENTRIODS AND AREA MOMENT OF INERTIA 9+3

Introduction – Centroids of simple Plane Areas and Curves (rectangle, triangle, circle, hollow circle, T-section & I-section) – Area moment of inertia for rectangle, circle, hollow circle, triangle, I-Section and T-Section - Parallel axis theorem and Perpendicular axis theorem. Principle moments of inertia of plane areas.

UNIT V DYNAMICS OF PARTICLES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of particles. Principle of Impulse and Momentum - Impact of elastic bodies.

TOTAL: 45+15=60 PERIODS

OUTCOMES

On successful completion of this course, The Students can able to:

- Illustrate the vector and scalar representation of forces and moments
- Analyze the rigid body in equilibrium.
- Determine the friction and the effects by the laws of friction.
- Solve the moment of inertia of the structural members.

- Apply the principles of dynamics to study the motion of a body.

TEXT BOOKS

1. Dr.N.Kottiswaran, "Engineering Mechanics", 11th Edition, Sri Balaji Publications, Coimbatore, 2017.
2. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education.,12th Edition, 2019.
3. Vela Murali, "Engineering Mechanics", Oxford University Press, 2017.

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education, 2010.
2. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th Edition, Wiley student edition, 2013.
3. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/122/104/122104015/ - ((Engineering Mechanics)
2. https://www.courses.com/indian-institute-of-technology-guwahati/engineering-mechanics - (Engineering Mechanics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
2	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
3	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
4	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
5	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	1	2	-	-	-	-	-	-	2	3	1	2

1- Low 2-Medium 3-High '-' – No Correlation

23RMT301 BASICS OF ROBOTICS L T P C
3 0 0 3

OBJECTIVES

- To understand the Robot types and its end effectors.
- To introduce the concept of robot kinematics.
- To understand the methods in trajectory and motion planning.
- To impart knowledge on dynamics of robots.
- To learn the actuators used in robots.

UNIT I INTRODUCTION TO ROBOTICS 9

History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT II ROBOT KINEMATICS 9

Differential kinematics of planar and spherical manipulators, Jacobians problems.

UNIT III TRAJECTORY AND MOTION PLANNING 9

Introduction, Linear trajectory function, polynomial trajectory function, Gross and fine motion planning, motion planning schemes-visibility graph, voronoi diagram ,tangent graph, accessibility graph, path velocity decomposition, incremental planning, relative velocity approach, reactive control strategy and potential field approach.

UNIT IV ROBOT DYNAMICS 9

Lagrange, Euler formulations, Newton-Euler formulations, problems on planar two link manipulators

UNIT V ACTUATORS 9

Definition, types and selection of Actuators- Pneumatic actuator- Electro-Pneumatic actuator- Mechanical actuating system, Hydraulic actuator - Electrical actuating systems -D.C motors - AC motors

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Select the robot and its grippers based on application.
- Calculate robot position and orientation.
- Develop optimal trajectory and path planning of robots.
- Determine joint torques and forces in a robot.
- Select actuators for any robotic system.

TEXT BOOKS

1. Pratihar.D.K, "Fundamentals of Robotics",Narosa Publishing House,India,2019
2. Fu. K.S, Gonzalez. R.C, Lee. C.S.G "Robotics –Control, Sensing, Vision, and Intelligence", McGraw Hill, 2015

REFERENCE

1. Groover Mikell .P, "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2014
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Harry H. Poole , "Fundamentals of Robotics Engineering ", Springer Netherlands,2012

E-RESOURCES

1.https://archive.nptel.ac.in/courses/112/104/112104298 (Introduction to Robotics)
2. https://archive.nptel.ac.in/courses/112/105/112105249 (Trajectory , motion Planning)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
2	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
3	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
4	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
5	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1
6	-	-	-	-	-			-	-		-	-	-	-	-
AVG	2	2	-	2	-	2	2	-	-	2	-	-	2	3	1

1- Low 2-Medium 3-High '-' – No Correlation

23EEE303 DIGITAL ELECTRONICS AND LINEAR INTEGRATED CIRCUITS L T P C
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To study various number systems and basic theorems of Boolean algebra and gate level minimization and implementation
- To practice the design of various combinational digital circuits using logic gates
- To study the analysis and design procedures for synchronous Sequential circuits
- To learn linear and non linear applications of operational amplifiers
- To interpret the internal functional blocks and the applications of Application ICs
- To learn design, testing and characterizing of circuit behavior with digital ICs and Analog ICs

UNIT I NUMBER SYSTEMS AND BOOLEAN ALGEBRA 9

Review of number systems, Types and conversion, Binary codes - Error detection and correction codes (Parity and Hamming code). Boolean theorems and properties - DeMorgan's theorem, SOP and POS forms - Logic gates - Switching functions and minimization using K-maps - Simulation of logic gates using MATLAB.

UNIT II COMBINATIONAL CIRCUITS AND PROGRAMMBLE LOGIC DEVICES 9

Design of adders, subtractors - Multiplexers and Demultiplexers - Magnitude comparator - Code Converters - Encoders and Decoders - Introduction to Programmable Logic Devices: PROM, PLA, PAL, CPLD, FPGA - Simulation of Adder and Subtractor using MATLAB.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - Level triggering and edge triggering - Counters - Asynchronous and synchronous type - Modulo counters - Shift registers - Design of synchronous sequential circuits - Moore and Mealy models - Counters, state diagram; state reduction; state assignment.

UNIT IV OPERATIONAL AMPLIFIER CHARACTERISTICS & APPLICATIONS 9

Introduction to IC - Operational Amplifier: Ideal Op-Amp, DC and AC characteristics, Inverting and Non-inverting Amplifiers - Differentiator and integrator - Sample and Hold circuit - Schmitt trigger - Multivibrators - First and second order low pass and high pass active filters - D/A converter (R - 2R ladder and weighted resistor types) - A/D converter (Flash and Successive approximation types) - Simulation of Differentiator and integrator using MATLAB.

UNIT V APPLICATION ICS 9

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators: LM78XX, LM79XX fixed series voltage regulator - LM317, LM723 adjustable voltage regulators - Switched mode power supply - ICL 8038 function generator IC.

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using digital logic gates.
2. Design and implementation of adder, subtractor and parity generator / checker circuits.
3. Design and implementation of encoder, decoder, multiplexers and demultiplexers.
4. Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types
5. Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes
6. Application of Op-Amp: Inverting and non-inverting amplifier, Adder.
7. Application of Op-Amp: Comparator, Integrator and Differentiator.
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Voltage to frequency characteristics of NE/ SE 566 IC.
10. Design and implementation of a simple digital system (Mini Project).

