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

(REVISION I)

(I - VI SEMESTER)

(For the Students Admitted in the Academic Year 2023-2024 and 2024-2025 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.

Chairman - BoS

DEAN (ACADEMICS)
SENGUNTHAR ENGINEERING COLLEGE
TIRUCHENGODE-637 205

PRINCIPAL
SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
TIRUCHENGODE - 637 205

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REGULATIONS

UG REGULATIONS -2023

SENGUNTHAR
Strive & Succeed
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MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO											PSO	
			1	2	3	4	5	6	7	8	9	10	11	1	2
I	I	23HST101 - Professional English	1.00	1.00	1.50	2.00	1.00	-	-	1.80	3.00	1.50	2.00	-	-
		23MAT101 - Matrices and calculus	3.00	3.00	2.00	-	-	-	-	-	-	-	2.00	-	-
		23HST102 - தமிழர்மரபு / Heritage of Tamils	-	-	-	-	-	-	2.00	1.00	2.00	-	1.00	-	-
		23PHT101 - Engineering Physics	3.00	3.00	1.00	1.00	-	-	-	-	-	-	-	-	-
		23CYT102 - Chemistry for Engineers	2.40	2.00	2.80	2.50	2.20	2.00	2.00	1.75	1.50	1.33	2.33	-	-
		23GEE101 - Programming in C	2.83	2.83	2.50	1.80	3.00	–	1.00	1.00	1.33	1.00	2.00	3.00	2.67
		23RAL101- Reverse Engineering Laboratory	3.00	3.00	2.00	3.00	3.00	–	–	–	2.00	2.00	–	3.0	2.00
		23EEC101 - Soft Skills & Life Skills	1.25	1.60	1.00	1.00	3.00	1.40	2.00	2.60	2.80	2.60	2.00	-	-
		23MDC101 - Induction Program (2 Weeks)	-	-	-	-	-	-	-	-	-	-	-	-	-
	II	23MAT201- Statistics and Numerical Methods	3.00	3.00	2.00	2.00	2.00	-	-	-	-	-	1.00	-	-
		23PHT201- Advanced Physics of Materials	3.00	2.00	1.00	1.00	-	-	-	-	-	-	-	-	-
		23CYT201- Environmental Science and Sustainability	2.00	1.40	3.00	2.00	2.75	3.00	3.00	2.00	2.67	2.40	2.20	-	-
		23HST202 - தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	-	-	-	-	-	-	2.00	1.00	-	-	1.00	-	-
		23GET201 - Engineering Graphics	3.00	2.00	2.00	-	3.00	1.00	-	-	-	-	2.00	2.00	3.00
		23HSE201- English For engineers: Theory And Practice	1.00	2.00	-	2.00	1.00	-	1.33	2.50	3.00	2.00	1.60	-	-
		23EEE202 - Basic Electrical and Electronics Engineering	3.00	2.50	2.00	1.00	-	-	1.00	3.00	3.00	-	3.00	2.33	2.33
		23CYL101 - Engineering Chemistry Laboratory	3.00	3.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	-	-	-	-
		23PHL201 - Engineering Physics Laboratory	3.00	3.00	1.00	1.00	-	-	-	-	-	-	-	-	-
		23EEC201- Indian Language (Except Mother Tongue) / Foreign Language													
		Hindi	-	-	-	-	-	1.00	1.33	1.67	2.80	-	1.60	-	-

		German	-	-	-	-	-	1	1.50	1.75	3	-	1.60	-	-
		Japanese	-	-	-	-	1.40	1.60	1.00	2.00	2.60	-	1.0	-	-
		23MDC201- Aptitude Skills	-	-	-	-	-	-	-	-	-	-	-	-	-
II	III	23MAT304 Transforms and Partial Differential Equations	3.00	3.00	2.00	2.00	2.00	-	-	-	-	-	2.00	-	-
		23MET302 Engineering Mechanics	3.00	2.00	2.00	-	-	-	-	-	-	-	2.00	2.17	2.67
		23RMT301 Fundamentals of Robotics and Applications	3.00	2.00	-	-	-	2.00	-	-	-	-	2.00	-	3.00
		23RME301 - Digital Electronics and Microprocessor	3.00	2.00	1.00	1.00	1.00	1.00	-	2.00	1.00	2.00	1.00	3.00	1.00
		23RME302 - Electric Machines and Power System	2.67	2.33	1.00	1.50	1.83	1.00	–	1.00	1.00	1.00	1.17	2.00	1.67
		23RME303 - Manufacturing Processes and Technology	2.17	1.17	-	-	-	1.00	-	-	-	-	2.00	2.00	1.00
		23EEC302 - Professional Development	-	-	-	-	-	-	-	-	-	-	-	-	-
	IV	23RMT401- Embedded Systems and Programming	3.00	2.20	1.33	1.25	2.00	–	–	1.00	1.00	1.00	1.20	2.60	2.20
		23RMT402 - Sensors and Actuators	3.00	2.20	1.67	1.25	1.60	–	–	1.00	1.00	–	1.20	2.40	1.80
		23RMT403 - Kinematics and Dynamics of Robots	3.00	3.00	3.00	1.00	-	-	-	-	-	-	3.00	-	2.00
		23RME401 - PLC and SCADA	2.50	2.17	1.17	1.40	2.00	3.00	2.00	3.00	1.60	–	1.00	2.33	2.83
		23MEE402 - Strength of Materials	3.00	3.00	1.00	-	-	1.00	-	2.00	-	-	3.00	2.00	3.00
		23GEE301 - Problem solving and Python Programming	2.83	2.67	2.17	1.50	2.83	–	1.00	1.00	1.50	1.00	2.00	3.00	2.83
		23EEC401 - Online Certification Courses	-	-	-	-	-	-	-	-	-	-	-	-	-
III	V	23RMT501 - AI For Robotics	3.00	2.60	2.00	1.80	2.40	–	–	1.00	1.00	1.00	2.20	3.00	2.00
		23RMT502 - Hydraulics and Pneumatics	1.00	2.00	3.00	-	-	-	-	-	-	-	2.00	1.00	-
		Professional Elective I													
		23RMP501 - Robots and Systems in Smart Manufacturing	3.00	2.00	2.00	3.00	2.00	-	-	-	-	-	2.00	3.00	2.00
		23RMP502 - Drone Technologies	3.00	3.00	3.00	1.00	3.00	2.00	-	-	-	-	1.00	2.00	2.00

		23RMP503 - Micro robotics	3.00	2.00	1.00	1.00	2.00	-	-	-	-	-	1.00	2.00	2.00
		23RMP504 - Agricultural Robotics and Automation	3.00	2.00	3.00	-	2.20	1.40	-	-	-	-	2.00	2.00	2.00
		23RMP505 - Collaborative Robotics	3.00	2.00	1.00	1.00	-	-	-	-	-	2.00	2.00	1.00	1.00
		23RMP506 - Robot Operating Systems	3.00	2.00	1.00	2.00	-	-	-	-	-	1.00	1.00	3.00	2.00
		Professional Elective II													
		23RMP507 - Robot and Machine Elements Design	3.00	2.00	1.00	1.00	1.00	2.00					1.00	2.00	2.00
		23RMP508 - Lean Manufacturing	3.00	2.00	1.00	1.00	1.00	2.00	-	-	-	-	1.00	1.00	2.00
		23RMP509 - Computer Integrated Manufacturing	3.00	2.00	2.00	1.00	2.00	-	-	-	1.00	-	1.00	2.00	1.00
		23RMP510 - Electronics Manufacturing Technology	3.00	2.00	1.00	-	-	2.00	-	-	-	-	2.00	3.00	2.00
		23RMP511 - Digital Manufacturing	3.00	2.00	1.00	3.00	-	2.00	-	-	-	-	2.00	3.00	2.00
		23RMP512 - Computer Aided Inspection and Testing	3.00	2.00	1.00	1.00	-	-	-	-	-	-	1.00	1.00	2.00
		Professional Elective III													
		23RMP513 - Electric and Hybrid Vehicles	3.00	2.00	2.00	1.00	-	3.00	2.00	-	-	-	2.00	1.00	2.00
		23RMP514 - Embedded System Design	3.00	2.00	2.00	1.00	-	3.00	2.00	-	-	-	-	3.00	2.00
		23RMP515 - Automotive System Modeling andSimulation	3.00	2.00	1.00	1.00	-	1.00	-	-	-	-	1.00	2.00	2.00
		23RMP516 - Field and Service Robotics	3.00	2.00	1.00	1.00	-	1.00	1.00	-	-	-	1.00	2.00	2.00
		23RMP517 - Automatic Control Systems	2.00	1.00	1.00	1.00	2.00						1.00	2.00	2.00
		23RMP518 - Smart Mobility and IntelligentVehicles	3.00	2.00	1.00	1.00	-	1.00	-	-	-	-	1.00	2.00	1.00
		23RME501 CNC Machines and Technology.	3.00	2.00	3.00	-	2.00	1.33	-	-	-	-	2.00	3.00	3.00
		23EEC501 Industrial Training	-	-	-	-	-	-	-	-	-	-	-	-	-
		Mandatory Course – I													
		23MDC501 - Introduction to Women and Gender Studies	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC502 - Elements of Literature	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC503 - Film Appreciation	-	-	-	-	-	-	-	-	-	-	-	-	-

		23MDC504 - Disaster Risk Reduction and Management	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC505 - Constitution of India	-	-	-	-	-	-	-	-	-	-	-	-	-
III	VI	**Professional Elective IV**													
		23RMP601 - Applied Signal Processing	3.00	2.80	3.00	2.80	2.80	-	-	-	1.20	-	-	3.00	3.00
		23RMP602 - Machine Learning for Intelligent Systems	3.00	-	3.00	-	2.80	-	-	1.20	1.00	-	1.80	3.00	3.00
		23RMP603- Systems Modeling and Simulation Methods	3.00	2.00	2.00	-	-	-	-	-	2.00	-	2.00	3.00	2.80
		23RMP604 - Optimization Techniques	3.00	2.80	2.80	-	-	-	-	-	-	1.50	2.00	3.00	2.80
		23RMP605 - Maintenance and Safety Engineering systems	3.00	2.20	3.00	2.80	-	-	1.50	-	-	2.00	1.80	3.00	3.00
		23RMP606 - Micro Electro Mechanical Systems	3.00	2.80	1.40	2.80	-	1.40	-	-	-	-	1.40	-	2.80
		Professional Elective -V													
		23RMP607 - Robot Programming and Simulation	3.00	3.00	-	2.80	2.80	2.00	2.00	-	-	1.00	1.00	3.00	2.80
		23RMP608 - Virtual Instrumentation	3.00	3.00			2.80		1.00		1.00		1.33	1.00	2.80
		23RMP609 - Farm Automation	3.00	3.00	2.80			1.60	1.40		1.00		1.33	1.60	3.00
		23RMP610 - Motion Control System	3.00	3.00	1.50	1.00	1.00				1.00	1.67	2.00	3.00	3.00
		23RMP611 - Materials for Robotics	3.00	2.20	-	2.80	2.80	1.50	-	-	1.00	-	1.50	2.80	2.80
		23RMP612 - Digital Twin and Industry 5.0	3.00	2.80	3.00	1.00	2.00	1.50	-	-	1.40	1.67	2.00	2.80	2.80
		Professional Elective – VI													
		23RMP613 - Robotic Vision and Intelligence	3.00	1.00	1.00	-	-	1.00	1.00	-	-	-	3.00	2.00	3.00
		23RMP614 - Wireless Sensors Networks for Robotics	3.00	2.00	-	1.00		1.00	-	-	-	-	3.00	1.00	3.00
		23RMP615 - Integrated Product Development	3.00	1.80	2.00	–	–	–	–	–	1.80	2.80	2.00	2.80	2.80
		23RMP616 - Navigation and Communication System	3.00	3.00	-	-	2.80	1.33	1.50	2.00	3.00	-	1.00	3.00	2.80
		23RMP617 - Design of UAV systems	3.00	3.00	1.00	1.00	2.80	-	1.00	2.00	1.67	1.00	2.00	3.00	2.80

		23RMP618 - Humanoid Robotics	3.00	3.00	2.00	-	-	-	-	1.40	3.00	2.00	2.40	2.80	2.80
		Open Elective-I													
		23CEO607 - Environmental and Social Impact Assessment	3.00	3.00	2.40	2.00	2.00	2.20	3.00	–	–	–	2.33	-	-
		23CSO610 - Introduction to Drone Technologies	2.60	2.80	2.40	1.80	3.00	-	-	1.50	-	-	2.60	-	-
		23ECO602 - Fundamentals of Electronic Devices and Circuits	3.00	3.00	3.00	3.00	2.80	2.40	-	-	-	-	2.40	-	-
		23EEO603 - Electric Vehicle Technology	3.00	3.00	3.00	3.00	3.00	-	-	-	-	-	2.00	-	-
		23EEO604 - Renewable Energy Systems	3.00	3.00	3.00	3.00	3.00	1.00	1.00	-	1.00	-	2.00	-	-
		23MEO601 - Introduction to Industrial Engineering	3.00	3.00	2.00	-	-	-	-	-	-	-	2.00	-	-
		23MEO605 - CNC Machining Technology	3.00	3.00	2.00	2.00	3.00	-	-	-	-	-	1.00	-	-
		23MDO611 - Hospital Management	1.00	2.40	2.00	1.50	2.00	1.60	1.40	1.00	1.00	1.60	1.40	-	-
		23RAO609 - Fundamentals of Robotics	3.00	2.00	-	2.80	3.00	2.00	1.00	2.00	2.00	2.33	2.00	-	-
		23CSO612- Cyber Forensics and Ethical Hacking	3.00	2.60	1.75	2.25	2.60	1.60	2.20	1.00	1.50	1.00	2.00	-	-
		23PMO608 - Pharamaceutical Nanotechnology	2.40	2.60	2.40	2.80	2.40	1.80	2.00	1.00	-	1.00	2.20	-	-
		23MAO606 - Graph Theory	3.00	2.80	2.25	1.00	-	-	-	-	-	-	1.40	-	-
		NCC L1/ L3													
		23NCCL01 - NCC Air Force Level-1	2.50	2.33	2.20	2.00	2.00	3.00	2.83	2.33	2.60	2.25	2.00	–	–
		23NCCL03 - NCC Army Wing Level-3	2.00	2.00	2.50	-	-	2.50	3.00	2.50	2.50	2.00	2.00	-	-
		23RME601 - Automation System Design	3.00	2.83	3.00	-	1.00	1.83	-	-	-	-	3.00	3.00	2.83
		23RME602 - Electric Drives and Control	3.00	2.00	2.00	-	-	1.00	-	-	-	-	2.00	-	2.00
		23EEJ601 - Project Work – Phase I	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
		Mandatory Course – II													
		23MDC601 Well Being with Traditional Practices- Yoga, Ayurveda and Siddha	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC602 History of Science and Technology in India	-	-	-	-	-	-	-	-	-	-	-	-	-

		23MDC603 Political and Economical Thought for a Human Society	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC604 State, Nation Building and Politics in India	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC605 Industrial Safety	-	-	-	-	-	-	-	-	-	-	-	-	-

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SCHEME FOR CURRICULUM

B.E. –RM (ROBOTICS AND AUTOMATION)

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	HS	3	0	0	3	40	60	100
23MAT101	Matrices and Calculus	BS	3	1	0	4	40	60	100
23HST102	தமிழர்மரபு / Heritage of Tamils	HS	1	0	0	1	40	60	100
23PHT101	Engineering Physics	BS	3	0	2	4	40	60	100
23CYT102	Chemistry for Engineers	BS	3	0	2	4	40	60	100
EMBEDDED COURSE									
23GEE101	Programming in C	ES	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC101	Soft Skills & Life Skills	EEC	1	0	0	1	100	-	100
MANDATORY COURSE									
23MDC101	Induction Program (2 Weeks)	MC	-	-	-	-	-	-	-
	TOTAL CREDITS IN SEMESTER - I		21						

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

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- SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MAT201	Statistics and Numerical Methods	BS	3	1	0	4	40	60	100
23PHT201	Advanced Physics of Materials	BS	3	0	0	3	40	60	100
23CYT201	Environmental Science and Sustainability	HS	3	0	0	3	40	60	100
23HST202	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	1	40	60	100
23GET201	Engineering Graphics	ES	3	1	0	4	40	60	100
EMBEDDED COURSE									
23HSE201	English for Engineers: Theory and Practice	HS	3	0	2	4	50	50	100
23EEE202	Basic Electrical and Electronics Engineering	PC	3	0	2	4	50	50	100
PRACTICALS									
23GEL201	Engineering Practice Laboratory	ES	0	0	4	2	60	40	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC201	Indian Language (Except Mother Tongue) / Foreign Language	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
23MDC201	Aptitude Skills	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER - II			27						

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

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- THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MAT304	Transforms and Partial Differential Equations	BS	3	1	0	4	40	60	100
23MET302	Engineering Mechanics	ES	3	1	0	4	40	60	100
23RMT301	Fundamentals of Robotics and Applications	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RME301	Digital Electronics and Microprocessor	PC	3	0	2	4	50	50	100
23RME302	Electric Machines and Power System	PC	3	0	2	4	50	50	100
23RME303	Manufacturing Processes and Technology	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						

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
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
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	Embedded Systems and Programming	PC	3	0	0	3	40	60	100
23RMT402	Sensors and Actuators	PC	3	0	0	3	40	60	100
23RMT403	Kinematics and Dynamics of Robots	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23RME401	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	Online Certification Courses	EEC	3	0	0	3	100	-	100
TOTAL CREDITS IN SEMESTER - IV			24						

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

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- FIFTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23RMT501	AI For Robotics	PC	3	0	0	3	40	60	100
23RMT502	Hydraulics and Pneumatics	PC	3	0	0	3	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 Machines and Technology	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC501	Industrial Training	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
	Mandatory Course - I	MC	3	0	0	0	-	-	-
	TOTAL CREDITS IN SEMESTER - V		21						

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

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- 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	Electric Drives and Control	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEJ601	Project Work – Phase I	EEC	0	0	8	4	60	40	100
MANDATORY COURSE									
	Mandatory Course - II	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER - VI			24						

HS : Humanities and Social Sciences
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EEC : Employability Enhancement Courses
MC : Mandatory Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
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TOT : Total

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- 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									
23EEJ701	Project Work – Phase II	EEC	0	0	8	4	60	40	100
	TOTAL CREDITS IN SEMESTER - VII					16			

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
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									
23EEJ801	Product Development	EEC	0	0	12	6	60	40	100
23EEC801	Internship	EEC	0	0	4	2	100	-	100
TOTAL CREDITS IN SEMESTER - VIII			08						

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
L	:	Lecture
T	:	Tutorial
P	:	Practical
C	:	Credit Point
CIA	:	Continuous Internal Assessment
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	HS	3	0	0	3	40	60	100
23HST102	தமிழர்மரபு / Heritage of Tamils	HS	1	0	0	1	40	60	100
23HSE201	English for Engineers: Theory and Practice	HS	3	0	2	4	50	50	100
23CYT201	Environmental Sciences and Sustainability	HS	3	0	0	3	40	60	100
23HST202	தமிழரும் தொழில்நுட்பமும் / 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
23RAL101	Reverse Engineering Laboratory	BS	0	0	4	2	50	50	100
23CYE102	Chemistry for Engineers	BS	3	0	2	4	50	50	100
23MAT201	Statistics and Numerical Methods	BS	3	1	0	4	40	60	100
23PHT201	Advanced Physics of Materials	BS	3	0	0	3	40	60	100
23MAT304	Transforms and Partial Differential Equations	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
23GET201	Engineering Graphics	ES	3	1	0	4	40	60	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
23MET302	Engineering Mechanics	PC	3	1	0	4	40	60	100
23RMT301	Fundamentals of Robotics and Applications	PC	3	0	0	3	40	60	100
23RME301	Digital Electronics and Microprocessor	PC	3	0	2	4	50	50	100
23RME302	Electric Machines and Power System	PC	3	0	2	4	50	50	100
23RME303	Manufacturing Processes and Technology	PC	3	0	2	4	50	50	100
23RMT401	Embedded Systems and Programming	PC	3	0	0	3	40	60	100
23RMT402	Sensors and Actuators	PC	3	0	0	3	40	60	100
23RMT403	Kinematics and Dynamics of Robots	PC	3	0	0	3	40	60	100
23RME401	PLC and SCADA	PC	3	0	2	4	50	50	100
23MEE402	Strength of Materials	PC	3	0	2	4	50	60	100
23RMT501	AI for Robotics	PC	3	0	0	3	40	60	100
23RMT502	Hydraulics and Pneumatics	PC	3	0	0	3	40	60	100
23RME501	CNC Machines and Technology	PC	3	0	2	4	50	50	100
23RME601	Automation System Design	PC	3	0	2	4	50	50	100
23RME602	Electric Drives and Control	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	Electronics Manufacturing Technology	PE	3	0	0	3	40	60	100
23RMP511	Digital Manufacturing	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	Automatic Control Systems	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 Systems	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	Robot Programming and Simulation	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	Materials for Robotics	PE	3	0	0	3	40	60	100
23RMP612	Digital Twin and Industry5.0	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	Robotic Vision and Intelligence	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	Humanoid Robotics	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

OPEN ELECTIVES – I

Offered by the Departments	Course Code / Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
CIVIL	23CEO607 / Environmental and Social Impact Assessment	OE	3	0	0	3	40	60	100
CSE	23CSO610 / Introduction to Drone Technologies	OE	3	0	0	3	40	60	100
ECE	23ECO602 / Fundamentals of Electronic Devices and Circuits	OE	3	0	0	3	40	60	100
EEE	23EEO603 / Electric Vehicle Technology	OE	3	0	0	3	40	60	100
	23EEO604 / Renewable Energy Systems	OE	3	0	0	3	40	60	100
MECHANICAL	23MEO601 / Introduction to Industrial Engineering	OE	3	0	0	3	40	60	100
	23MEO605 / CNC Machining Technology	OE	3	0	0	3	40	60	100
MEDICAL ELECTRONICS	23MDO611 / Hospital Management	OE	3	0	0	3	40	60	100
ROBOTICS AND AUTOMATION	23RAO609 / Fundamentals of Robotics	OE	3	0	0	3	40	60	100
CSE(Cyber Security)	23CSO612 / Cyber Forensics and Ethical Hacking	OE	3	0	0	3	40	60	100
PHARMACEUTICAL TECHNOLOGY	23PMO608 / Pharamaceutical Nanotechnology	OE	3	0	0	3	40	60	100
MATHEMATICS	23MAO606 / Graph Theory	OE	3	0	0	3	40	60	100

OPEN ELECTIVES- II

Offered by the Departments	Course Code / Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
CIVIL	23CEO704 / Remote Sensing Concepts	OE	3	0	0	3	40	60	100
ECE	23ECO708 / Energy Technology	OE	3	0	0	3	40	60	100
EEE	23EEO709 / Sensors, Actuators and its Application	OE	3	0	0	3	40	60	100
MECHANICAL	23MEO703 / Fundamentals of Mechatronics	OE	3	0	0	3	40	60	100
	23MEO704 / Nano Technology	OE	3	0	0	3	40	60	100
	23MEO712 / Smart Manufacturing	OE	3	0	0	3	40	60	100
MEDICAL ELECTRONICS	23MDO705 / Ultrasound Principles and its Medical Applications	OE	3	0	0	3	40	60	100
ROBOTICS AND AUTOMATION	23RAO707 / Mobile Robots	OE	3	0	0	3	40	60	100
CSE(Cyber Security)	23CSO711 / Introduction to Cyber Security	OE	3	0	0	3	40	60	100
PHARMACEUTICAL TECHNOLOGY	23PMO706 / Intellectual Property Rights for Pharma Industry	OE	3	0	0	3	40	60	100
MATHEMATICS	23MAO710 / Operations Research	OE	3	0	0	3	40	60	100

OPEN ELECTIVES – III

Offered by the Departments	Course Code / Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
CIVIL	23CEO717 / Geographical Information System	OE	3	0	0	3	40	60	100
CSE	23CSO715 / Fundamentals of Blockchain Technology	OE	3	0	0	3	40	60	100
ECE	23ECO718 / VLSI Design	OE	3	0	0	3	40	60	100
EEE	23EEO716 / Electrical, Electronic and Magnetic Materials	OE	3	0	0	3	40	60	100
MECHANICAL	23MEO720 / Marine Vehicles	OE	3	0	0	3	40	60	100
MEDICAL ELECTRONICS	23MDO719 / Wearable Technology	OE	3	0	0	3	40	60	100
	23MDO723 / Medical Waste Management								
	23MDO724 / Lifestyle Diseases								
ROBOTICS AND AUTOMATION	23RAO721 / Robotics Process Automation	OE	3	0	0	3	40	60	100
MATHEMATICS	23MAO714 / Advanced Numerical Methods	OE	3	0	0	3	40	60	100
MANAGEMENT	23MGO722 / Cost management of Engineering Projects	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 WING LEVEL-3	GE	3	0	0	3	40	60	100
23NCCL04	NCC ARMY WING 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	Supply Chain 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 & Life Skills	EEC	1	0	0	1	100	-	100
23EEC201	Indian Language (Except Mother Tongue) / Foreign Language	EEC	0	0	4	2	100	-	100
23EEC301	Professional Development	EEC	0	0	2	1	100	-	100
23EEC401	Online Certification Courses	EEC	3	0	0	3	100	-	100
23EEC501	Industrial Training	EEC	0	0	4	2	100	-	100
23EEJ601	Project Work – Phase I	EEC	0	0	8	4	60	40	100
23EEJ701	Project Work – Phase II	EEC	0	0	8	4	60	40	100
23EEJ801	Product Development	EEC	0	0	12	6	60	40	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	Industrial Safety	MC	3	0	0	0	-	-	-

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NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU

ESTD 2001

ISO 9001 REGISTERED

SCHEME

CREDIT SUMMARY

SENGUNTHAR
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CURRICULUM AND SYLLABI

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

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

CREDIT SUMMARY

B.E. ROBOTICS AND AUTOMATION

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	4	8	-	-	-	-	3	-	15
BS	12	9	4	-	-	-	-	-	25
ES	4	4	4	4	-	-	-	-	16
GE	-	-	-	-	-	-	3	-	3
PC	-	4	15	17	10	8	-	-	54
PE	-	-	-	-	9	9	-	-	18
OE	-	-	-	-	-	3	6	-	9
EEC	1	2	1	3	2	4	4	8	25
MC	-	-	-	-	-	-	-	-	-
Total	21	27	24	24	21	24	16	8	165

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SCHEME FOR SYLLABI

B.E. –RM (ROBOTICS AND AUTOMATION)

SEMESTER I

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

OBJECTIVES

- To build vocabulary proficiency and familiarity with varied lexical and contextual usages.
- To strengthen grammatical accuracy for effective sentence construction and language application.
- To develop clarity and coherence in written communication across academic and business contexts.
- To enhance oral fluency, confidence, and interactive communication skills.
- To promote efficient reading strategies for comprehension, analysis, and note-making.

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 - modalverbs- 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 effectively in oral and written communication.
- Frame grammatically and meaningfulsentences.
- Write formal and informal letters, develop coherent paragraphs and essays, and engage in meaningful dialogues.

- Apply speaking skills for self-introduction, speeches, and technical presentations.
- Read, comprehend, and take organized notes from passages and technical content.

TEXT BOOKS

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

REFERENCES

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", First Edition, Orient Black Swan,2012.
2. Krishna Mohan, Meera Banerji,"Developing Communication Skills", Paperback,MacMillan, 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	PSO1	PSO2
1	1	-	-	-	1	-	-	2	3	-	2	-	-
2	1	-	-	-	1	-	-	2	3	-	2	-	-
3	-	1	2	-	1	-	-	2	3	1	2	-	-
4	-	-	1	-	-	-	-	2	3	2	2	-	-
5	1	1	-	2	1	-	-	1	3	-	2	-	-
AVG	1.00	1.00	1.50	2.00	1.00	-	-	1.80	3.00	1.50	2.00	-	-

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

Chairman - BoS

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 and its properties.
- To explore the techniques of differential and integral calculus.
- To categorize methods for functions of several variables.
- To introduce the use of multiple integrals and their applications.
- To provide knowledge of vector calculus.

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:

- Apply matrix algebra methods to solve practical problems.
- Apply the concepts of differential and integral calculus.
- Analyze the ideas of differential calculus for functions of several variables.
- Apply multiple integral ideas in solving areas and volumes.
- Solve the engineering problems using the concepts of vector calculus.

LIST OF EXPERIMENTS

1. Computation of Eigen values and Eigenvectors.
2. Matrix addition and multiplications.
3. Calculate differentiations of simple functions.
4. Calculate integrations of simple functions.
5. Determining Maxima and minima of functions for one variable.
6. Determining Maxima and minima of functions for two variables.
7. Evaluating double integral with constant limits.
8. Evaluating triple integral with constant limits.
9. Computing Gradient, divergence and curl of point functions.
10. Evaluating line integral in vector calculus.

TOTAL:45+15 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Fourty Third Edition, New Delhi, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, Seventh 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, Seventh Edition, 2009.
2. Kanti B. Dutta., "Mathematical Methods of Science and Engineering – Aided with MATLAB", Cengage Learning, New Delhi, Second Edition, 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	PSO1	PSO2
1	3	3	2	-	-	-	-	-	-	-	2	-	-
2	3	3	2	-	-	-	-	-	-	-	2	-	-
3	3	3	2	-	-	-	-	-	-	-	2	-	-
4	3	3	2	-	-	-	-	-	-	-	2	-	-
5	3	3	2	-	-	-	-	-	-	-	2	-	-
AVG	3	3	2	-	-	-	-	-	-	-	2	-	-

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

Chairman - BoS

23HST102	HERITAGE OF TAMILS (Common to All Branches)	L T P C 1 0 0 1

OBJECTIVES

- To familiarize the students on extensive literature of classical Tamil.
- To analyze rock art paintings to modern art.
- To acquire knowledge on folk and martial arts.
- To apply the concepts of Thinai in Tamils.
- To realize the contribution of Tamils in Indian freedom struggle.