TOTAL: 45+15 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Use electronic circuits involved in the design of logic gates
- Design various combinational digital circuits and PLDs
- Acquire and design synchronous sequential circuits using flip-flops
- Generate Waveforms using Op - Amp circuits
- Analyze the Application of ICs
- Design and implement circuits with digital ICs like decoders, multiplexers and analog ICs like timers, VCOs

TEXT BOOKS

1. M. Morris Mano, Michael D.Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education, 6th Edition, 2018.
2. D. Roy Choudhary, Shail B. Jain, "Linear Integrated Circuits", New Age International Publishers, 1st Edition, 2021.

REFERENCES

1. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI Education, 4th Edition, 2016.
2. S.Salivahanan, V.S.Kanchan Bhaaskaran, "Linear Integrated Circuits", Tata McGraw Hill Education, 2nd Edition, 2017.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/117/105/117105080/ - (Digital Systems Design)
2. https://archive.nptel.ac.in/courses/108/108/108108111/ - (Integrated Circuits MOSFETs OP- Amps and their Applications

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
2	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
3	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
4	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
5	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
6	3	3	3	3	-	-	-	-	3	3	-	1	3	2	1
AVG	3	3	3	2.2	2	-	-	1	3	1.3	-	1	3	2	1

1-Low 2-Medium 3-High '-' – No Correlation

23EEE304 ELECTRIC MACHINES AND POWER SYSTEM L T P C
(Lab Embedded Theory Course) 3 0 2 4

OBJECTIVES

- To learn the types, construction and working of DC machines
- To realize construction , working and types of transformers
- To impart knowledge in types, construction and working of Induction Motors
- To recognize the construction and function of Synchronous and Special Machines .
- To introduce the basics of power system .
- To expose the students to the operation of machines and power system and give them experimental skill.

UNIT I DC MACHINES 9

Principle and Construction of DC Machines - EMF equation - Methods of excitation – Types - Principle of operation of DC Motor – back emf and torque equation - Characteristics of DC series and shunt motors - Starting of DC Motors, Need for Starters - Speed control and Braking of DC motors (Voltage Control & Dynamic Braking Only) .

UNIT II TRANSFORMERS 9

Constructional Details – Principle of Operation – EMF Equation – Transformation ratio - Transformer on no load – Transformer on load- Regulation - Losses and efficiency - Load test - Three phase transformer connections - Applications of Transformer in Robotics and Automation.

UNIT III INDUCTION MOTORS 9

Principle of Operation of single phase induction motor – Starting of Single phase Induction motor - Construction – Types – Principle of operation of three phase induction motors - Speed Torque characteristics - Equivalent circuit - Starting and Speed control - Introduction to Linear induction motor - PMSIM - Applications.

UNIT IV SYNCHRONOUS AND SPECIAL MACHINES 9

Construction of Synchronous machines - Types – Induced emf - Working principles of: BLDC - Stepper motor - Servomotor – Universal motor.

UNIT V INTRODUCTION TO POWER SYSTEM 9

Structure of electric power systems - Generation, transmission, sub- transmission and distribution systems - EHVAC and EHVDC transmission systems - Substation layout. (Concepts only).

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of self exited DC shunt generator.
2. Load test on dc shunt motor.
3. Speed control of dc shunt motor.
4. Load test on single phase transformer.

5. Load test on Single phase induction motor.
6. Calculation of Transmission Line parameter using MATLAB.
7. Modeling and simulation of a DC motor's speed control using MATLAB.

TOTAL : 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Understand construction and working of DC machines.
- Get the concept of transformer.
- Expand the knowledge on working principal and construction of induction motor
- Acquire information about construction , working principle of Synchronous and Special Machines.
- Expand the concept of Power System
- Do load test ,speed control and MATLAB Simulation.

TEXT BOOKS

1. B.L.Thereja and A.K.Theraja, "A Text of Electrical Technology", S.Chand publications, Volume 2 , 2015.
2. V.K.Mehta, Rohit Mehta, "Principles of power system", S. Chand & Company Ltd, New Delhi, Revised Edition, 2021.

REFERENCES

1. B.R.Gupta "Fundamental of Electric Machines" New age International Publishers, 3rd Edition Reprint, 2015.
2. D.P.Kothari, I.J. Nagarath, "Power System Engineering " , McGraw-Hill Publishing Company limited, New Delhi, 3rd Edition, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/102/108102146/ - (Electrical Machines)
2. https://archive.nptel.ac.in/courses/108/102/108102047/ - (Power System Generation , Transimision and Distribution).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	1	-	2	-	3	3	3	3
2	3	3	3	3	-	-	-	1	-	2	-	-	3	3	3
3	3	3	3	3	-	-	-	1	-	2	-	-	3	3	3
4	3	3	3	3	-	-	-	1	-	2	-	3	3	3	3
5	3	3	3	3	-	-	-	1	-	2	-	3	3	3	3
6	3	3	3	3	-	-	-	1	3	2	-	3	3	3	3
AVG	3	3	3	3	-	-	-	1	3	2	-	3	3	3	3

1-Low 2-Medium 3-High '-' – No Correlation.

23RME301 **MANUFACTURING PROCESS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To Study the sand casting for a two part mould
- To learn about the types of metal joining process.
- To Understand the working of lathe and milling machine.
- To study the machine tools and its types working operation.
- To understand the operation of grinding & gear generation.
- To provide working skill and knowledge on shaping, planing, slotting and different drilling operations**.**

UNIT I CASTING PROCESSES **9**

Sand casting - Sand moulds - Type of patterns - Pattern materials - Pattern allowances - Types of moulding sand - Properties - Core making - Methods of Sand testing - CO2 process - Moulding machines - Melting furnaces. Working principle of special casting processes - Shell, investment casting - Pressure die casting -Centrifugal casting - Sand Casting defects

UNIT II METAL JOINING PROCESSES **9**

Fusion welding processes - Types of Gas welding - Equipments used - Flame characteristics - Filler and Flux materials - Arc welding equipments - Electrodes - Coating and specifications - Principles of Resistance welding - Spot/butt, Seam welding - Percussion welding - Gas metal arc welding - Flux cored – Submerged arc welding - Electro slag welding - TIG welding. Principle and application of special welding processes - Plasma arc welding - Thermit welding - Electron beam welding, Laser Beam Welding, Friction stir welding, Ultrasonic Welding - Weld defect

UNIT III LATHE AND MILLING MACHINE **9**

Lathe machine - Centre lathe, tool nomenclature, operations, machining time and power estimation – Milling -Specifications - Types - Cutter nomenclature - Operations - Milling processes - Indexing - Gear forming.

UNIT IV MACHINE TOOLS AND HOLE MAKING **9**

Types, Specification and Quick return Mechanisms: Shaper, Planer and Slotter - Hole making operations - drilling, reaming, boring, counter boring, counter sinking and tapping.