UNIT I LANGUAGE AND 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, Villu Pattu, Kaniyan Koothu, 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: 15 PERIODS

OUTCOMES

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

- Analyze the extensive literature Tamil and classical nature.
- Understand the heritage of sculpture, painting and musical instruments.

- Classify the folk and martial arts of Tamil people.
- Examine Thinai concepts, trade and victory of Chozha dynasty.
- Interpret the contribution of Tamils in Indian freedom struggle, Self-esteem movement and siddha medicine.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.கீழடி–வைகைநதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை –ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs-POs & PSOs

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

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

Chairman - BoS

23HST102 **தமிழர்மரபு** L T P C
(அனைத்துதுறைகளுக்கும்பொதுவானது) 1 0 0 1

நோக்கங்கள்

மாணவர்கள்கண்டிப்பாகஅறியவேண்டுவன

- செம்மொழியான தமிழ்மொழியின் விரிவான இலக்கியத்தைப் பற்றி அறிதல்.
- பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை உள்ள கலைகளை பகுப்பாய்வு செய்தல்.
- நாட்டுப் புறக்கலைகள் மற்றும் வீர விளையாட்டுகளைப் புரிந்து கொள்ளுதல்.
- தமிழர்களின் திணைக் கோட்பாடுகளைச் செயல்படுத்துதல்.
- இந்திய விடுதலைப் போராட்டத்திற்கும் பண்பாட்டிற்கும் தமிழர்களின் பங்களிப்பை உணருதல்.

அலகு 1 மொழிமற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச்சார் பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள்- தமிழகக்காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் –தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கியவளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன்சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பபாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –

சங்ககால நகரங்களும் துறைமுகங்களும் –சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப்பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

முடிவுகள்

பாடத்தின்முடிவில், மாணவர்கள் அறிந்து கொள்வன:

- தமிழ்மொழியின் செம்மொழி தன்மையையும் சங்க இலக்கியத்தின் முக்கியத்துவத்தையும் உணர்வார்கள்.
- தமிழர்களின் சிற்ப, ஓவிய, இசை மரபுகளை புரிந்து கொள்வார்கள்.
- நாட்டுப்புறக் கலைகளையும் வீர விளையாட்டுகளையும் வகைப்படுத்துவார்கள்.
- தமிழர்களின் திணைக்கோட்பாடுகளும் சங்ககால வர்த்தகமும் புரிந்து கொள்வார்கள்.
- இந்திய விடுதலைப் போராட்டம், சுயமரியாதை இயக்கம், சித்த மருத்துவம் ஆகியவற்றில் தமிழர்களின் பங்களிப்பை விளக்குவார்கள்.

உரைமற்றும்குறிப்புபுத்தகங்கள்

1. தமிழகவரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள்கழகம்).
2. கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3. கீழடி – வைகைநதிக் கரையில் சங்ககால நகரநாகரிகம் (தொல்லியல் துறைவெளியீடு)
4. பொருநை -ஆற்றங்கரைநாகரீகம். (தொல்லியல்துறைவெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu

Textbook and Educational Services Corporation, Tamilnadu.)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs-POs & PSOs

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

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

Chairman - BoS

23PHE101	ENGINEERING PHYSICS	L T P C
	(Common to Civil, Mechanical, R & A and Pharm.Tech)	3 0 2 4

OBJECTIVES

- To impart knowledge of the structure of crystalline materials using crystallographic techniques.
- To enable students to understand the concepts of elasticity, plasticity, stress, and strain and their significance in industrial applications.
- To introduce the fundamentals of ultrasonics and sound waves, along with their practical engineering applications.
- To explain complex physical phenomena through the principles of quantum mechanics and Schrödinger's wave equation.
- To provide an understanding of the modes of heat transmission, thermal conduction in solids, and their engineering applications.
- To determine the optical, mechanical, acoustic, thermal, and electrical properties of materials through laser, interferometric, bending, and thermal methods.

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 (Concept only) - 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.

UNIT IV QUANTUM PHYSICS 9

Black Body Radiation – Planck's Theory (derivation) – Electron Diffraction – Wave function and its Physical significance – Schrödinger's Wave Equations: Time independent and time dependent equation - 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 (Parallel & Series)– Thermal Conductivity Lee's disc method: Theory and Experiment - Geothermal Energy - Geothermal power - Thermal battery - Thermal Energy Storage.

LIST OF EXPERIMENTS

(Any Eight experiments to be conducted

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:45+15=60PERIODS

OUTCOMES

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

- Apply crystallographic knowledge to get familiar with the structure of crystalline solids.
- Analyze the mechanical properties of solids and fluids.
- Explain the fundamentals of sound waves and ultrasonic's and their engineering applications.
- Analyze the principles of quantum mechanics and Schrödinger's wave equation to identify complex physical phenomena.
- Analyze the concept of thermal conductivity and its engineering applications.
- Evaluate fundamental properties of materials—such as wavelength, particle size, elastic constants, ultrasonic velocity, viscosity, thermal conductivity and electrical resistance.

TEXT BOOKS

1. Mani P, "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, 2015.
2. Wahab M.A. "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House, 2017
3. Thyagarajan K and Ghatak A. "Lasers: Fundamentals and Applications", Laxmi Publications, (Indian Edition), 2019
4. Halliday D, Resnick R and Walker J. "Principles of Physics", Wiley (Indian Edition), 2019

E-RESOURSES

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

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
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

Chairman - BoS

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

OBJECTIVES

- To apply water quality analysis and treatment methods for industrial applications.
- To explain the classification, properties, manufacture, and applications of fuels.
- To utilize spectroscopic and chromatographic techniques for chemical analysis.
- To familiarize students with the principles of energy conversion in nuclear reactors, solar cells, batteries, and fuel cells.
- To apply electrochemical principles to understand corrosion and corrosion control methods.
- 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 (phosphate, calgon and carbonate conditioning methods) – External conditioning – Zeolite process, Demineralization process – Desalination of brackish water by reverse osmosis.

UNIT II FUELS AND COMBUSTION 9

Fuels: Introduction - Classification of fuels - Coal - 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) - Power Alcohol and Biodiesel. Combustion of fuels: Introduction - Calorific value - Higher and lower calorific values- 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 - Gas 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 –lead acid battery, lithium-ion-battery Fuel Cells - H_2 -O_2 fuel cell.

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, 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.

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.

TOTAL: 45 + 15 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to

- Explain the quality parameters of water and suitable methods for removing impurities in domestic and industrial applications.
- Interpret the characteristics of fuels and their role in efficient and eco-friendly combustion systems.
- Analyze the interaction of light with matter and the use of analytical techniques to characterize molecules.
- Explain the energy resources and their applications in the energy sector.
- Analyze the causes of corrosion and effective methods for its prevention and control.
- 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", Second Edition, DhanpetRai Publishing Company (P) Ltd.,New Delhi, 2015.
2. R.Gopalan, "Analytical Chemistry" Sultan Chand & Sons,ThirdEdition,2017.

REFERENCES

2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", Tenth Edition, S. Chand & Company Ltd, New Delhi, 2015.
3. Shobha Ramakrishnan, BananiMukhopadhyay,"Essentials of Analytical Chemistry"Third Edition, Pearson Education India,2018.

E-RESOURCES

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

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	3	-	1	-	3	-	-	-	-	-	-
2	2	2	3	2	1	2	2	2	2	1	2	-	-
3	3	3	3	3	3	2	2	2	2	2	3	-	-
4	2	2	2	3	3	2	2	1	1	1	-	-	-
5	3	2	3	2	3	2	1	2	1	-	2	-	-
6	3	3	2	1	1	2	1	1	2	-	-	-	-
Avg.	2.50	2.17	2.67	2.20	2.00	2.00	1.83	1.60	1.60	1.33	2.33	-	-

1 - Low 2 - Medium 3 - High '-' – No Correlation0

Chairman - BoS

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

OBJECTIVES

- To impart fundamental knowledge of C programming concepts, syntax, data types, operators, control structures, and program development.
- To develop students' understanding of arrays, strings, searching, and sorting techniques for solving computational problems.
- To train students in designing modular programs using functions, recursion, pointers, and parameter passing mechanisms.
- To familiarize students with structures, unions, dynamic memory allocation, and their applications in software development.
- To enable students to perform file handling operations and develop efficient C programs using sequential and random file processing.
- To develop C programs to solve real-world programming problems.

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.

Coding practices :

1. Develop a program to find the largest of three numbers using nested if statements.
2. Develop a program to generate multiplication tables using loops.

Problem - solving assignments :

1. Write a program to calculate the area and perimeter of a rectangle, circle, and triangle.

Write a program to calculate simple interest and compound interest.

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.

Coding practices :

1. Develop a program to perform matrix addition and transpose using two-dimensional arrays.
2. Write a program to sort an array using Insertion Sort.

Problem - solving assignments :

1. Develop a program to perform matrix operations such as addition and transpose using two-dimensional arrays.
2. Write a program to search for an element in an array using Linear Search 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.

Coding practices :

1. Develop a recursive program to generate the Fibonacci series.
2. Develop a program to implement a scientific calculator using built-in mathematical functions.

Problem - solving assignments :

1. Write a program to perform arithmetic operations using user-defined functions.
2. Write a program to swap two numbers using pass-by-value and 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

Coding practices :

1. Develop a program to generate an employee salary slip using structures and pointers.
2. Develop a program using nested structures to represent student academic details.

Problem - solving assignments :

1. Write a program to store and display employee details using an array of structures.
2. Develop a program to demonstrate dynamic memory allocation using structures.

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.

Coding practices :

1. Write a program to create, write, and read a text file.
2. Develop a program to copy the contents of one file to another.

Problem - solving assignments :

1. Write a program to create, write, and read student records using sequential file processing.
2. Write a program to implement command-line arguments for performing arithmetic operations or file processing.

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,

- Explain the fundamental concepts of C programming and develop programs using data types, operators, expressions, and control structures.
- Develop C programs using arrays, strings, searching, and sorting techniques to solve computational problems.
- Construct modular C programs by applying functions, recursion, pointers, and parameter passing techniques.
- Develop applications using structures, unions, pointers, and dynamic memory allocation for efficient data organization and manipulation.
- Analyze file processing techniques using sequential and random access methods to perform data storage and retrieval operations.
- Develop reliable software solutions using C programming for real-world applications.

TEXT BOOKS

1. E.Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, Eighth 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	PSO1	PSO2
1	3	2	2	–	3	–	–	–	–	–	2	3	1
2	3	3	2	1	3	–	–	–	–	–	2	3	3
3	3	3	3	2	3	–	–	–	–	–	2	3	2
4	3	3	3	2	3	–	–	–	1	–	2	2	3
5	2	3	2	2	3	–	–	–	1	–	2	2	3
6	3	3	3	2	3	–	1	1	2	1	2	3	3
AVG	2.83	2.83	2.50	1.80	3.00	–	1.00	1.00	1.33	1.00	2.00	3.00	2.67

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

Chairman - BoS

23EEC101 **SOFTSKILLS & LIFE SKILLS** L T P C

(Common to all First year / First Semester B.E., B.Tech., Branches) 1 0 0 1

OBJECTIVES

- To understand the Universal Human Values
- To have an overview on Life skills required in their profession
- To manage the behavior with emotional intelligent skills
- To learn professional Skills required for 21st century
- To formulate and implement effective leadership strategies.

UNIT I UNIVERSAL HUMAN VALUES 3

Understanding harmony in the human being - understanding harmony in the family and society - understanding harmony in the nature and existence - understanding of harmony on professional ethics

UNIT II LIFE SKILLS 3

Soft Skills – Positive Attitude - Empathy - Effective Communication - Decision-Making Skills - Communication Skills - Problem Solving - Critical Thinking- Analytical thinking

UNIT III EMOTIONAL SKILLS 3

Self-Awareness - Interpersonal Relationship - Stress – Stress management - Focus and Self Control - Positive Thinking – Anger management

UNIT IV PROFESSIONAL SKILLS 3

21st century skills – Hard Skills - General computer skills - Spreadsheet proficiency - Career Skills - developing a long - term career plan – Team Work -- Time management

UNIT V LEADERSHIP SKILLS 3

Leadership, Levels of Leadership, Making of a leader, Types of leadership, describing a leadership style.

TOTAL: 15 PERIODS

OUTCOMES

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

- Treat and respect the human beings with harmony,
- Develop the capabilities needed to utilize their potential wherever required.
- Control their emotional feelings and manage the stress.
- Explore the career & professional skills.
- Become highly confident as a leader and find new ways of influencing the teams they lead.

TEXT BOOKS

1. Life Skills for Engineers, McGraw Hill Education (India) Private Ltd., 2016
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Sydänmaanlakka Pentti. "Intelligent leadership and leadership competencies". Dissertation Series.

REFERENCES

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.

E-RESOURSES

1. https://uhv.org.in/
2. https://nptel.ac.in

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	1	-	-	-	2	2	3	2	1	-	-	-
2	1	3	1	1	-	1	-	2	3	3	1	-	-
3	-	1	-	-	-	1	-	3	3	3	1	-	-
4	2	2	1	1	3	1	-	2	3	3	3	-	-
5	1	1	1	-	-	2	-	3	3	3	3	-	-
AVG	1.25	1.60	1.00	1.00	3.00	1.40	2.00	2.60	2.80	2.60	2.00	-	-

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

Chairman - BoS

23MDC101 **INDUCTION PROGRAMME (2 Weeks)**

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character."

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Physical Activity

This would involve a daily routine of physical activity with games and sports etc.

Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References: Guide to Induction program from AICTE

Chairman - BoS

SEMESTER II

23MAT201	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	[Common to Mechanical, R&A and PT]	3	1	0	4

OBJECTIVES

- To introduce basic concepts in testing of hypothesis.
- To explore the knowledge of classifications of design of experiments.
- To develop the concepts of solving algebraic, transcendental and system of linear equations.
- To introduce the numerical techniques of interpolation and integration.
- To explain various numerical methods of 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 variance 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 with equal intervals: Newton's forward interpolation formula – Newton's backward interpolation formula – Interpolation with unequal intervals: Lagrange's interpolation formula – Divided differences – Newton's divided difference formula – Numerical integration: Trapezoidal rule – Simpson's one-third rule – Numerical double integration by Trapezoidal rule.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method – Euler's method – Modified Euler's method – Runge-Kutta method – Predictor-corrector methods: Milne's method – Adams-Bashforth method.

OUTCOMES

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

- Apply the concepts of hypothesis testing to analyze small and large sample data.
- Analyze the basic concepts of classifications of design of experiments.
- Compute the numerical solution of algebraic, transcendental and system of linear equations.
- Apply the numerical techniques of interpolation and integration.
- Evaluate the numerical solution of ordinary differential equations.

LIST OF EXPERIMENTS

1. Solving one sample and paired sample 't' Test.
2. Statistical Analysis Using Chi-Square Test.
3. One-Way ANOVA Table
4. Two-Way ANOVA Table
5. Solution of simultaneous algebraic equations by Gauss Seidel method.
6. Find the Eigen values of a matrix by Power method.
7. Illustrate Lagrange's interpolation formula.
8. Evaluation of line integral by Simpson's one-third rule.
9. Solving ordinary differential equations by Euler's method.
10. Solving ordinary differential equations by Runge-Kutta method.

TOTAL: 45+15 PERIODS

TEXT BOOKS

1. Grewal,B.S., "Numerical Methods in Engineering and Science", Khanna Publishers, Eleventh Edition, 2023.
2. Dr.Kandasamy. P, Dr.Thilagavathy . K and Dr. Gunavathy .K., "Statistics and Numerical Methods", S. Chand and Company Ltd., First Edition, 2010.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, Nineth Edition, 2016.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and sons, Twelth Edition, 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	PSO1	PSO2
1	3	3	2	2	2	-	-	-	-	-	1	-	-
2	3	3	2	2	2	-	-	-	-	-	1	-	-
3	3	3	2	2	2	-	-	-	-	-	1	-	-
4	3	3	2	2	2	-	-	-	-	-	1	-	-
5	3	3	2	2	2	-	-	-	-	-	1	-	-
AVG	3.00	3.00	2.00	2.00	2.00	-	-	-	-	-	1.00	-	-

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

Chairman - BoS

23PHT201 **ADVANCED PHYSICS OF MATERIALS** 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 know the application of physics concepts to microscopic and NDT Testing.
- To understand different kind of nano materials and synthesis of nano materials, applications.
- To acquire 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.

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.

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: Types, Properties and applications - Micro Electro Mechanical Systems (MEMS).

UNIT IV SMART MATERIALS 9

Smart materials – Functional materials – Polyfunctional Materials – Structural Materials, Electrical Materials, Bio-Compatible Materials - Metallic Glasses: Properties, 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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the principles of cryogenics and superconductivity and describe their properties and applications.

- Describe and interpret results from material characterization techniques and NDT methods.
- Explain nanoscale properties, quantum structures and identify suitable nanomaterial synthesis methods.
- Describe the behavior and applications of smart materials such as metallic glasses and shape memory alloys.
- Classify composite materials and compare their properties with conventional materials for engineering applications.

TEXT BOOKS

1. Mani P, "A Text book of Engineering Physics ",Dhanam Publications, 2018.
2. Rajendran V, "Engineering Physics", TaTa McGraw Hill Publications, 2017.
3. Sam Zhang, Lin Ki, Ashok Kumar, "Materials Characterization Techniques", CRC Press, Taylor & Francis Group, 2019.

REFERENCES

1. Askeland D, "Materials Science and Engineering", Brooks/Cole, 2015.
2. Wahab M.A. "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House, 2017.
3. Santhana Ragavan P and Ramasamy P, "Crystal Growth Processes and Methods", KRU Publications, 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	PSO1	PSO2
1	3	2	1	1	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	-
AVG	3.00	2.00	1.00	1.00	-	-	-	-	-	-	-	-	-

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

Chairman - BoS

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

OBJECTIVES

- To familiarize students with the concepts of environment, ecosystems, biodiversity, and their conservation.
- To create awareness about environmental pollution, individual responsibilities in pollution prevention, and basic disaster management.
- To impart knowledge about major social and environmental issues, environmental protection laws, and green chemistry principles.
- To analyze population-related issues, human health, social welfare, and the role of information technology in environmental and human health.
- To develop an understanding of sustainability concepts, climate change issues, and sustainable management practices for addressing environmental challenges

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 (d) aquatic ecosystems (oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity –Value 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 – 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 ENVIRONMENT 9

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Green Chemistry and principles - Environment production act – Air (Prevention and Control of Pollution) act –Water (Prevention and control of Pollution) act

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-—-Sustainable Development Goals-Targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-Case studies. Zero waste, Material Life cycle 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, the students will be able to:

- Explain the basics of environment, ecosystems, biodiversity, and conservation.
- Identify major sources of pollution and understand individual responsibilities in pollution prevention and disaster management.
- Describe key social and environmental issues, environmental laws, and green chemistry principles.
- Analyse population growth, human health, social welfare, and the role of IT in environmental and health management.
- Apply sustainability concepts, climate change mitigation, and sustainable management practices to environmental challenges.

TEXT BOOKS

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, 2019.
2. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Eighth Edition, Pearson Education, 2021.
3. Allen, D. T. and Shonnard, D. R., "Sustainability Engineering: Concepts, Design and Case Studies", Third Edition, Prentice Hall, 2018.

REFERENCES

1. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt Ltd, 2016.
2. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, 2018.
3. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2019.

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	PSO1	PSO2
1	2	2	3	-	-	3	3	-	-	2	1	-	-
2	2	2	3	2	3	3	3	-	-	3	3	-	-
3	2	1	3	2	2	3	3	-	2	3	3	-	-
4	2	1	3	2	3	3	3	2	3	2	2	-	-
5	2	1	3	2	3	3	3	2	3	2	2	-	-
AVG	2.00	1.40	3.00	2.00	2.75	3.00	3.00	2.00	2.67	2.40	2.20	-	-

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

Chairman - BoS

23HST202	TAMILS AND TECHNOLOGY (Common to All Branches)	L T P C 1 0 0 1

OBJECTIVES

- To gain knowledge about weaving and ceramic Technology
- To create a design and construction Technology
- To analyze manufacturing Technology
- To apply agriculture and irrigation Technology
- To remember scientific and scientific Tamil and Tamil computing

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)- Thirumalai Nayakar 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: 15 PERIODS

OUTCOMES

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

- Understand weaving under ceramic Technology.
- Develop new design and construction Technology.
- Identify the manufacturing Technology.
- Understand agriculture and irrigation.
- Knowledge of scientific Tamil and Tamil computing.

TEXT-CUM-REFERENCE BOOKS

1. தமிழகவரலாறு - மக்களும்பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு:தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2. கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3.கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4. பொருநை -ஆற்றங்கரைநாகரீகம். (தொல்லியல்துறைவெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	-	-	-	-	-	-	2	1	-	-	1	-	-
2	-	-	-	-	-	-	2	1	-	-	1	-	-
3	-	-	-	-	-	-	2	1	-	-	1	-	-
4	-	-	-	-	-	-	2	1	-	-	1	-	-
5	-	-	-	-	-	-	2	1	-	-	1	-	-
AVG	-	-	-	-	-	-	2.00	1.00	-	-	1.00	-	-

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

Chairman - BoS

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

(அனைத்து துறைகளுக்கும் பொதுவானது) 1 0 0 1

நோக்கம்

மாணவர்கள்கண்டிப்பாகஅறியவேண்டுவன:

- நெசவுமற்றும்பீங்கான்தொழில்நுட்பம்பற்றியஅறிவைப்பெறுதல்.
- வடிவமைப்புமற்றும்கட்டுமானதொழில்நுட்பத்தைஉருவாக்குதல்.
- உற்பத்திதொழில்நுட்பத்தைப்பகுப்பாய்வுசெய்தல்.
- விவசாயம்மற்றும்நீர்ப்பாசனத்தொழில்நுட்பத்தைப்பயன்படுத்துதல்.
- அறிவியல்மற்றும்அறிவியல்தமிழ்மற்றும்தமிழ்கணிப்பொறிதொடர்பானஅறி வைநினைவில்கொள்ளுதல்.

அலகு 1 நெசவு மற்றும் பாணைதொழில்நுட்பம் **3**

சங்ககாலத்தில் நெசவுத்தொழில் – பாணை தொழில்நுட்பம் - கருப்பு, சிவப்பு பாண்டங்கள் – பாண்டுகளில் கீறல் குறியீடுகள்.

அலகு 2 வடிவமைப்பு மற்றும் கட்டிடத்தொழில்நுட்பம் **3**

சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடைஅமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச்சிற்பங்கள், கோவில்களும் – சோழர்காலத்தூபெருங்கோயில்கள் மற்றும் பிறவழிபாட்டுத்தலங்கள் நாயக்கர்கால கோயில்கள் – மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக்கட்டிடக்கலை.

அலகு 3 உற்பத்தித்தொழில்நுட்பம **3**

கப்பல் கட்டும் கலை - உலோகவியல் – இரும்பு தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் – நாணயங்கள் அச்சடிகள் – மணிஉருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண்மணிகள் - சங்குமணிகள் - எலும்புதுண்டுகள் - தொல்லியல்சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனதொழில்நுட்பம் **3**

அணை, குளங்கள், மடகு – சோழர்காலகுமுளிதூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு - மீன்வளம் – முத்து மற்றும் முத்து குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5 அறிவியல் தமிழ் மற்றும் கணித்தமிழ் **3**

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ்நூல்களை மின்பதிப்பு செய்தல் – தமிழ்மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக்கல்விக்கழகம் - தமிழின்நூலகம் – இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத்திட்டம்.

TOTAL: 15 PERIODS

முடிவுகள்

- பாடத்தின்முடிவில், மாணவர்கள்அறிந்துகொள்வன:
- பீங்கான்மற்றும்நெசவுதொழில்நுட்பத்தைப்புரிந்துகொள்ளுதல்.
- புதியவடிவமைப்புமற்றும்கட்டுமானதொழில்நுட்பத்தைஉருவாக்குதல்.
- உற்பத்தித்தொழில்நுட்பத்தைஅடையாளம்காணுதல்.
- விவசாயம்மற்றும்நீர்ப்பாசனத்தைப்புரிந்துகொள்ளுதல்.
- அறிவியல்தமிழ்மற்றும்தமிழ்கணிப்பொறிதொடர்பானஅறிவைபெறுதல்.

உரைமற்றும்குறிப்புபுத்தகங்கள்

1. தமிழகவரலாறு - மக்களும்பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை –ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	-	-	-	-	-	-	2	1	-	-	1	-	-
2	-	-	-	-	-	-	2	1	-	-	1	-	-
3	-	-	-	-	-	-	2	1	-	-	1	-	-
4	-	-	-	-	-	-	2	1	-	-	1	-	-
5	-	-	-	-	-	-	2	1	-	-	1	-	-
AVG	-	-	-	-	-	-	2.00	1.00	-	-	1.00	-	-

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

Chairman - BoS

23GET201 **ENGINEERING GRAPHICS** **L T P C**

(Common to Mech, Civil and Robotics Department) **3 1 0 4**

OBJECTIVES

- To introduce the fundamental principles of engineering graphics, drawing instruments, and construction of plane curves.
- To teach methods for projecting points, lines, and plane surfaces, including determination of true lengths and inclinations.
- To explain projection techniques of simple solids and handling axes inclined to reference planes using change of position method.
- To train learners in sectioning of solids and development of lateral surfaces of regular and truncated solids.
- To present conversion between orthographic and isometric projections and their practical applications in engineering drawing.

UNIT I PLANE CURVES **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 **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 PROJECTION OF SOLIDS **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 IV SECTION OF SIMPLE SOLIDS AND DEVELOPMENT OF SURFACES **9+3**

Sectioning of simple solids like prisms and cone - Inclined to one reference plane. Development of lateral surfaces of simple and truncated solids: pyramids and cylinders.

UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS **9+3**

Conversion of isometric projection into orthographic projection, Conversion of orthographic projection into isometric projection.

TOTAL : 45+15=60 PERIODS

OUTCOMES

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

- Construct multiple views of engineering components.
- Construct the pictorial drawings as per the standards.
- Develop the projection of solids.
- Draw the section of solids drawings and development of surfaces of given objects.
- Apply free hand sketching and concept of isometric in engineering practice.

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, Fourth Edition, 2019.
2. Natarajan K.V., "Engineering Graphics", Dhanalakshmi Publishers, Thirty Second Edition, 2019.

REFERENCES

1. K.R. Gopalakrishna, "Engineering Drawing Volume 1 & 2", Subhas Publications, Thirteenth Edition, 2021.
2. T.Jeyapoovan. "Engineering Graphics using Auto CAD" Vikas publishing house Pvt Ltd, Sixth Edition, 2022

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	PSO1	PSO2
1	3	2	2	-	3	1	-	-	-	-	2	2	3
2	3	2	2	-	3	1	-	-	-	-	2	2	3
3	3	2	2	-	3	1	-	-	-	-	2	2	3
4	3	2	2	-	3	1	-	-	-	-	2	2	3
5	3	2	2	-	3	1	-	-	-	-	2	2	3
Avg.	3.00	2.00	2.00	-	3.00	1.00	-	-	-	-	2.00	2.00	3.00

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

Chairman - BoS

23HSE201 **ENGLISH FOR ENGINEERS: THEORY AND PRACTICE** **L T P C**
(Common to all B.E. & B.Tech. Branches) **3 0 2 4**

OBJECTIVES

- To strengthen grammatical accuracy for effective communication.
- To develop listening and reading comprehension skills.
- To improve writing proficiency for academic and formal purposes.
- To train in business and professional correspondence.
- To enhance speaking abilities for social and professional contexts.
- To provide practical exposure through interactive language activities.

UNIT I GRAMMAR 9

Articles - Prepositions - Conditionals - Subject verb agreement- Error Spotting - Active and Passive voice.

UNIT II LISTENING & READING 9

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

UNIT III WRITING 9

Checklist - Recommendations - Formal letters – inviting guests – acceptance/declining letters

UNIT IV BUSINESS WRITING 9

E-mail writing - fixing an appointment, cancelling appointment, paper submission for seminars and conferences - Job Application Letter andRésumé.

UNIT V SPEAKING 9

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Suggesting - Comparing and Contrasting - Situational Role-play.

TOTAL: 45PERIODS

LIST OF EXERCISES

1. Stage Dynamics (Body Language and Paralanguage - Presentation)
2. Day today real time speaking exposures – Story narration, simple, general topics and incidents.
3. Group Discussion
4. Power Point Presentation (Corporate Skills & Public Speaking)
5. Loud Reading
6. Picture Description
7. Interview Skills (Mock Interview & Interview Etiquette)
8. Case Study Report

TOTAL: 15 PERIODS

OUTCOMES

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

- Use correct grammar in speech and writing.
- Understand and interpret information from various audio and reading sources.
- Write clear, structured, and formal documents.

- Prepare professional emails, résumés, and job-related letters.
- Communicate effectively in group discussions and presentations.
- Apply communication skills confidently in real-time situations.

TEXT BOOKS

1. S. Sumant,"Technical English II",MavenLearning Private Limited, 2012.
2. Joshi, Manmohan,*"Soft Skills"*, First Edition, Bookboon, 2017.

REFERENCES

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, "Resonance English for Engineers and Technologists", Cambridge University Press, First Edition, 2013.
2. Seely, John. "Oxford Guide to Effective Writing and Speaking", Oxford University Press.UK,2013.