UNIT V GRINDING AND GEAR GENERATION **9**

Grinding - Types of grinding - Grinding wheel designation and selection - Honing, lapping, super finishing, polishing and buffing - Gear generation - Gear shaping and gear hobbing - Specifications - Cutting spur andhelical gears

LIST OF EXPERIMENTS

1. Mould with solid and split patterns.
2. Mould with loose-piece pattern.
3. Perform facing, plain turning and step turning operations in centre lathe.
4. Perform taper turning, thread cutting and knurling operations in centre lathe.
5. Fabrication of simple structural shapes using welding.
6. Spur gear/contour cutting in milling machine.
7. Keyway cutting in shaper
8. Round to square in shaper
9. Prepare good surface finish on flat metal.
10. Gear generation in hobbing machine.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the principle of different metal casting processes.
- Describe the various metal joining processes.
- Identify the components of lathe and milling machine
- Describe the fundamentals of metal cutting in machining operations.
- Apply various machining processes such as Grinding
- Identify the components of Manufacturing Process..

TEXT BOOKS

1. P.N.Rao "Manufacturing Technology" Volume 1, Mc Grawhill Education, Fifth Edition,2018.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,Fourth Edition, 2013.

REFERENCES

1. Rao,P.N. "Manufacturing Technology Foundry, Forming and Welding", Fourth Edition, TMH-2013.
2. Rajput R. K, "Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, 2013.
3. Hajra Choudhury S.K, "Elements of Workshop Technology", Vol. II, Media Promoters & Publishers Pvt Ltd., Mumbai, 2010.

E-RESOURCES

1. http://nptel.ac.in/courses/1121 05126/ - Rao P.N, "Manufacturing Technology - Metal Cutting andMachine Tools"
2. https://nptel.ac.in /courses/112/105/112105126/ - (Manufacturing Process – II)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	-	-	1	2	-	-	-	1	1	2	1	2
2	2	1	1	-	-	1	2	-	-	-	1	1	2	1	2
3	2	1	1	-		1	2	-	-	-	1	1	2	1	2
4	2	1	1	-	-	1	2	-	-	-	1	1	2	1	2
5	2	1	1	-		1	2	-	-	-	1	1	2	1	2
6	3	2	1	-	-	1	-	-	-	-	-	1	1	1	2
AVG	2	1	1	0	0	1	2	0	0	0	1	1	2	1	2

1- Low 2-Medium 3-High '-' – No Correlation

SEMESTER IV

23RMT401	**AUTOMATIC CONTROL SYSTEMS**	**L T P C**
		3 0 0 3

OBJECTIVES

- To study the basics of control system and its response .stability of mechanical and electrical systems . Use of MATLAB to design a stable control system.
- To introduce methods for analyzing the time response
- To impart knowledge about the frequency response.
- To Study about the system stability
- To Learn about Root locus concept and its Methods.

UNIT I INTRODUCTION 9

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function- Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tacho- generator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gainformula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT II TIME DOMAIN ANALYSIS 9

Standard Test signals – Time response of second order system - Time domain specifications – Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT IV SYSTEM STABILITY 9

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability – Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin.(Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT V ROOT LOCUS METHOD 9

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the basic of the loop systems.
- Explain about the time domain analysis
- Explain about the Frequency Domain Analysis
- Analyze the System Stability
- Apply the Root Locus Method

TEXT BOOKS

1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018.
2. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.

REFERENCES

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.
2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.
3. Norman C. Nise S, "Control system Engineering", John Wiley & Sons, Singapore, 2004.

E-RESOURCES

1.https://archive.nptel.ac.in/courses/108/103/108103007(Introduction)

2. https://archive.nptel.ac.in/courses/108/103/108103008 (frequency domain analysis)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1
2	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1
3	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1
4	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1
5	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	2	1	1	1	2	-	-	-	-	-	-	1	2	2	1

1- Low 2-Medium 3-High '-' – No Correlation

23RMT402 SENSORS AND INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn about the Force, Magnetic And Heading Sensors
- To learn about the optical, pressure and temperature sensor
- To understand the signal conditioning and DAQ systems

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 7

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 11

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Recognize with various calibration techniques and signal types for sensors.
- Describe the working principle of Motion, Proximity and Ranging Sensors
- Describe the working principle of force, magnetic, heading, sensors.
- Describe the working principle of Optical, Pressure and Temperature Sensors
- Apply the DAQ Systems with different sensors for real time application.

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TEXT BOOKS

1. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Twelfth Edition, Dhanpat Rai & Co, New Delhi, 2013
2. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009

REFERENCES

1. C. Sujatha .Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2. Hans Kurt Tönshoff (Editor), Ichiro , "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/108/108108147(Introduction)
2. https://archive.nptel.ac.in/courses/115/107/115107122(Optical, Pressure and temperature sensors)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
2	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
3	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
4	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
5	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2

1- Low 2-Medium 3-High '-' – No Correlation

23RMT403 ROBOT KINEMATICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce Robots history, terminologies, classification and configurations.
- To acquire knowledge about basic Geometrical and Algebraic approach to solve forward kinematics of serial manipulator.
- To acquire knowledge about advanced forward kinematics of serial manipulator.
- To acquire knowledge about inverse kinematics of various serial manipulator.
- To acquire knowledge about Jacobian aspects and infinitesimal motion of robot mechanisms.

UNIT I OVERVIEW OF ROBOTICS 9

Introduction to Robotics - History - Definitions - Law of Robotics – Terminologies - Classifications Overview – Links & Joints - Degrees of Freedoms - Coordinate Systems - Work Volume - Precision, Repeatability & Accuracy - Position and Orientation of Objects - Roll, Pitch and Yaw Angles - Joint Configuration of Five Types of Serial Manipulators - Wrist Configuration- Overview of end effector - Selection and Application of Serial Manipulators.

UNIT II FORWARD KINEMATICS - GEOMETRICAL AND ALGEBRAIC APPROACH 9

Need for forward and Inverse Kinematics Equation – Parameters in Design and Control – Methods of forward and inverse kinematics- Geometrical and Algebraic Approach in Forward Kinematics Solution, 1 DOF - 2 DOF Planar Robot (2P and 2R); 3DOF 2RP Spatial Robot.

UNIT III FORWARD KINEMATIC MODELING 9

Unit Circle Trigonometry - Translation Matrix - Rotation matrix, Euler Angles - Quaternion Fundamental - Dot and Cross Products - Frames and Joint Coordinates - Homogeneous Transformation - D-H and Modified D-H Convention and Procedures – Forward kinematics Solution using D-H Convention: 3 DOF wrist , RR Planar, 3 DOF RRP, Cartesian, Cylindrical, Spherical , SCARA and Articulated 3 DOF robots - 3 DOF robot with wrist.