E-RESOURCES

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

EXTENSIVE READING

1. Stephen R. Covey, " The 7 Habits of Highly Effective People",Simon & Schuster, 2019.

Mapping of COs-POs& PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	-	-	-	1	-	-	2	3	-	2	-	-
2	1	2	-	2	-	-	-	-	3	-	1	-	-
3	1	-	-	-	-	-	1	-	3	2	2	-	-
4	-	-	-	-	1	-	2	-	3	2	2	-	-
5	-	-	-	-	-	-	1	3	3	2	1	-	-
6	-	-	-	-	-	2	2	2	3	-	2	-	-
AVG	1.00	2.00	-	2.00	1.00	-	1.33	2.50	3.00	2.00	1.60	-	-

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

Chairman - BoS

23EEE202 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

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

(Common to AIDS, CSE, CSE-CS, IT, Robotics, PT)

OBJECTIVES

- To enhance the basic concepts of DC and AC electrical circuits and fundamental circuit laws.
- To impart knowledge on the construction, working principles, and applications of basic electrical machines
- To instruct the operation and characteristics of basic semiconductor devices
- To familiarize the fundamentals of number systems and basic digital logic circuits in digital world
- To instruct the principles of electrical measuring instruments and power measurement
- To provide basic electrical and electronic concepts through simple hands-on experiments

UNIT I ELECTRICAL CIRCUITS 9

DC circuits: Circuit components: Conductor, Resistor, Inductor, Capacitor - Ohm's Law - Kirchhoff's Laws - Independent and Dependent sources - Mesh analysis, Nodal 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 induction motor, BLDC, Stepper Motor.

UNIT III ANALOG ELECTRONICS 9

PN junction diodes and its applications - Zener diode: structure, operation, Zener diode as regulator –Construction, Working Principle and Characteristics: BJT, JFET, SCR, MOSFET.

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, Combinational logic - Representation of logic functions - SOP and POS forms - Minimization using K maps for SOP - 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 EXPERIMENT

1. Verification of KVL & KCL.
2. Load test on DC shunt motor.
3. Characteristics of PN and zener diodes
4. Characteristics of BJT in CE Configuration.
5. Half wave and full wave rectifiers
6. Verifications of Half adder and Full adder.
7. Measurement of Single Phase Power.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Apply basic electrical laws and theorems to analyze simple DC and AC circuits.
- Explain the working principles and applications of DC machines, transformers and motors.
- Analyze the characteristics and applications of diodes and semiconductor devices.
- Apply digital logic concepts to design and analyze simple combinational circuits.
- Examine the operation of electrical instruments and basic data acquisition systems.
- Analyze the basic electrical and electronics concepts by performing simple hands-on laboratory experiments and interpreting the results.

TEXT BOOKS

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

REFERENCES

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill Education, Fourth Edition, 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	1	-	-	1	-	-	-	3	2	1
2	3	1	-	1	-	-	1	-	-	-	3	3	3
3	3	-	-	1	-	-	1	-	-	-	3	3	2
4	3	3	2	1	-	-	1	-	-	-	3	2	3
5	3	-	-	-	-	-	1	-	-	-	3	2	3
6	3	3	2	-	-	-	1	3	3	-	-	2	2
AVG	3.00	2.50	2.00	1.00	-	-	1.00	3.00	3.00	-	3.00	2.33	2.33

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

Chairman - BoS

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:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- 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.
- 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 inhouse hold appliances.

WOOD WORK:

a) Sawing,
b) Planning 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 board wiring 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 using Diac / 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 air conditioner.

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: 30 PERIODS

COURSE 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	PSO1	PSO2
1	3	2	-	-	1	1	-	-	-	-	2	2	1
2	3	2	-	-	1	1	-	-	-	-	2	2	1
3	3	2	-	-	1	1	-	-	-	-	2	2	1
4	3	2	-	-	1	1	-	-	-	-	2	2	1
AVG	3	2	-	-	1	1	-	-	-	-	2	2	1

Chairman - BoS

23EEC201	INDIAN LANGUAGE(EXCEPT MOTHER TONGUE) / FOREIGN LANGUAGE	L T P C 0 0 4 2

(Common to all B.E. & B.Tech. Branches)

OBJECTIVES

- To learn the Hindi alphabet, pronunciation, and basic writing.
- To understand and use basic Hindi grammar correctly.
- To develop basic reading, writing, listening, and speaking skills in Hindi.
- To use Hindi for simple everyday communication.
- To prepare learners to successfully clear the Hindi Examination.

UNIT I वर्णमालाएवंमूलभूतव्याकरण (ALPHABET AND BASIC GRAMMAR) 5

Hindi Vowels (स्वर)- Hindi Consonants (व्यंजन) -Matras (मात्राएँ)- Barakhadi (बारहखड़ी)-Word Formation (शब्दनिर्माण)- Gender (लिंग)- Number (वचन)- Basic Sentence -Formation (सरलेवाक्यरचना)

UNIT II शब्दभंडारएवंव्याकरण (VOCABULARY AND GRAMMAR) 7

Nouns (संज्ञा)- Pronouns (सर्वनाम) -Adjectives (विशेषण) -Verbs (क्रिया) -Tenses (काल– Present, Past, Future) - Opposite Words (विलोमशब्द) -Synonyms (पर्यायवाची) -One-word Substitutions (अनेकशब्दोंकेलिएएकशब्द)

UNIT III पठनएवंलेखनकौशल (READING AND WRITING SKILLS) 7

Reading Simple Hindi Passages -Comprehension (गद्यांश) -Paragraph Writing (अनुच्छेदलेखन)- Letter Writing (पत्रलेखन)- Dialogue Writing (संवादलेखन) -Picture Description (चित्रवर्णन) -Dictation Practice (श्रुतिलेख)

UNITIVदैनिकजीवनमेंहिंदी (HINDI FOR EVERYDAY COMMUNICATION) 7

Greetings and Introductions -Family Members (परिवार)- Days, Months, Seasons -Numbers (१–१००) -Time and Date - Colours, Fruits, Vegetables - Shopping Conversations - School and Classroom Vocabulary -Common Everyday Conversations

UNITVसाहित्यएवंपुनरावृत्ति (LITERATURE AND REVISION) 4

Simple Poems (कविताएँ)- Short Stories (लघुकथाएँ)- Proverbs and Idioms (मुहावरेएवंलोकोक्तियाँ– basic) -Moral Stories - Translation (English/Tamil to Hindi – Simple Sentences) - Revision of Grammar - Model Question Papers and Practice Tests

TOTAL: 30 PERIODS

OUTCOMES

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

1. Write basic Hindi words and sentences.
2. Apply fundamental Hindi grammar in simple communication.
3. Develop basic reading, writing, listening, and speaking skills in Hindi.
4. Use Hindi confidently in day-to-day conversations.
5. Develop proficiency required to successfully clear the Hindi Examination.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	1	1	3	-	1	-	-
CO3	-	-	-	-	-	-	1	2	3	-	2	-	-
CO4	-	-	-	-	-	1	2	2	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	2	-	3	-	-
AVG	-	-	-	-	-	1.00	1.33	1.67	2.80	-	1.60	-	-

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

P. Sathya
Chairman - BoS

23EEC201	INDIAN LANGUAGE(EXCEPT MOTHER TONGUE) / FOREIGN LANGUAGE	L T P C 0 0 4 2

(Common to all B.E. & B.Tech. Branches)

OBJECTIVES

- To learn the German alphabet, pronunciation, and basic communication.
- To understand and use basic German grammar and vocabulary.
- To communicate in German in simple everyday situations.
- To develop basic reading, writing, listening, and speaking skills in German.
- To apply basic German language skills confidently through practice and revision.

UNIT I INTRODUCTION TO GERMAN LANGUAGE 6

German alphabet and pronunciation –Greetings -Self-introduction (Name, age, nationality, profession) - Numbers (0–100) -Days, months, seasons, and dates - Basic classroom expressions - Personal pronouns -Verb **sein** (to be) -Simple sentence formation

UNIT II BASIC GRAMMAR AND VOCABULARY 7

Definite and indefinite articles (der, die, das; ein, eine) - Nouns and gender - Singular and plural forms - Verb conjugation (regular verbs) - Present tense - Question words (Wer, Was, Wo, Wann, Wie, Warum) - Negation (nicht, kein) - Vocabulary: Family, occupations, countries, languages, colors

UNITIII EVERYDAY COMMUNICATION 7

Daily routine - Time and clock reading - Food and beverages - Shopping conversations - Asking for and giving directions -Making simple requests -Modal verbs (möchten, können) -Vocabulary: Home, school, transportation, weather

UNIT IV READING, WRITING, LISTENING, AND SPEAKING SKILLS 5

Reading short dialogues - Listening to simple conversations - Writing short paragraphs- Describing people, places, and objects - Introducing family and friends

UNIT V PRACTICAL APPLICATIONS AND REVISION 5

Travel and tourism vocabulary - At the restaurant - At the railway station and airport - Revision of grammar topics - Translation of simple sentences (English to German and German to English)

TOTAL: 30 PERIODS

OUTCOMES

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

- Identify the German alphabet and pronounce basic German words correctly.
- Use basic German vocabulary and simple grammar in sentences.
- Practice in simple German for everyday situations.
- understand basic German texts and conversations.
- Apply basic German language skills confidently in simple real-life situations.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	1	1	3	-	1	-	-
CO3	-	-	-	-	-	1	2	2	3	-	2	-	-
CO4	-	-	-	-	-	-	1	2	3	-	2	-	-
CO5	-	-	-	-	-	1	2	2	3	-	2	-	-
AVG	-	-	-	-	-	1	1.50	1.75	3	-	1.60	-	-

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

P. Kavitha
Chairman - BoS

23EEC201	INDIAN LANGUAGE(EXCEPT MOTHER TONGUE) / FOREIGN LANGUAGE	L T P C 0 0 4 2

(Common to all B.E. & B.Tech. Branches)

OBJECTIVES

- To learn the Japanese writing system, pronunciation, and basic vocabulary.
- To understand and use basic Japanese grammar and sentence patterns.
- To communicate in Japanese in simple everyday situations.
- To develop basic reading, writing, listening, and speaking skills in Japanese.
- To apply basic Japanese language skills confidently through practice and real-life communication.

UNIT I WRITING SYSTEMS & PRONUNCIATION 5

Hiragana chart reading and writing - Katakana chart reading and writing - Basic pronunciation rules (long vowels, double consonants) – Numbers - Colours, body parts, pets description

UNIT II KANJI& BASIC GRAMMAR 7

First 50 Kanji (Numbers, Time & Days, Basic Directions & People) - Topic marker は (wa) - Identification sentences: Noun + です (desu) - Possession particle の (no) - Inclusion particle も (mo) - Subject marker が (ga) - Direction particles へ (he) and に (ni) - Self-introductions and greetings (Aisatsu) - Numbers, prices, shopping terms - Days, months, relative time - Family members and occupations

UNIT III KANJI & FUNCTIONAL GRAMMAR 8

Next 50 Kanji (Nature, Core Verbs, Adjectives & Nouns) - Verb groups (Group 1, Group 2, Group 3) - Masu forms (Present, Past, Positive & Negative) - Te-form (~て): requests, connecting sentences, continuous actions (~ている) - Adjective conjugation (い & な adjectives) - Desires (~たい) and Invitations (~ましょう)

UNIT IVVOCABULARY& FUNCTIONAL COMMUNICATION 5

Action verbs (daily routine, hobbies) - Adjectives for people, food, and places - Positional words (inside, outside, next to, between) - Transport, travel, and location vocabulary - Simple conversations in everyday situations

UNIT V READING& LISTENING COMPREHENSION 5

Reading short sentences in Hiragana, Katakana, and basic Kanji - Understanding classroom instructions - Listening to slow, clear daily-life conversations - Understanding simple shopping dialogues

TOTAL: 30 PERIODS

OUTCOMES

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

- Identify the Japanese writing system and pronounce basic Japanese words correctly.
- Use basic Japanese vocabulary and simple grammar in sentences.
- Communicate in simple Japanese for everyday situations.
- Read, write, listen to, and understand basic Japanese texts and conversations.

- Apply basic Japanese language skills confidently in simple real-life situations.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	1	1	-	1	2	-	-	-	-
CO2	-	-	-	-	1	2	-	2	2	-	-	-	-
CO3	-	-	-	-	2	2	1	2	3	-	1	-	-
CO4	-	-	-	-	2	2	1	3	3	-	1	-	-
CO5	-	-	-	-	1	1	1	2	3	-	1	-	-
AVG	-	-	-	-	1.40	1.60	1.00	2.00	2.60	-	1.0	-	-

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

P. Kavitha
Chairman - BoS

23MDC201	APTITUDE SKILLS (Common to all Branches)	L T P C 3 0 0 0

OBJECTIVES

- To introduce the basics concepts and techniques of numbers, Highest common factor and Least common multiple.
- To develop the use of decimal fraction and problems on ages.
- To introduce the basic concepts of time, work, distance, calendar and clock.
- To explain the student with the concept of simple and compound interest.
- To provide the knowledge of polynomial and quadratic equations.

UNIT I NUMBERS, HIGHEST COMMON FACTOR AND LEAST COMMON MULTIPLE 9

Numbers and their basic classification – Types of number – Basic operations of numbers – Progression – Tests of divisibility – Highest common factor – Least common multiple

UNIT II DECIMAL FRACTION AND PROBLEMS BASED ON AGES 9

Decimal fraction – Types of fraction – Comparison of fractions – Inserting fractions in between two given fractions – Relation between decimal fraction and normal fraction – Conversion of a decimal fraction into a vulgar fraction – Types of decimals – Conversion of mixed recurring decimal into a vulgar fraction – Standard form of decimal – Problems based on ages.

UNIT III TIME, WORK, DISTANCE, CALENDER AND CLOCK 9

General rule for time and work – General rule for work and wages – Speed – Unit of speed – Average speed – Some useful relations – Problems on Trains – Calendars and clocks – Odd days – Ordinary year – Leap year.

UNIT IV SIMPLE INTEREST, COMPOUND INTEREST AND ELEMENTARY ALGEBRA 9

Simple interest – Compound interest – Some useful relations – Difference between compound interest and simple interest – Short cut methods to solve special types of problems – Elementary Algebra and averages

UNIT V POLYNOMIAL AND QUADRATIC EQUATIONS 9

Polynomial introduction – Degree of a polynomial – Types of polynomial – Operations on polynomial – Remainder and factor theorem – Quadratic equation – Pure Quadratic equation – Discriminant – Roots of the Quadratic equations – Solution of Quadratic equation – Framing of a Quadratic equation – Special types of roots.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply basic concepts and techniques highest common factor and least common multiple on numbers.
- Apply the concept of decimal fraction and problems on ages.
- Apply the concept of time, work, distance, calendar and clock.
- Develop proficiency in simple interest, compound interest and basic algebraic skills.
- Explain the concepts and properties of polynomial and quadratic equations.

TEXT BOOKS

1. Agarwal R.S., "Quantitative Aptitude", S. Chand & Company Ltd, New Delhi, 2012.
2. Dinesh Khattar, "Quantitative Aptitude for competitive examinations ", Pearson India Education Services Pvt. Ltd., New Delhi, 2019.

REFERENCES

1. Praveen R.V., "Quantitative Aptitude and Reasoning", PHI Learning Private Limited, Delhi, 2013.
2. Gupta P, "A unique Approach to Quantitative Aptitude ", Unique Publishers (I) Pvt. Ltd, New Delhi, 2017.

E-RESOURCES

1. https://youtube.com/playlist?list=RDQM5Xl256aOq24
2. https://youtu.be/KE7tQf9spPg

Chairman - BoS

SEMESTER III

23MAT304	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**P**	**T**	**C**
	[Common to Civil, Mech, R&A and PT]	**3**	**1**	**0**	**4**

OBJECTIVES

- To introduce the basics of Fourier transforms and their properties.
- To compute the Z-transforms of standard functions and their properties.
- To provide knowledge of Fourier series and half-range series.
- To explore the basic concepts of partial differential equation.
- To explain the classification and applications of partial differential equations.

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 PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of partial differential equations – Method of separation of variables – Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

OUTCOMES

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

- Apply various Fourier transform techniques in physical problems of engineering.
- Solve engineering problems using the concept of Z transforms.
- Analyze Fourier series for periodic functions and functions with discrete data.
- Apply the standard types of partial differential equations.
- Evaluate the Fourier series techniques in application of partial differential equations.

TOTAL:45+15 PERIODS

TEXT BOOKS

1. Grewal B.S.,"Higher Engineering Mathematics", Khanna Publishers, Fourty Fourth Edition, 2022.
1. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G., "Advanced Mathematics for Engineering Students", S.Viswanathan Publishers, Fourth Edition,1998.

REFERENCES

1. N.P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, Nineth Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, Tenth Edition, 2016.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/111/102/111102129/# (Transforms)
2. https://archive.nptel.ac.in/courses/111/103/111103021/ (Partial differential equations)

Mapping of COs-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	2	2	-	-	-	-	-	2	-	-
2	3	3	2	2	2	-	-	-	-	-	2	-	-
3	3	3	2	2	2	-	-	-	-	-	2	-	-
4	3	3	2	2	2	-	-	-	-	-	2	-	-
5	3	3	2	2	2	-	-	-	-	-	2	-	-
AVG	3.00	3.00	2.00	2.00	2.00	-	-	-	-	-	2.00	-	-

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

Chairman - BoS

23MET302 ENGINEERING MECHANICS L T P C

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

OBJECTIVES

- To train students in the fundamental concepts of mechanics, including scalars, vectors, laws of mechanics, forces, and equilibrium of particles.
- To teach the principles of equilibrium of rigid bodies, moments, couples, and reactions at supports in two and three dimensional systems.
- To develop understanding of friction and its applications in engineering systems such as inclined planes, belts, ladders, and wedges.
- To explain the concepts of centroids and area moments of inertia for simple and composite plane areas.
- To train students in the dynamics of particles, including rectilinear and curvilinear motion, impulse, momentum, and impact of 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

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

- Apply the fundamental concepts of mechanics to resolve forces and determine equilibrium of particles.
- Analyze the equilibrium of rigid bodies by calculating moments, couples, and support reactions in two and three dimensions.
- Examine the effects of friction in engineering applications such as inclined planes, belts, ladders, and wedges.
- Calculate the centroids and area moments of inertia for simple and composite plane areas using relevant theorems.
- Analyze the motion of particles using principles of kinematics, impulse, momentum, and impact.

TEXT BOOKS

1. Dr.N.Kottiswaran, "Engineering Mechanics", Sri Balaji Publications, Eleventh Edition, 2018.
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, Twelfth Edition, 2019.
3. Vela Murali, "Engineering Mechanics", Oxford University Press, Second Edition, 2018.

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Eleventh Edition, Pearson Education, 2017.
2. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, Nineth Edition, Wiley student edition, 2019.
3. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, Fifth Edition, McGraw Hill Higher Education, 2020.

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	PSO1	PSO2
1	3	2	2	-	-	-	-	-	-	-	2	2	2
2	3	2	2	-	-	-	-	-	-	-	2	2	3
3	3	2	2	-	-	-	-	-	-	-	2	2	3
4	3	2	2	-	-	-	-	-	-	-	2	2	3
5	3	2	2	-	-	-	-	-	-	-	2	3	3
AVG	3.00	2.00	2.00	-	-	-	-	-	-	-	2.00	2.17	2.67

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

Chairman - BoS

23RMT301 FUNDAMENTALS OF ROBOTICS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamental concepts of robotics and automation and understand their role in modern engineering applications.
- To inculcate the concept of degrees of freedom and various robot movements such as vertical, radial, rotational traverse, roll, pitch, and yaw.
- To focus on the working principles of different grippers including mechanical, vacuum, magnetic, and adhesive grippers.
- To provide knowledge of joint space techniques used for planning robot movements between positions.
- To familiarize with various robotic applications in material handling such as pick and place, palletizing, and depalletizing operations.

UNIT I INTRODUCTION TO ROBOTICS 9

Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots.

UNIT II ROBOT ANATOMY AND MOTION ANALYSIS 9

Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

UNIT III ROBOT DRIVES AND END EFFECTORS 9

Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

UNIT IV PATH PLANNING 9

Definition-Joint space technique, Use of P-degree polynomial-Cubic, polynomial- Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.

UNIT V ROBOTICS APPLICATIONS 9

Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots.

TOTAL : 45 PERIODS

OUTCOMES

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

- Explain the interaction between human systems and robotic systems along with essential safety measures in robotics.
- Analyze the robot anatomy, configurations, degrees of freedom, work envelope, and basic kinematics involved in robotic motion.
- Examine the robot drive systems, end effectors, gripper mechanisms, and various robot control methods used in robotic operations.
- Apply path planning techniques using joint space and Cartesian space methods for position and orientation control in robotic motion.
- Apply the use of robotics in various applications and classify different types of robots.

TEXT BOOKS

1. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education,Third Edition, 2022.
2. Robert J. Schilling, "Fundamentals of Robotics" CRC Press, Second Edition, 2020.

REFERENCE BOOKS

1. Dr. Kingsley F. Botto-Danford and Dr. H. Thomas McKenna, "Robotics Engineering – An Integrated Approach", Wiley, Second Edition,2022.
2. Fu K S, Gonzalez R C, Lee C.S G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, Second Edition,2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/108/112108298 - (Introduction to Robotics)
2. https://archive.nptel.ac.in/courses/112/108/112108298/ - (Motion Planning)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	-	-	-	2	-	-	-	-	2	-	3
2	3	2	-	-	-	2	-	-	-	-	2	-	3
3	3	2	-	-	-	2	-	-	-	-	2	-	3
4	3	2	-	-	-	2	-	-	-	-	2	-	3
5	3	2	-	-	-	2	-	-	-	-	2	-	3
AVG	3.00	2.00	-	-	-	2.00	-	-	-	-	2.00	-	3.00

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

Chairman - BoS

23RME301	DIGITAL ELECTRONICS AND MICROPROCESSOR (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To impart skills in logic minimization using Karnaugh Map (K-Map) and the Quine-McCluskey method.
- To inculcate the design of adders, subtractors, multiplexers, decoders, flip-flops, counters, and shift registers.
- To focus on the concepts of cycles, races, state reduction, and race-free state assignments in asynchronous circuit design.
- To provide knowledge of the pin diagram and functional building blocks of the processor used in microprocessor operations.
- To develop knowledge of programming techniques including loop structures with counting and indexing methods
- To develop practical skills in the design and implementation of digital logic circuits and microprocessor-based programs using the 8085 processor and peripheral interfacing.

UNIT I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and QuineMcCluskey method of minimization.

UNIT II COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder -Multiplexer, Demultiplexer, Decoder, Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM – EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

UNIT IV 8085 PROCESSOR 9

Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory rganization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT V PROGRAMMING PROCESSOR 9

Instruction - format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions – stack -8255 architecture and operating modes

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using digital logic gates.
2. Design and implementation Combinational circuits using basic gates for arbitrary functions.
3. Design and implementation of encoder, decoder, multiplexers and demultiplexer.
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. Basic arithmetic operations of 8085.
7. Move a data block without overlap.
8. Ascending Descending Order.
9. Write a program to control the traffic light system using 8085 & 8255.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

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

- Apply number systems, codes, Boolean algebra, logic gates, and minimization methods to design and simplify digital circuits.
- Construct combinational and sequential circuits including adders, subtractors, multiplexers, decoders, flip-flops, counters, and shift registers.
- Examine asynchronous sequential circuits, hazards, and memory devices including ROM, RAM, PLDs, PLA, PAL, and FPGA.
- Analyze the 8085 processor architecture, memory organization, I/O operations, timing diagrams, and interrupt handling.
- Interpret assembly language programs and 8255 interfacing to perform data transfer, manipulation, control, and subroutine operations.
- Demonstrate the design, implementation, and verification of digital circuits and 8085/8255 programs for practical applications.

TEXT BOOKS

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", Pearson, Sixth Edition, 2021.
2. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Prentice Hall of India, Fourth Edition, 2019.

REFERENCES

1. Charles H.Roth. "Fundamentals of Logic Design", Thomson Learning,Seventh Edition, 2019.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson Education Inc, Eleventh Edition, 2019.
3. R.S. Gaonkar, "Microprocessor Architecture Programming and Application with 8085", Wiley Eastern Ltd., Sixth Edition, 2021.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/117/106/117106114/ - (Digital Circuits and systems)
2. https://archive.nptel.ac.in/courses/108/105/108105102/ - (8085 Microprocessor)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	1	1	-	-	1	-	1	3	1
2	3	2	1	1	1	1	-	-	1	-	1	3	1
3	3	2	1	1	1	1	-	-	1	-	1	3	1
4	3	2	1	1	1	1	-	-	1	-	1	3	1
5	3	2	1	1	1	1	-	-	1	-	1	3	1
6	-	-	-	-	1	-	-	2	1	2	1	3	1
AVG	3.00	2.00	1.00	1.00	1.00	1.00	-	2.00	1.00	2.00	1.00	3.00	1.00

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

Chairman - BoS

23RME302 **ELECTRIC MACHINES AND POWER SYSTEM** L T P C
(Lab Embedded Theory Course) 3 0 2 4

OBJECTIVES

- To inculcate the principles, operation, and control of DC machines and motors.
- To impart knowledge of the construction, operation, performance, and applications of transformers in robotics and automation.
- To focus on the principles, construction, operation, and control of single-phase and three-phase induction motors and their applications.
- To familiarize with the construction and functions of synchronous and special machines.
- To provide an overview of the structure of electric power systems including generation, transmission, sub-transmission, and distribution.
- To develop practical skills in testing electrical machines and using MATLAB for system analysis and simulation

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, the students will be able to:

- Explain the principles, construction, characteristics, and operation of DC machines, including speed control, braking, and starting methods.
- Analyze the construction, operation, performance, and applications of single-phase and three-phase transformers.
- Analyze the construction, operation, performance, and applications of single-phase and three-phase induction motors.
- Examine the construction, operation, and applications of synchronous and special machines.
- Apply the structure and components of electric power systems, including generation, transmission, distribution, and substations.
- Demonstrate the operation and performance of DC machines, transformers, induction motors, and transmission systems, including MATLAB simulations.

TEXT BOOKS

1. B.L.Thereja and A.K.Theraja, "A Text of Electrical Technology", S.Chand publications, Volume 2, 2022.
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, Fourth Edition Reprint, 2021.
2. D.P.Kothari, I.J. Nagarath, "Power System Engineering", and McGraw-Hill Publishing Company limited, New Delhi, Third 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	PSO1	PSO2
1	3	2	–	–	2	–	–	–	–	–	1	2	1
2	3	3	–	1	2	–	–	–	–	–	1	2	1
3	3	3	–	1	2	–	–	–	–	–	1	3	2
4	3	2	–	1	1	–	–	–	–	–	1	2	2
5	2	2	–	–	1	1	–	–	–	–	1	1	2
6	2	2	1	3	3	–	–	1	1	1	2	2	2
AVG	2.67	2.33	1.00	1.50	1.83	1.00	–	1.00	1.00	1.00	1.17	2.00	1.67

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

Chairman - BoS

23RME303 **MANUFACTURING PROCESSES AND TECHNOLOGY** L T P C
(Lab Embedded Theory Course) 3 0 2 4

OBJECTIVES

- To inculcate knowledge of sand casting processes including moulding materials,
- Patterns, and core making methods.
- To provide knowledge of fusion welding processes and different types of gas welding and their equipment.
- To focus on milling machine specifications and types of milling machines.
- To enhance skills in machine tools and hole-making operations.
- To focus on grinding processes, finishing operations, and gear generation techniques.
- To develop working skills and knowledge in shaping, planing, slotting, and various 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, the students will be able to:

- Categorize metal casting processes, associated defects, merits and demerits.
- Classify the different metal joining processes.
- Apply the components of lathe and milling machine
- Explain the fundamentals of metal cutting in machining operations.
- Apply various machining processes such as Grinding and gear Operation.
- Demonstrate mould preparation using solid, split, and loose-piece patterns for basic casting operations.

TEXT BOOKS

1. P.N.Rao, "Manufacturing Technology", Mc Grawhill Education, Volume 1, Sixth Edition, 2023.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, Eighth Edition, 2020.

REFERENCES

1. Rao,P.N, "Manufacturing Technology Foundry, Forming and Welding", Fifth Edition, TMH-2022.
2. Rajput R. K, "Manufacturing Technology", Laxmi Publications (P)Ltd., Fourth Edition, 2021.

E-RESOURCES

1. http://nptel.ac.in/courses/1121 05126/ - (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	PSO1	PSO2
1	2	1	-	-	-	1	-	-	-	-	2	2	1
2	2	1	-	-	-	1	-	-	-	-	2	2	1
3	2	1	-	-	-	1	-	-	-	-	2	2	1
4	2	1	-	-	-	1	-	-	-	-	2	2	1
5	2	1	-	-	-	1	-	-	-	-	2	2	1
6	3	2	-	-	-	1	-	-	-	-	2	2	1
AVG	2.17	1.17	-	-	-	1.00	-	-	-	-	2.00	2.00	1.00

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

Chairman - BoS

23EEC301 **PROFESSIONAL DEVELOPMENT** L T P C
0 0 2 1

OBJECTIVES

To be proficient in important Microsoft Office tools: MS WORD, EXCEL and POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: **10 Hours**

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: **10 Hours**

Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate and Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyze data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

Select slide templates, layout and themes
Formatting slide content and using bullets and numbering

Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

OUTCOMES

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

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements.
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding.
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	2	-	3	-	-	-	1	3	-	2	2
2	3	3	2	2	3	-	-	-	-	2	1	2	2
3	2	1	2	-	3	-	-	-	2	3	-	2	2
AVG	2.3	1.6	2	2	3	-	-	-	1.5	2.6	1	2	2

1-Low, 2-Medium, 3-High, "-" - No Correlation

Chairman - BoS

SEMESTER IV

23RMT401 EMBEDDED SYSTEMS AND PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the fundamentals, architecture, and instruction set of 8051 microcontrollers.
- To impart knowledge of programming and communication techniques for 8051 microcontrollers, including assembly, C, and serial/I2C/SPI/CAN interfaces.
- To familiarize with peripheral interfacing of 8051 microcontrollers, including I/O devices, sensors, motors, and control programming.
- To discuss the architecture, instruction set, and basic programming of ARM7 processors.
- To inculcate understanding of single board computers, embedded programming, and interfacing techniques.

UNIT I INTRODUCTION TO MICROCONTROLLER 9

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization -Instruction Sets – Addressing Modes.

UNIT II PROGRAMMING AND COMMUNICATION 9

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT III PERIPHERAL INTERFACING 9

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV ARM PROCESSOR 9

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING 9

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages -– Python for Embedded Systems- GPIO Programming – Interfacing .