UNIT IV INVERSE KINEMATICS MODELING 9

Introduction to inverse kinematics -Issues in inverse kinematics - Inverse kinematics of 2 DOF Planar robot - 2 and 3DOF planar and Spatial robot - Tool configuration - Inverse kinematics of 3 axis robot and 6 axis Robot - Inverse kinematics Computation- Closed loop solution

UNIT V KINEMATIC MODELING OF DIFFERENTIAL DRIVE ROBOT 9

Degree of Mobility, Steerability and Maneuverability- Mobile Robot kinematics - Kinematic model and constraints, Mobile robot workspace – Representation of robot position – Kinematic models of differential wheel drive - Fixed wheel and steered wheel - Mobile manipulators and its applications – swarm robots.

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the history, classifications, and basic terminologies of robotics and various configuration of robots.
- Analyse the forward kinematic model for planar and spatial robot manipulator.
- Analyse the forward kinematic model for multi-DOF robot manipulators.
- Analyse the inverse kinematic model for multi-DOF robot manipulators.
- Analyse the forward kinematic model for differential drive mobile robot.

TEXT BOOKS

1. Lynch, Kevin M., and Frank C. Park. Modern Robotics: Mechanics, Planning, and Control, First Edition. Cambridge University Press, 2017.
2. Mikell P. Groover, "Industrial Robotics", McGraw Hill, Second Edition, 2012.

REFERENCES

1. S K Saha, Introduction to Robotics, Tata McGraw-Hill, Second Edition, 2017
2. Arthor Critchlow, "Introduction to Robotics", First Edition, Macmillan, 2009.
3. Mohsen Shahinpoor, "A Robot Engineering Text Book", First Edition, Harper and Row, 2004.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/105/112105236(Forward Kinematics)
2. https://archive.nptel.ac.in/courses/112/105/112105268(Kinematic Modeling)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
2	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
3	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
4	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
5	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	-	2	-	-	1	-	-	-	1	3	1	2

1- Low 2-Medium 3-High '-' – No Correlation

23EEE401 **PLC AND SCADA** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To introduce the basic concepts of PLC.
- To study the logic fundamentals, PLC timer and counter.
- To gain knowledge in PLC Programming.
- To understand the basic concepts of DCS.
- To categorizes the applications of PLC and HMI Systems.
- To provide practical knowledge on PLC.

UNIT I INTRODUCTION 9

History and developments in Industrial Automation - Vertical Integration of Industrial Automation - Control elements in Industrial Automation – Safety standards - PLC Introduction to Industrial Automation : Basics of History and developments in Industrial Automation - Vertical Integration of Industrial Automation - Control elements in Industrial Automation - Safety standards - PLC Introduction : Basics of PLC - Advantages - Capabilities of PLC - Architecture of PLC - Scan cycle - Types of PLC : Types of I/O modules - Configuring a PLC - PLC wiring – Redundant systems.

UNIT II PROGRAMMING OF PLC 9

Introduction to state machine theory - Types of Programming – IEC61131 Standard - Process Control Programs using Relay Ladder Logic – FBD, structure, arithmetic functions - Timers and counters –data transfer- Comparison and manipulation instructions - PTO /PWM generation.

UNIT III NETWORKING OF PLCS 9

Industrial Networking Buses (Flow Diagram Only) - Introduction to Industrial Buses - Protocols - Device Net - Ethernet - IP, Modbus TCP - Ether CATor CAN bus protocol - Details of CAN bus.

UNIT IV HMI SYSTEMS 9

Necessity and Role of HMI in Industrial Automation – Types of HMI panels :Text display - operator panels - Touch panels - Panel PCs - Integrated displays, Interfacing PLC to HMI: Case studies of Machine automation, Process automation.

UNIT V SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

SCADA overview - Developer and runtime packages - Architecture - Tools - Tag - Internal & External graphics - Alarm logging - Tag logging - Trends – History - Report generation - Communication Protocols of SCADA - Open Protocols. OLE/OPC, OPCUA - DDE - Server/Client - Interfacing of SCADA with PLC and other field devices

LIST OF EXPERIMENTS

1. Write and Implement Ladder logic diagram for Boolean functions and verification using I/O devices.
2. Write and implementation of simple ladder logic program using timer: On, Off & Retentive timer using PLC.
3. Write and implementation of simple ladder logic program using (up & down) counter.
4. Write and implement ladder logic program to on-off the DC motor using PLC.
5. Simulation of PLC wiring for three phase induction motor starting and direction control.
6. Study about the traffic light controller system by using PLC.
7. Study about conveyor control system using PLC.

TOTAL : 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able:

- To explain the major components of PLC and its applications.
- To summarize the logical functions, timers and counters of PLC.
- To discuss the various instructions and modes of operations related to PLC.
- To realize the architecture and various interfacing techniques of distributed control systems.
- To examine the different applications of PLC and distributed control systems (DCS).
- To understand and analyse practical PLC.

TEXT BOOKS:

1. John W Webb and Ronald A Reis , "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2019.
2. Hans Berger , "Automating with Simatic S7-1200", Publicis Publishing, 2018.

REFERENCES:

1. Kelvin T Erikson , "Programmable Logic Controllers", Dogwood Valley Press, 2020.
2. R.S.Manoj , "Industrial Automation with SCADA : Concepts, Communications and Security", Notion Press, 2019.

E RESOURCES:

1. https://nptel.ac.in/courses/108105088 - (Industrial Automation and control).
2. https://nptel.ac.in/courses/108105063 - (Industrial Automation and control).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	-	1	-	1	-	2	3	1	3
2	3	3	3	2	-	-	-	1	-	1	-	2	3	1	3
3	3	3	3	2	-	-	-	1	-	1	-	2	3	1	3
4	3	3	3	2	-	-	-	1	-	1	-	2	3	1	3
5	3	3	3	2	-	-	-	1	-	1	-	2	3	1	3
6	3	3	3	2	3	-	-	1	3	1	-	2	3	1	3
AVG	3	3	3	2	3	-	-	1	3	1	-	2	3	1	3

1-Low 2-Medium 3-High '-' – No Correlation.

23MEE402 **STRENGTH OF MATERIALS** **L T P C**

(Lab Embedded Theory Course) **3 0 2 4**

(Common to Mechanical and Robotics and Automation)

OBJECTIVES

- To make the students to understand the concepts of stress and strains.
- To study the concept of two dimensional stress systems and stresses in thin and thick cylinders.
- To familiarize about shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To impart knowledge on finding slope and deflection of beams by various methods..
- To provide awareness on stresses on shafts and helical springs based on theory of torsion.
- To learning the mechanical properties of materials when subjected to different types of loading.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Stresses types -Tension, Compression and Shear Stresses - Hooke's law - Stresses and strains due to axial force in stepped and composite bars - Stresses due to thermal effect in composite bars - Factor of safety - Poisson ratio - Elastic constants and their relationship.