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the architecture, memory organization, instruction set, and addressing modes of 8051 microcontrollers.
- Apply assembly and C programming to interface and communicate with 8051 microcontrollers using timers, interrupts, and serial protocols.
- Construct interfacing circuits and control programs for I/O devices, sensors, and motors using 8051 microcontrollers.
- Analyze the ARM7 architecture, pipelining, and instruction sets to optimize processor-based applications.
- Analyze SBC and SoC architecture, and analyze embedded systems, focusing on real-time OS, GPIO, and interfacing.

TEXT BOOKS

1. Frank Vahid and Tony Givargis, "Embedded System Design:A Unified Hardware/Software Introduction", Wiley, Third Edition, 2020.
2. Kenneth J. Ayala, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Cengage Learning, Fourth Edition, 2019.

REFERENCES

1. Simon Monk, "Programming the Raspberry Pi, Second Edition: Getting Started with Python", McGraw Hill TAB, Third Edition, 2020.
2. James W. Stewart, "The 8051 Microcontroller: Hardware, Software, and Interfacing" ,Prentice Hall, Third Edition, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/106/105/106105193/ - (Introduction to Embedded systems)
2. https://archive.nptel.ac.in/courses/106/105/106105193/ - (ARM instruction Set)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	–	–	1	–	–	–	–	–	1	2	1
2	3	3	1	1	2	–	–	–	–	–	1	3	2
3	3	2	2	2	3	–	–	1	1	–	1	3	3
4	3	2	–	1	2	–	–	–	–	–	1	2	2
5	3	2	1	1	2	–	–	1	1	1	2	3	3
AVG	3.00	2.20	1.33	1.25	2.00	–	–	1.00	1.00	1.00	1.20	2.60	2.20

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

Chairman - BoS

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

OBJECTIVES

- To introduce sensors, their characteristics, signal types, and applications in measurement systems.
- To impart knowledge on inductive and capacitive transducers, including their principles, construction, characteristics, and applications.
- To enhance understanding of actuators, their types, selection, and applications in pneumatic, hydraulic, and electrical systems.
- To familiarize with micro sensors and micro actuators, their principles, types, and applications
- To focus on sensor materials and micro fabrication processing techniques.

UNIT I SENSORS 9

Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

UNIT II INDUCTIVE & CAPACITIVE TRANSDUCER 9

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT III ACTUATORS 9

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle ofoperation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

UNIT IV MICRO SENSORS AND MICRO ACTUATORS 9

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT V SENSOR MATERIALS AND PROCESSING TECHNIQUES 9

Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the principles, characteristics, and applications of sensors, transmitters, and transducers.
- Understand the principles, construction, characteristics, and applications of inductive and capacitive transducers.
- Construct electrical, pneumatic, and hydraulic actuator systems.
- Analyze the principles, types, and performance of micro sensors and micro actuators for different applications.
- Categorize sensor materials and processing techniques for designing and developing sensor devices.

TEXT BOOKS

1. Hans-Peter Baeumler and Hans-Joachim Albrecht, "Micro system Technology and Microbotics", Springer, Third Edition, 2019.
2. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application",Springer, Fifth Edition, 2020.

REFERENCES

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, Second Edition, 2023.
2. Thomas. G. Bekwith and Lewis Buck.N, "Mechanical Measurements", Oxford and IBH publishing Co. Pvt. Ltd., Seventh Edition ,2019.

E-RESOURCES

1. https://www.slideshare.net/saaz1425/dc-motor-23906628(DC Motor principles)
2. https://www.electricaleasy.com/2014/01/basic-working-of-dc-motor.html (Motor working animation)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	–	–	1	–	–	–	–	–	1	2	1
2	3	2	–	1	1	–	–	–	–	–	1	2	1
3	3	2	2	1	2	–	–	1	1	–	1	3	3
4	3	3	1	2	2	–	–	–	–	–	1	3	2
5	3	2	2	1	2	–	–	–	–	–	2	2	2
AVG	3.00	2.20	1.67	1.25	1.60	–	–	1.00	1.00	–	1.20	2.40	1.80

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

Chairman - BoS

23RMT403 **KINEMATICS AND DYNAMICS OF ROBOTS** L T P C
3 0 0 3

OBJECTIVES

- To introduce concepts of object positioning, orientation, and coordinate transformations in robotic systems.
- To inculcate understanding of direct kinematics using D-H representation and ARM equations for different robot types.
- To familiarize with inverse kinematics and solution techniques for SCARA and articulated robots.
- To enhance understanding of workspace analysis and trajectory planning for SCARA and articulated robots.
- To acquire knowledge of manipulator dynamics using Lagrange-Euler and Newton-Euler formulations.

UNIT 1 INTRODUCTION 9

Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.

UNIT II DIRECT KINEMATICS 9

Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.

UNIT III INVERSE KINEMATICS 9

The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.

UNIT IV WORKSPACE ANALYSIS AND TRACJECTORY PLANNING 9

Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique – continuous path motion, Interpolated motion, straight line motion and Cartesian space teclmique in trajectory planning.

UNIT V MANIPULATOR DYNAMICS 9

Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, problems.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand position, orientation, and coordinate transformations of robots.
- Apply D–H representation and arm equations to determine the direct kinematics of SCARA and articulated robots.
- Construct inverse kinematic solutions for SCARA and articulated robots.

- Develop the ability to calculate and define the work envelope and operational limits of different robotic systems.
- Analyze dynamic models of robotic systems, including a two-axis planar robot, using Euler's method

TEXT BOOKS

1. R.K.Mittal and I.J.Nagrath, "Robotics and Control", Tata McGraw Hill, Third Edition, 2021.
2. JohnJ.Craig, "Introduction to Robotics Mechanics and Control", Pearson Education, Fourth Edition, 2021.

REFERENCES

1. Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, Second Edition, 2019.
2. Edwin Wise, "Applied Robotics", Cengage Learning, Second Edition, 2022.

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	PSO1	PSO2
1	3	3	3	1	-	-	-	-	-	-	3	-	2
2	3	3	3	1	-	-	-	-	-	-	3	-	2
3	3	3	3	1	-	-	-	-	-	-	3	-	2
4	3	3	3	1	-	-	-	-	-	-	3	-	2
5	3	3	3	1	-	-	-	-	-	-	3	-	2
AVG	3.00	3.00	3.00	1.00	-	-	-	-	-	-	3.00	-	2.00

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

Chairman - BoS

23RME401 **PLC AND SCADA** L T P C

(Lab Embedded Theory Course) 3 0 2 4

OBJECTIVES

- To introduce the fundamentals of industrial automation, PLC architecture, control elements, and safety standards.
- To impart knowledge of PLC programming, including relay ladder logic, function block diagrams, timers, counters, and data manipulation.
- To enhance knowledge of PLC networking and industrial communication protocols.
- To discuss HMI systems, their types, and interfacing with PLCs for industrial automation applications.
- To foster understanding of SCADA systems, including architecture, communication protocols, and PLC/field device interfacing.
- To enhance hands-on experience in PLC programming, I/O interfacing, and automation of motors, traffic lights, and conveyor systems.

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, the students will be able to:

- Categorize the fundamental control elements and adhere to international safety standards required for industrial environments.
- Construct PLC programs using relay ladder logic, FBD, timers, counters, and data manipulation instructions
- Apply industrial bus protocols and their use in PLC networking and integration.
- Classify HMI types and analyze their roles and interfacing with PLCs in industrial automation.
- Analyze SCADA architecture, protocols, and integration with PLCs and field devices.
- Apply PLC programming and ladder logic to implement timers, counters, motor control, and automation systems such as traffic lights and conveyor systems.

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, Third Edition, 2020.

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 - (Introduction to Industrial Automation).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	1	–	1	3	2	–	–	–	1	2	2
2	2	2	1	1	2	–	–	–	2	–	1	2	3
3	2	2	1	1	2	3	2	–	2	–	1	2	3
4	3	3	2	2	3	–	–	–	1	–	1	3	3
5	3	2	1	1	2	–	–	–	1	–	1	2	3
6	3	2	1	2	2	–	–	3	2	–	1	3	3
AVG	2.50	2.17	1.17	1.40	2.00	3.00	2.00	3.00	1.60	–	1.00	2.33	2.83

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

Chairman - BoS

23MEE402	STRENGTH OF MATERIALS (Lab Embedded Theory Course) (Common to Mechanical and Robotics and Automation)	L T P C 3 0 2 4

OBJECTIVES

- To teach different types of stresses and strains, axial and thermal effects, elastic constants, and factor of safety in solids.
- To explain principal stresses, stresses on inclined planes, Mohr's circle, and stresses in thin and thick-walled cylinders.
- To familiarize learners with bending and shear stress distribution, load carrying capacity, and proportioning of beam sections.
- To guide learners in evaluating beam deflections and column strength using standard methods and formulas.
- To teach torsion in shafts, stresses in helical and carriage springs, and related practical examples
- To guide students in performing experiments and demonstrate practical measurements of stress, strain, hardness, deflection, torsion, and heat treatment effects.

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 AND COLUMNS 9

Evaluation of slope and deflection of cantilever and simply supported beams – Double integration method - Macaulays method. Types of Columns, Equivalent length, Euler and Rankine formulae, Slenderness ratio.

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:

- Examine how variations in material properties and structure configurations affect the overall stress and strain responses.
- Analyze the importance of two dimensional stress systems and stresses in thin and thick cylinders.
- Draw the shear force and bending moment diagrams for beams subjected to various loading conditions, such as point loads, distributed loads, and moments.
- Apply the impact of estimated slopes and deflections on the overall design and safety of structural components.
- Apply torsion equation in design of circular shafts and helical springs.
- Examine how the results from different tests compare and what they reveal about the specimen's overall mechanical behavior.

TEXT BOOKS

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, Sixth Edition, 2021
2. Rajput R K., "A Textbook of Strength of Materials (Mechanics of Solids)", S Chand and Company Ltd., Fourth Edition, 2020.
3. F.P. Beer and R.Johnston, "Mechanics of Materials", McGraw Hill Education India (P) Ltd., Seventh Edition, 2023.

REFERENCES

1. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, Second Edition, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", Prentice Hall of India, Fourth Edition, 2023.
3. Rattan.S.S, "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., Fourth Edition, 2023.

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	PSO1	PSO2
1	3	3	1	-	-	1	-	-	-	-	3	2	3
2	3	3	1	-	-	1	-	-	-	-	3	2	3
3	3	3	1	-	-	1	-	-	-	-	3	2	3
4	3	3	1	-	-	1	-	-	-	-	3	2	3
5	3	3	1	-	-	1	-	-	-	-	3	2	3
6	3	3	1	-	-	1	-	2	-	-	3	2	3
AVG	3.00	3.00	1.00	-	-	1.00	-	2.00	-	-	3.00	2.00	3.00

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

Chairman - BoS

23GEE301 **PROBLEM SOLVING AND PYTHON PROGRAMMING** L T P C
(Lab Embedded Theory Course) 3 0 2 4

OBJECTIVES

- To impart the fundamentals of computational thinking, algorithm design, and problem-solving techniques for developing efficient software solutions.
- To develop students proficiency in Python programming using data types, expressions, operators, statements, and debugging techniques.
- To enable students to apply control structures, functions, recursion, and string manipulation for solving computational problems.
- To train students to use lists, tuples, dictionaries, and advanced data processing techniques for structured programming.
- To inculcate the knowledge of file handling, exception handling, modules, packages, and data visualization for developing robust Python applications.
- To develop the students in analytical, programming, and computational skills through coding practices, and to solve real-world problems 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.

Coding practices:

1. Develop Algorithm and flowchart to find the greatest of three numbers.
2. Develop Algorithm and flowchart to find a minimum number in a List.

Problem-solving Assignments:

1. Develop Algorithm and Flowchart to solve Towers of Hanoi Problem.
2. Develop Algorithm, Pseudo code and flowchart for finding factorial of a given number using recursion.

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

Coding practices:

1. Develop python program to find area of a Circle
2. Develop python program to convert Fahrenheit to Celsius.

Problem-solving Assignments:

1. Develop Python program to find Quadratic Equation
2. Develop Python program to find Student mark statement based on 5 subjects.

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.

Coding practices:

1. Develop python program to find GCD of a given number.
2. Develop python program to find factorial of a number.
3. Develop Python program to find sum of array of given numbers.

Problem-solving Assignments:

1. Develop Python program to find whether an element is found in the List by using (A) Linear Search and (B) Binary Search method
2. Develop Python program to print Fibonacci Series

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

Coding practices:

1. Develop python program for Insertion Sorting & Selection Sorting.
2. Develop python program for Histogram

Problem-solving Assignments:

1. Develop Python program for student mark statement using List
2. Develop Python program to print Retail bill statement

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.

Coding practices:

1. Develop python program to append the contents of one file to another.
2. Develop python program to copy contents of one file to another file using command Line Arguments

Problem-solving Assignments:

1. Develop a python program for calculator using python packages.
2. Develop a suitable python program to demonstrate each case in Exceptional Handling.
3. Develop a suitable python program using Matplotlib for Visualizing Errors.

LIST OF EXPERIMENTS

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 trings using.(reverse,palindrome,charactercount,replacing characters)

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,

- Analyze computational problems to develop effective problem-solving strategies.
- Apply python constructs to develop programs for python applications.
- Apply control structures and functions to solve computational problems.
- Apply Python built-in data structures such as lists, tuples, and dictionaries to process and manipulate data efficiently.
- Analyze the operations of file handling, exception handling, modules, packages, and data visualization techniques for real-world applications.
- Implement python programs for solving various computational problems.

TEXTBOOKS

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

REFERENCES

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, First Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", Notion Press, First Edition, 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	PSO1	PSO2
1	3	3	2	1	2	–	–	–	–	–	2	3	2
2	3	2	2	–	3	–	–	–	–	–	2	3	3
3	3	3	2	1	3	–	–	–	–	–	2	3	3
4	3	2	2	–	3	–	–	–	–	–	2	3	3
5	2	3	2	2	3	–	–	–	1	–	2	3	3
6	3	3	3	2	3	–	1	1	2	1	2	3	3
AVG	2.83	2.67	2.17	1.50	2.83	–	1.00	1.00	1.50	1.00	2.00	3.00	2.83

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

Chairman - BoS

23EEC401 **ONLINE CERTIFICATION COURSES** L T P C
3 0 0 3

Students may be permitted to study online courses (NPTEL, SWAYAM or any Proctored Assessment Certification Courses) with 3 credits during the 4th semester curriculum for all B.E./B.Tech. Programmes. Such courses offered to students shall be recommended by the Department Academic Committee (DAC). The DAC shall ensure that the courses offered are not core courses in their respective curriculum.

The number of credits and transfer of credits are based on the procedure explained in following Table. The mapping of marks with grades is applicable only if the student passes the course as per the guidelines of NPTEL.