UNIT II STRESSES IN TWO DIMENSIONS 9

Stresses on inclined planes - Principal planes and Principal stresses - Mohr's circle for bi-axial stress with shear stress - Analytical and Graphical methods. Hoop and longitudinal stresses in thin and thick cylindrical vessels, Maximum Shear stress, Changes in dimensions and volume.

UNIT III TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAMS 9

Types of supports, Loads and beams - Shear force and bending Moment in cantilever, simply supported and overhanging beams. Theory of simple bending - Bending stress distribution – Load carrying capacity - Proportioning of sections - Shear stress distribution.

UNIT IV DEFLECTION OF BEAMS 9

Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

.UNIT V TORSION IN SHAFT AND HELICAL SPRING 9

Torsion of circular solid and hollow shafts - Shear strength - Angle of twist and torsional stiffness - Stresses in helical springs - Deflection of helical springs, carriage springs.

LIST OF EXPERIMENTS

1. Tension test on steel rod in U.T.M.
2. Torsion test on steel rod.
3. Impact test on metal specimen.
4. Hardness test on metals - Brinell and Rockwell Hardness.
5. Deflection test on beams.
6. Spring Test - Open coil and Closed coil.
7. Effect of Hardening – improvement of hardness and impact resistance of steels
8. Tempering- Improvement Mechanical properties Comparison
   (i) Unhardened specimen
   (ii) Quenched Specimen and
   (iii) Quenched and tempered specimen.
9. Double shear test on metal
10. Microscopic Examination of
    (i) Hardened samples and
    (ii) Hardened and tempered samples.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Calculate the stress and strains in regular and composite structures subjected to axial loads.
- Analyze the importance of two dimensional stress systems and stresses in thin and thick cylinders.
- Draw the shear force diagram, bending moment diagram for beams subjected to different loading conditions. Evaluate the bending stress and shear stress distribution.
- Estimate the slope and deflection of beams.
- Apply torsion equation in design of circular shafts and helical springs.
- Perform tension test, torsion test, impact test, hardness test, deflection test and spring test on given specimen.

TEXT BOOKS

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 6th Edition, 2017
2. Rajput R K., "A Textbook of Strength of Materials (Mechanics of Solids)", S Chand and Company Ltd., New Delhi, 7th Edition, 2018.
3. F.P. Beer and R.Johnston, "Mechanics of Materials", McGraw Hill Education India (P) Ltd., 7th Edition, 2017.

REFERENCES

1. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 3rd Edition, 2016.

2. Egor P Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi 2010.
3. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107146 - (Strength of Materials)
2. https://nptel.ac.in/courses/105/105/105105108/ - (Introduction to Strength of Materials)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
2	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
3	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
4	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
5	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
6	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3
AVG.	3	3	3	-	-	3	-	3	2	3	-	3	3	2	3

1- Low 2-Medium 3-High '-' – No Correlation

23GEE301 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn the data types, expressions and the statements in python.
- To study the Python functions and function calls to solve problems.
- To learn python data structures-list, tuples, dictionaries to represent complex data.
- To understand the file modules and python packages.
- To practice various computational operations and develop solutions using python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocksofalgorithms(statements,state,controlflow,functions),notation(pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS,TUPLES,DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation

UNIT V FILES, MODULES, PACKAGES& DATA VISUALIZATION 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file - Importing Matplotlib – Introduction to plotting – visualizing errors – density and contour plots – Histograms.

TOTAL :45 PERIODS

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3.Scientific problems using Conditionals and Iterative loops.(Number series,Number Patterns, pyramid pattern)
4.Implementation of real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementation of real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets &Dictionaries)
6. Implementation of programs using Functions.(Factorial,largest number in a list,area of shape)
7. Implementation of programs using Strings.(reverse,palindrome,charactercount,replacingcharacters)
8.Implemenation of programs using written modules and Python Standard Libraries(p and as, numpy. Matplotlib, scipy)
9. Implementation of real-time/technical applications using File handling.(copy from one file to another, word count, longest word)
10. Implementation of real-time/technical applications using Exception handling.(divide by zero error, voter's age validity, student mark range validation)

TOTAL : 45 +15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to,

- Develop algorithmic solutions to solve simple computational problems.
- Develop python programs using expressions to solve the problem.
- Deploy functions and function calls to decompose python programs.
- Implement solutions using compound data in Python lists, tuples, dictionaries.
- Utilize file modules and python packages for developing applications
- Implement python programs for solving various computational problems

TEXTBOOKS

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

E – RESOURCES

1. https://nptel.ac.in/courses/106104074(Introduction to Algorithms)
2. https://archive.nptel.ac.in/courses/106/106/106106182/ (Joy of Computing)

Mapping of Cos-Pos& PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-
AVG	2.33	2.5	1.5	1.83	1.83	-	-	-	-	-	1.5	0.66	2.66	0.5	-

1 - Low, 2 - Medium, 3 - High, '-"- No correlation

DEPARTMENT OF ROBOTICS AND AUTOMATION

REGULATION-2023

MINOR DEGREE / HONOURS

INDUSTRIAL ROBOTICS

CURRICULUM AND SYLLABI

CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(MINOR DEGREE / HONOURS - INDUSTRIAL ROBOTICS)

B.E- ROBOTICS AND AUTOMATION

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23RMIT01	Introduction to Robotics	PC	3	0	0	3	40	60	100
23RMIT02	Principles of Industrial Robotics	PC	3	0	0	3	40	60	100
23RMIT03	Applied and Industrial Robotics	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RMIE01	Robotic Automation Process	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23RMIP01	Project Work	EEC	0	0	12	6	40	60	100

PC :Professional Core
EEC :Employability Enhancement Courses
L : Lecture
T :Tutorial
P :Practical
C :Credit Point
CIA :Continuous Internal Assessment
ESE :End Semester Examination
TOT :Total

SEMESTER III

23RMIT01	INTRODUCTION TO ROBOTICS	LT P C 3 0 0 3

OBJECTIVES

- To introduce the functional elements of Robotics
- To impart knowledge on the Grippers and sensors
- To educate on various drives and control
- To introduce the Programming and Languages
- To introduce AI for Robotics

UNIT I INTRODUCTION TO ROBOTICS 9

Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

UNIT II GRIPPERS AND SENSORS FOR ROBOTICS 9

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.

UNIT III DRIVES AND CONTROL FOR ROBOTICS 9

Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.

UNIT IV PROGRAMMING AND LANGUAGES FOR ROBOTICS 9

Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

UNIT V ARTIFICIAL INTELLIGENCE IN ROBOTICS 9

Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.

TOTAL = 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to;

- Interpret terminologies related to Robotics technology.
- Analyze the various grippers and sensors for robotics.
- Apply logic for drives and control robotic systems
- Apply the Programming and Languages
- Integrate knowledge of AI techniques in the area of robotic technology.

TEXT BOOKS

1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019).

REFERENCES

1. S. B. Niku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
2. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

E-RESOURCES

1. https://www.youtube.com/watch?v=M0fjtV9nPJY
2. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-me05/

SEMESTER IV

23RMIT02 PRINCIPLES OF INDUSTRIAL ROBOTICS LT P C
3 0 0 3

OBJECTIVES

- To Introduction to automation
- To learn Fluid power and fluid power systems
- To Assembly automation equipment
- To learn Programmable Logic Controllers
- To learn Microprocessors and Microcontrollers

UNIT I INTRODUCTION TO AUTOMATION 9

History, Elements of Automation, Types of Automation systems, Applications of Automation, Goals of Automation, low cost automation, Hierarchical levels in industrial automation systems.

UNIT II FLUID POWER AND FLUID POWER SYSTEMS 9

Introduction to fluid power- Classification of fluid power systems, comparison of electrical, hydraulic and Pneumatic systems; Basic circuit diagram of Hydraulic fluid power and pneumatic power systems, Components of Hydraulic fluid power systems, Components of Pneumatic power system, Logic Gates, Truth tables and Boolean algebra.

UNIT III ASSEMBLY AUTOMATION EQUIPMENT 9

Material Handling: Principles of Material Handling, Material handling equipment- Wheel conveyor, Gravity Roller conveyor, Chain conveyor, Flat belt conveyor, Magnetic belt conveyor, bucket conveyor, Vibrating conveyor, screw conveyor, vertical lift conveyor, trolley conveyor, Sortation conveyor, cranes and Hoists, storage equipment, AS/RS, AGV.

Transfer and assembly equipment: Introduction to feeder units, Cycled transfer equipment and non-cycled transfer equipment. Automated assembly machines: Dial indexing machine, In-line machine, and floating work platform machines.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable Logic Controllers (PLC): Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Applications.

PLC hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, Typical Discrete I/O Module Specifications, Typical Analog I/O Module Specifications, The Central Processing Unit (CPU),Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).

UNIT V MICROPROCESSORS AND MICROCONTROLLERS 9

Evolution of microprocessors and microcontrollers; Architectures of microprocessors and microcontrollers; Integration of mechanical systems with computer and electronic systems

(Mechatronic systems). Feedback devices: LVDT, Linear/Rotary encoders, absolute encoders, resolvers and potentiometers, Fundamentals of SCADA and Data Acquisition Systems.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to;

- Demonstrate knowledge of automation and its different applications.
- Analyze functional characteristics of power systems for industrial applications.
- Apply knowledge of assembly automation equipment and its related components.
- Demonstrate the knowledge of programming logic controller units for industrial applications.
- Apply the knowledge of microprocessors and microcontrollers in integrating mechanical systems with computer and electronic systems.

TEXT BOOKS

1. Khushdeep Goyal, Industrial Automation and Robotics, S.K.Kataria & Sons, 4th Edition, 2013.
2. Frank. D.Petruzella, Programmable Logic Controllers, Tata McGraw-Hill Education, 4th Edition, 2011.

REFERENCES

1. M.P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Fourth edition, PHI Learning, 2016.
2. Geoffrey Boothroyd, Assembly Automation and Product design, Taylor and Francis Publishers, Second edition 2005.

E-RESOURCES

1. https://www.youtube.com/watch?v=M0fjtV9nPJY – (Theories of accident causation)
2. https://www.safetyproresources.com/blog/9-steps-for_accident-investigations - (OSHA inspection process)

SEMESTER V

23RMIT03 APPLIED AND INDUSTRIAL ROBOTICS LT P C
3 0 0 3

OBJECTIVES

- To General considerations in Robot material handling Sysytem
- To learn Expert system
- To study the Cooperative and Swarm Robot
- To understand the Field Robotics
- To Learn health care Robot

UNIT I ROBOT MATERIAL HANDLING 10

General considerations in Robot material handling, material transfer application, machine loading and unloading, CNC machine tool loading, Robot centered cell Assembly and parts presentation methods, Assembly operation, Compliance and the Remote center compliance (RCC) Device, Assembly system configurations, Adaptable programmable assembly system, Designing for robotic assembly, Inspection automation - vision inspection system, robot - manipulated inspection.

UNIT II EXPERT SYSTEMS 9

Factors influencing the choice of a robot, Robot performance testing - Path/point accuracy and repeatability, Maximum working envelop, Kinematic and State values. Robot safety Considerations, Factors affecting robot safety measures, Safety features built into industrial robot, Safety barriers and other devices.

UNIT II COOPERATIVE AND SWARM ROBOTS 7

Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications; Introduction to swarm Robots, Comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots.

UNIT IV FIELD ROBOTS 10

Forestry, Robot locomotion, Forestry automation, Broad acre Applications- Automatic guidance, sowing, weeding, spraying and broad-acre harvesting; Horticulture, Picking of fruits, Robot milking, Sheep shearing, Slaughtering, livestock inspection, Robots in construction, Future directions; Robots for hazardous applications, Enabling technologies- Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, Promising robots, open issues – Case studies; Cleaning Robots, lawn moving Robots- Smart appliances and smart homes.

UNIT V ROBOTS IN HEALTH CARE 9

Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and

applications; Rehabilitation and Health care robotics- Overview, physical therapy and training Robots; Robotic aid for people with disabilities- Smart prostheses and orthoses, diagnosis and monitoring.

TOTAL = 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to;

- Apply the knowledge of robotic material handling and assembly systems.
- Analyze the expert systems in robotic performance testing and safety
- Demonstrate knowledge of various cooperative and SWARM robots and its applications.
- Analyze robotic configurations and specifications for field and service applications.
- Demonstrate the core concepts of robots in medical applications.

TEXT BOOKS

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, Mc Graw Hill Book company, 4th edition, 2016.
2. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing House, 1993.
3. Bruno Siciliano, OussamaKhatib, —Springer Handbook of Robotics, Springer-Verlag Berlin Heidelberg, 2008

REFERENCES

1. Yangsheng Xu Huihuan Qian Xinyu Wu, Household and Service Robots, Elsevier Ltd, 2015.
2. L Marques,A de Almeida,Mo Tokhi,GSVirk, —Advances in Mobile Robotics, World Scientific Publishing Co. Pte. Ltd. 2008.

E-RESOURCES

1. https://nptel.ac.in/courses/120108004 - (Environment Management)
2. https://www.youtube.com/watch?v=9QM-3LMeBQA–(FactoriesAct)

SEMESTER VI

23RMIE01 ROBOTIC PROCESS AUTOMATION L T P C
3 0 0 3

OBJECTIVES

- To understand the basic concepts of Robotic process automation (RPA) is a software technology
- To learn Basics of RPA Tool in Robotics
- To Study Advanced Automation and its Techniques
- To explore the Exception Handling, Debugging and Logging operations in RPA
- To learn to deploy and maintain the software bot.
- To learn and understand the basics of fundamentals of robotics systems

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 7

History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document - Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

UNIT II RPA TOOL INTRODUCTION AND BASICS 10

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation - Data Manipulation Introduction - Scalar variables, collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data.

UNIT III DVANCED AUTOMATION CONCEPTS & TECHNIQUES 10

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel Data Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data

Manipulation in excel - Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

UNIT IV HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING 9

Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

EXCEPTION HANDLING: Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

UNITV DEPLOYING AND MAINTAINING THE BOT 9

Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages

TOTAL = 45+15=60 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to;

- Describe RPA, where it can be applied and how it's implemented.
- Describe the different types of variables, Control Flow and data manipulation techniques.
- Identify and understand Image, Text and Data Tables Automation.
- Describe how to handle the User Events and various types of Exceptions and strategies.
- Understand the Deployment of the Robot and to maintain the connection.
- Identify and understand the unique characteristics and components of robotics systems

TEXT BOOKS

1. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
2. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.
3. Srikanth Merianda,"Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.

REFERENCES

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.

E-RESOURCES

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

Fundamentals of Robotics Lab

List of Experiments

1. Study and analysis of robot grippers (includes the problems based on gripper force)
2. Demonstration of various robotic configurations using industrial robot
3. MATLAB program for simple kinematics of simple robot configuration
4. MATLAB program for inverse kinematics of simple robot configuration
5. To demonstrate simple robotic system using Matlab/ MscAdam / Robo Analyser software
6. Study of configuration of robots and motion of robot manipulator
7. Study of pick and place industrial robot
8. One Industrial visit for Industrial robotic application

SEMESTER VII

23RMIP01	PROJECT WORK	L T P C
		0 0 12 6

OBJECTIVES

The main objective of this course is to:

- Develop skills to formulate a technical project.
- Develop the ability to solve specific problem.
- Teach use of new tools, algorithms and techniques required to carry out the projects.
- Give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- Provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 180 PERIODS

OUTCOMES

At the end of the project, the students will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Test and validate through conformance of the developed
- Prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.
- On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering and find better solutions to it.

DEPARTMENT OF ROBOTICS AND AUTOMATION

REGULATION-2023

MINOR DEGREE / HONOURS

AI FOR ROBOTICS

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FOR B.E. / B.Tech. DEGREE PROGRAMMES

(MINOR DEGREE / HONOURS)

AI FOR ROBOTICS

B.E- ROBOTICS AND AUTOMATION

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23RMAT01	Fundamentals of Robotic System and Robot Programming	PC	3	0	0	3	40	60	100
23RMAT02	Fundamentals of Artificial Intelligence for Robotics	PC	3	0	0	3	40	60	100
23RMAT03	Machine Learning for Robotics	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RMAE01	Advanced Control Systems Drivers for Robots	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23RMAP01	Project Work	EEC	0	0	12	6	40	60	100

PC : Professional Core
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

SEMESTER III

23RMAT01	**FUNDAMENTALS OF ROBOTIC SYSTEM AND ROBOT PROGRAMMING**	**L T P C 3 0 0 3**

OBJECTIVES

- To understand fundamentals of robotic systems
- To understand the basics of robot controls
- To introduce the concept of robot kinematics and Sensors
- To learn Robot cell Design
- To learn Basic robot Program

UNIT I INTRODUCTION 9

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.

UNIT II END EFFECTORS AND ROBOT CONTROLS 9

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

UNIT III ROBOT TRANSFORMATIONS AND SENSORS 9

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

UNIT IV ROBOT CELL DESIGN AND MICRO/NANO ROBOTICS SYSTEM 9

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions- Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Micro/Nano Robotics system overview-Scaling effect- Top down and bottom up approach- Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/Nano grippers-Wall climbing micro robot working principles-Bio mimetic robot-Swarm robot-Nano robot in targeted drug delivery system.

UNIT V BASICS OF ROBOT PROGRAMMING **9**

Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation- Interlock commands- Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands..

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Apply the basic Concept of robot
- Analyze End Effectors and Robot Controls
- Apply the Robot Transformations and Sensors
- Explain about the Robot Cell Design
- Apply the Robot Programming

TEXT BOOKS

1. Craig. J. J. "Introduction to Robotics mechanics and control", Addison- Wesley,1999.
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
3. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,
4. Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012

REFERENCES

1. Mikell. P. Groover, "Industrial Robotics Technology", Programming and Applications, McGraw Hill Co, 1995.
2. Klafter. R.D, Chmielewski.T.A. and Noggin"s., "Robot Engineering : An Integrated Approach", Prentice Hall of Indiaz Pvt. Ltd.,1994.

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_de11/preview

SEMESTER IV

23RMAT02	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE FOR ROBOTICS**	**L T P C 3 0 0 3**

OBJECTIVES

- To Introduce the Artificial Intelligence.
- To learn about Methods of Solving problems.
- To Understand the Programming and Logics
- To Introduce the concepts of Expert Systems
- To understand the basic concepts of Artificial Intelligence.

UNIT I INTRODUCTION 9

Introduction – History, Definition of AI, Emulation of human cognitive process, Intelligent agents – The concept of rationality, the nature of environments, the structure of agents.

UNIT II SEARCH METHODS 9

Problem – Solving Agents : Problem Definitions, Formulating Problems, Searching for solutions – Measuring Problem – Solving Performance with examples. Search Strategies : Uninformed search strategies – Breadth – first Search, Uniform – Cost Search, depth –first search, depth – limited search, Iterative deepening depth – first search, bidirectional search, comparing uniformed search strategies. Informed search strategies – Heuristic information, Hill climbing methods, best – first search, branch – and – bound search, optimal search and A* and Iterative deepening A*.

UNIT III PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE 9

LISP and other programming languages – Introduction to LISP, Syntax and numerical function, LISP and PROLOG distinction, input, output and local variables, interaction and recursion, property list and arrays alternative languages, formalized symbolic logics – properties of WERS, non-deductive inference methods.

UNIT IV EXPERT SYSTEM 9

Potential of AM, Potentials and Resulting Perspectives - Complex Geometries, Integrated Geometry, Integrated Functionalities, Multi-Material Parts and Graded Materials. AM-Based New Strategies – Customization.

UNIT V AI IN ROBOTICS 9

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the Artificial Intelligence.
- Identify appropriate AI methods to solve a given problem.
- Apply the Programming and Logics for AI
- Analyze the Expert Systems
- Apply for AI in Robots

TEXT BOOKS

1. Russell Stuart, Norvig Peter, "Artificial Intelligence Modern Approach", Pearson Education series in AI, 3rd Edition, 2010.
2. Dan.W.Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI Learning, 2009.

REFERENCES

1. Donald.A.Waterman, "A guide to Expert Systems", Pearson, 2002.
2. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992..

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_ge20/preview

SEMESTER V

23RMAT03 MACHINE LEARNING FOR ROBOTICS LT P C
3 0 2 4

OBJECTIVES

- To Introduce Machine Learning
- To understand Foundation of Learning
- To Understand the Advanced Learning
- To Learn Unsupervised Learning
- To understand Neural Networks

UNIT I INTRODUCTION 9

Machine learning – Varieties of Machine learning – Learning Input- Output functions: Types of learning – Input Vectors – Outputs – Training regimes – Noise – Performance Evaluation.

UNIT II FOUNDATIONS OF SUPERVISED LEARNING 9

Decision trees and inductive bias – Geometry and nearest neighbour's – Logistic regression – Perceptron – Binary classification.

UNIT III ADVANCED SUPERVISED LEARNING 9

Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modelling – Model selection and feature selection – Model Complexity and Regularization.

UNIT IV UNSUPERVISED LEARNING 9

Curse of dimensionality, Dimensionality Reduction, PCA, Clustering – K- means – Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering.

UNIT V NEURAL NETWORKS 9

Network Representation, Feed-forward Networks, back propagation, Gradient- descent method. Case Studies: Line following using Supervised Learning techniques – A simulation model for understanding both regression and classification techniques - Study of the effectiveness of the Bias-variance. Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network -Use of stochastic PCA and the PCA neural network to find low dimensional features. Building a feed- orward neural network to ascertain automatic navigational queries.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Analyze the Machine Learning
- Analyze the types of trees and bias
- Apply the supervised learning methods with various case studies
- Compare the learning methodologies and dimensionality concepts
- Summarize the applications of neural networks in robotic applications.

TEXT BOOKS

1. Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014.
2. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data',Cambridge, 2014.

REFERENCES

1. Hal Daume III, 'A Course in Machine Learning', Todo, 2015.
2. Ethem Alpaydin,'Introduction to Machine Learning', The MIT Press, 2004
3. Bruno Apolloni, Ashish Ghosh, Ferda Alpasian, "Machine Learning and Robot Perception", Springer, 2005.

E-RESOURCES

1. Introduction to Machine Learning By Prof. Balaraman Ravindran, IIT Madras

SEMESTER VI

23RMAE01 ADVANCED CONTROL SYSTEMS DRIVERS FOR ROBOTS LT P C
(Lab Embedded Theory Course 3 0 0 3

OBJECTIVES

- To Introduce the Digital control systems.
- To knowledge of Stability theory of Digital systems
- To understand the Models of Digital Control Systems.
- To learn the control system analysis
- To study the Stable Variable Analysis
- To learn various Control system and drivers

UNIT I INTRODUCTION 9

Configuration of the basic Digital Control Systems, types of sampling operations, Sample and Hold operations, Sampling theorem, Basic discrete time signals.

UNIT II STABILITY METHODS 9

Mapping between s-plane and z-plane, stability methods: Modified Routh Criterion, Jury"s method, modified Schur-Cohn criterion.

UNIT III MODELS OF DIGITAL CONTROL SYSTEMS 9

Digital temperature control System, Digital position control system, stepping motors and their control. Design of Digital compensator using frequency response plots.

UNIT IV CONTROL SYSTEMS ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation, conversion of state variable models to transfer function and vice-versa, Eigen values and eigen vectors, Solution of state equations, Concepts of controllability and observability.

UNIT V STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS 9

State variable description of digital control systems, conversion of state variable models to pulse transfer function and vice versa, solution of state difference equations, controllability and observability.

ADVANCED CONTROL SYSTEM& DRIVES FOR ROBOTS LAB
List of Experiments (Any 7)

1. Determination of Transfer functions of an Electrical System.
2. Time Response Characteristics of a Second order System (Typical RLC network).
3. Characteristics of Synchros:
   (a) Synchro transmitter characteristics.
   (b) Implementation of error detector using synchro pair.
4. Determination of Magnetic Amplifier Characteristics with different possible connections.
5. Process Control Simulator:

(a) To determine the time constant and transfer function of first order process.
(b) To determine the time response of closed loop second order process with Proportional Control.
(c) To determine the time response of closed loop second order process with Proportional-Integral Control.
(d) To determine the time response of closed loop second order process withProportional-Integral-Derivative Control.
(e) To determine the effect of disturbances on a process.

6. To study the compensation of the second order process by using:
(a) Lead Compensator.
(b) Lag Compensator.
(c) Lead- Lag Compensator

7. Realization of AND, OR, NOT gates, other derived gates and ladder logic on Programmable Logic Controller with computer interfacing.
8. To determination of AC servomotor Characteristics.
9. To study the position control of DC servomotor with P, PI control actions.
10. Analog Computer:
(a) To examine the operation of potentiometer and adder.
(b) To examine the operation of integrator.
11. To solve a second order differential equation.

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Analyze the Control system
- Analyze the Stability methods of Plan
- Apply the models of digital control system
- Explain the State variable control system
- Explain the State variable analysis of Digital control systems
- To Practice the various Control system and drivers

TEXT BOOKS

1. M. Gopal, Digital Control and State Variable Methods, Tata Mc-Graw-Hill.
2. K.Ogata, Discrete Time Control Systems, Pearson Education, (Singapore) (Thomson Press India).

REFERENCES

1. B.C Kuo, Digital Control Systems, Prentice Hall.
2. I.J. Nagrath & M.Gopal, Control System Engg., John Wiley & sons.
3. K.K. Aggarwal, Control System Analysis and Design, Khanna Publishers.

E-RESOURCES

1. https://nptel.ac.in/courses/108103007
2. https://nptel.ac.in/courses/101108047

SEMESTER VII

23RMAP01	**PROJECT WORK**	**L T P C**
		0 0 12 6

OBJECTIVES

- Develop skills to formulate a technical project.
- Develop the ability to solve specific problem.
- Teach use of new tools, algorithms and techniques required to carry out the projects.
- Give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- Provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 180 PERIODS

OUTCOMES

At the end of the project, the students will be able to:

- Formulate a real-world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.
- On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering and find better solutions to it

CREDIT SUMMARY

FOR B.E. / B.Tech. DEGREE PROGRAMMES

MINOR DEGREE / HONOURS

(INDUSTRIAL ROBOTICS / AI FOR ROBOTICS)

B.E. ROBOTICS AND AUTOMATION

Category	Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	-	-	-	-	-	-	-	-	-
BS	-	-	-	-	-	-	-	-	-
ES	-	-	-	-	-	-	-	-	-
PC	-	-	3	3	3	4	-	-	13
PE	-	-	-	-	-	-	-	-	-
OE	-	-	-	-	-	-	-	-	-
EEC	-	-	-	-	-	-	6	-	6
MC	-	-	-	-	-	-	-	-	-
Total	-	-	3	3	3	4	6	-	19