S.No.	No. of Weeks	Credits
1	4	1
2	8	2
3	12	3
4	16	4

Chairman - BoS

SEMESTER V

23RMT501	AI FOR ROBOTICS	L T P C 3 0 0 3

OBJECTIVES

- To introduce fundamental AI concepts applied to robotics.
- To focus on probabilistic techniques for handling uncertainty in robotic systems.
- To provide knowledge on perception and computer vision techniques for robotic systems.
- To implement intelligent decision-making and path planning.
- To familiarize with learning and adaptive techniques used in intelligent robotic systems.

UNIT I INTRODUCTION TO AI IN ROBOTICS 9

Overview of AI in Robotics – Architectures of Intelligent Robots - Reactive and Deliberative Systems - Goal-based Agents and Utility-based Agents - Search Algorithms: BFS, DFS, A*, D*, Dynamic Programming - State-space representation

UNIT II PROBABILISTIC ROBOTICS 9

Bayesian Networks - Markov Decision Process (MDP) - Hidden Markov Models (HMM) - Kalman Filters - Particle Filters - Sensor Fusion.

UNIT PERCEPTION AND COMPUTER VISION 9

Visual Perception in Robotics - Image Processing Basics - Feature Detection (SIFT, SURF, ORB) - Object Recognition and Tracking - Camera Models and Calibration - Depth Perception and Stereo Vision.

UNIT IV MOTION PLANNING AND CONTROL 9

Path Planning Algorithms: PRM, RRT - Trajectory Generation - Obstacle Avoidance - SLAM (Simultaneous Localization and Mapping) - Localization Techniques (Monte Carlo, Grid-based) - Control Architectures (PID, Fuzzy, AI-based control)

UNIT V LEARNING AND ADAPTIVE SYSTEMS 9

Supervised and Unsupervised Learning - Reinforcement Learning (Q-learning, SARSA) - Deep Learning for Robotics (CNN, RNN) - Behavior Cloning - Imitation Learning - Applications: Autonomous Vehicles, Drones, Robotic Arms

TOTAL: 45 PERIODS

OUTCOMES

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

- Construct AI methodologies and their application in robotics.
- Apply Kalman Filters to estimate robot states from noisy sensor measurements.
- Analyze perception modules using vision-based systems
- Develop motion planning and control algorithms.
- Apply machine learning for adaptive robotic behavior.

TEXTBOOKS

1. Sebastian Thrun, "Wolfram Burgard, Dieter Fox – Probabilistic Robotics", MIT Press, Fourth Edition , 2018.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson, Third Edition, 2020.

REFERENCES

1. Siegwart, Nourbakhsh & Scaramuzza, "Introduction to Autonomous Mobile Robots", The MIT Press,Second Edition, 2020.
2. Oussama Khatib and Bruno Siciliano, "springer Handbook of Robotics" Springer International Publishing (Cham/Switzerland) ,Second Edition, 2019.

E RESOURCES

1. https://onlinecourses.nptel.ac.in/noc25_ee89/preview (Intelligent Control of Robotic Systems)
2. https://onlinecourses.nptel.ac.in/noc25_cs159/preview (Artificial Intelligence: Concepts and Techniques)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	2	–	–	–	–	–	2	3	2
2	3	3	1	2	2	–	–	–	–	–	2	3	1
3	3	2	2	2	3	–	–	1	1	–	2	3	2
4	3	3	3	2	2	–	–	1	1	1	2	3	3
5	3	3	2	2	3	–	–	1	1	–	3	3	2
AVG	3.00	2.60	2.00	1.80	2.40	–	–	1.00	1.00	1.00	2.20	3.00	2.00

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

Chairman - BoS

23RMT502	HYDRAULICS AND PNEUMATICS	L T P C
		3 0 0 3

OBJECTIVES

- To introduce fluid power principles and hydraulic pumps for efficient design and application of hydraulic systems.
- To focus on hydraulic actuators and control components for effective operation of fluid power systems.
- To provide knowledge on hydraulic circuits and systems for efficient design and operation of fluid power applications.
- To familiarize with pneumatic and electro-pneumatic systems, their components, and circuit design for industrial applications.
- To enhance troubleshooting and application skills in hydraulic and pneumatic systems.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

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

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

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

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

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

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

OUTCOMES

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

- Illustrate the Fluid power and operation of different types of pumps.
- Apply the features and functions of Hydraulic motors, actuators and Flow control valves
- Analyze the different types of hydraulic circuits and systems.
- Construct the operation of different pneumatic circuits and systems.
- Examine the various trouble shooting methods and applications of hydraulic and pneumatic systems.

TEXT BOOKS

1. Anthony Esposito,"Fluid Power with Applications", Pearson Education,Seventh Edition, 2020.
2. Majumdar S.R.,"Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, Third Edition, 2022.

REFERENCES

1. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, Fourth Edition, 2019.
2. Majumdar S.R., "Pneumatic systems Principles and maintenance", Tata McGraw-Hill, Tata McGraw Hill, Third Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/112105047 - (Hydraulic and Pneumatic System)
2. https:// nptel.ac.in/courses/112/106/112106300/ - (Oil Hydraulics and Pneumatics)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	3	-	2	1	-	-	-	-	2	1	-
2	1	2	3	-	2	1	-	-	-	-	2	1	-
3	1	2	3	-	2	1	-	-	-	-	2	1	-
4	1	2	3	-	2	1	-	-	-	-	2	1	-
5	1	2	3	-	2	1	-	-	-	-	2	1	-
AVG	1.00	2.00	3.00	-	2.00	1.00	-	-	-	-	2.00	1.00	-

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

Chairman - BoS

23RME501 **CNC MACHINES AND TECHNOLOGY** **L T P C**

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

OBJECTIVES

- To introduce the fundamentals and types of CNC machines.
- To familiarize with the constructional features and components of CNC machines.
- To provide interaction between control systems, feedback devices, and tooling.
- To focus on write simple CNC programs for basic machining operations.
- To develop skills in CNC part programming using manual and computer-assisted methods.
- To provide practical knowledge and hands-on experience in CNC machine operation and programming.

UNIT I FUNDAMENTALS OF CNC MACHINES **9**

Introduction to Computer Numerical Control- CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines

UNIT II CONSTRUCTIONAL FEATURES OF CNC MACHINES **10**

Features of CNC Machines- Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors.

UNIT III CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING **10**

Description of a simple CNC control system. Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices.

UNIT IV CNC PART PROGRAMMING **9**

Part Program Terminology-G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

UNIT V ECONOMICS AND MAINTENANCE **7**

Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements.

LIST OF EXPERIMENTS

1. Study of the CNC machine
2. Programming and simulation of a lathe using any CAM package
3. Programming and simulation of a machining centre using any CAM package
4. Programming and operation of a CNC Lathe
5. Programming and operation of a CNC machining centre

TOTAL: 45 +15=60PERIODS

OUTCOMES

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

- Apply CNC machine operation skills to perform basic machining tasks.
- Analyze the effects of constructional features on CNC machine accuracy and precision.
- Develop a tooling selection plan for a complex machining operation.
- Apply knowledge of CNC machine configuration to optimize program performance
- Analyze the economic impact of different maintenance strategies.
- Develop a custom CNC program for a specific machining operation.

TEXT BOOK

1. Yoreur Koren, "Computer Control of Manufacturing Systems", Pitman, Second Edition, 2019.
2. Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2020.

REFERENCES

1. Berry Leatham – Jones, "Computer Numerical Control", Pitman, Third Edition 2019.
2. Steave Krar and Arthur Gill, "CNC Technology and Programming", McGraw–Hill Publishing Company, Fifth Edition, 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-me21/ - (CNC Machines tools and process)
2. https://nptel.ac.in/courses/112102103 - (CNC part Programming and CNC software).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	-	2	1	-	-	-	-	2	3	2
2	3	2	3	-	2	1	-	-	-	-	2	3	2
3	3	2	3	-	2	1	-	-	-	-	2	3	2
4	3	2	3	-	2	3	-	-	-	-	2	3	2
5	3	2	3	-	2	1	-	-	-	-	2	3	2
6	3	2	3	-	2	1	-	-	-	-	2	3	2
AVG	3.00	2.00	3.00	-	2.00	1.33	-	-	-	-	2.00	3.00	3.00

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

Chairman - BoS

23EEC501	INDUSTRIAL TRAINING	L T P C 0 0 4 2

Students shall undergo Industrial Training for duration of four weeks carrying 2 credits during the Fifth Semester for all B.E./B.Tech. Programmes. The industry/organization shall be selected with the approval of the Head of the Department. Alternatively, the concerned department may arrange industrial training through an industry expert relevant to the student's discipline of study.

A faculty member nominated by the Head of the Department shall act as the faculty coordinator and shall be responsible for the periodic monitoring and evaluation of the student's progress during the training period.

Duration of Industrial Training	Credits
2 Weeks	1
4 Weeks	2

*1 week of Industrial Training = 40 hours.

Chairman - BoS

SEMESTER VI

23RME601	AUTOMATION SYSTEM DESIGN	L T P C
	(Lab Embedded theory Course)	3 0 2 4

OBJECTIVES

- To discuss the basics of manufacturing and automation, including types, strategies, and levels of automation.
- To impart skills in mechatronic system design and case studies.
- To enhance understanding of transfer lines, automated assembly, and AGVs.
- To familiarize with Industrial IoT, smart systems, and Industry 4.0.
- To develop the knowledge and skills to understand IoT hardware, devices, communication protocols, cloud/edge computing, and security issues in IoT systems.
- To develop skills in controlling automated and robotic systems using PLC, sensors, and PC interfacing.

UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

UNIT II DESIGN OF MECHATRONIC SYSTEMS 9

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

UNIT III TRANSFER LINES AND AUTOMATED ASSEMBLY 9

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

UNIT IV INTRODUCTION TO IoT AND AUTOMATION 9

Introduction to Industrial Automation: Concepts, Types, and Benefits-Evolution of Automation and Smart Systems-Introduction to Internet of Things (IoT): Definition, Characteristics, and Applications-IoT Architecture – Perception Layer, Network Layer, Application Layer-Comparison of Traditional Automation vs IoT-Enabled Automation-Role of IoT in Industrial Revolution (Industry 4.0) -Cyber-Physical Systems and Smart Factory

UNIT V IoT ARCHITECTURE, COMPONENTS AND PROTOCOLS 9

Hardware for IoT: Sensors, Actuators, Embedded Systems - IoT Devices:Microcontrollers (Arduino), Single Board Computers (Raspberry Pi)-Communication Models and APIs-IoT Protocols Overview:MQTT, CoAP, HTTP,TCP, UDP,IPv4, IPv6,Ethernet, Wi-Fi, Zigbee, LoRaWAN, BLE -Cloud and Edge Computing in IoT -Security Issues in IoT Communication.

LIST OF EXPERIMENTS

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems

3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Control of speed, direction and number of revolutions of a stepper motor using PC.
7. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

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

- Understand the fundamental concepts, types, and levels of industrial automation.
- Apply mechatronic system design principles to real-world case studies.
- Analyze transfer lines, automated assembly systems, AS/RS, and AGVs.
- Apply the Industrial IoT, cyber-physical systems, and smart factory concepts.
- Apply IoT architecture, components, protocols, and communication models for secure and efficient IoT system design.
- Demonstrate coordinated motion and sensor-based automation systems.

TEXT BOOKS

1. Mikell P Groover, "Automation Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi, Fifth Edition, 2024.
2. Raj Kamal, " Internet of Things: Architecture and Design", McGraw Hill Education, 2017.

REFERENCES

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New York, USA, Second Edition, 2018.
2. Adrian McEwen and Hakim, "Classically, Designing the Internet of Things", Wiley, First Edition, 2017.

E-RESOURCES

1. https:// nptel.ac.in/courses/108105063/ (Introduction to Industrial Automation and Control)
2. https://nptel.ac.in/courses/112102011/ (Automated System)

Mapping of COs - POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	-	1	1	-	-	-	-	3	3	3
2	3	3	3	-	1	2	-	-	-	-	3	3	3
3	3	3	3	-	1	2	-	-	-	-	3	3	3
4	3	3	3	-	1	2	-	-	-	-	3	3	3
5	3	3	3	-	1	2	-	-	-	-	3	3	3
6	3	2	3	-	1	2	-	-	-	-	3	3	2
AVG	3.00	2.83	3.00	-	1.00	1.83	-	-	-	-	3.00	3.00	2.83

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

Chairman & - BoS

23RME602	ELECTRIC DRIVES AND CONTROL (Lab Embedded theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To discuss the classification, dynamics, torque-speed characteristics, and application of electric drives in robotics and automation.
- To impart knowledge on DC motor drives, speed control methods, braking techniques, and their applications in robotics.
- To foster understanding of AC motor drives, speed control methods, and their applications in industrial automation.
- To enhance the characteristics, control strategies, and applications of servo and stepper motor drives in automation systems.
- To familiarize students with motion control, intelligent drive systems, and their applications in robotics and automation.
- To implement speed and position control of DC, induction, servo, and stepper motors, microcontroller, VFD, and MATLAB.

UNIT I FUNDAMENTALS OF ELECTRIC DRIVES 9

Electric drives – classification of electric drives – components of electric drive system – dynamics of electric drives – torque and speed relationships – load characteristics – duty cycles – thermal considerations – selection of electric drives for robotic and automation applications.

UNIT II DC MOTOR DRIVES 9

DC motors for automation – speed control of DC motors – armature voltage control – field control – controlled rectifier-fed DC motor drives – chopper-fed DC motor drives – closed-loop control – braking methods – applications in robotics.

UNIT III AC MOTOR DRIVES 9

Induction motors for drive applications – speed control methods – variable frequency drives – V/f control – introduction to vector control – synchronous motors – permanent magnet motors – applications in industrial automation.

UNIT IV SERVO AND STEPPER MOTOR DRIVES 9

Servo motors – DC and AC servo motors – characteristics and control of servo drives – feedback devices (encoder and resolver) – stepper motors – types and characteristics – drive circuits – micro stepping – applications in robotic joints and CNC machines.

UNIT V MOTION CONTROL AND INTELLIGENT DRIVES 9

Motion control fundamentals – position, speed, and torque control – digital control of electric drives – PLC and microcontroller-based drive systems – energy-efficient drives – regenerative braking – applications in robotics and line automation.

LIST OF EXPERIMENTS

1. Speed control of DC motor using armature voltage control.
2. Speed–torque characteristics of DC shunt motor.
3. Speed control of induction motor using VFD (V/F control).
4. Position control of servo motor using encoder feedback.
5. Stepper motor control using PLC or microcontroller.
6. Closed-loop speed control of DC motor using MATLAB.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

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

- Identify the components, classification, and selection criteria of electric drives for robotic and automation applications.
- Illustrate speed control methods and drive techniques for DC motors used in robotics.
- Analyze AC motor drive principles, speed control methods, and their applications in industrial automation.
- Examine servo and stepper motor characteristics, control mechanisms, and their use in robotic joints and CNC machines.
- Apply motion control techniques using energy-efficient drive systems.
- Analyze and implement speed control experiment for DC and AC, position control of servo motor, stepper motor control, closed loop speed control using MATLAB

TEXT BOOKS

1. G. K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House, Second Edition, 2022.
2. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, First Edition, 2018.

REFERENCES

1. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Pearson, First Edition .2012.
2. Vedam Subramanian, "Electric Drives: Concepts and Applications", Tata McGraw-Hill, Second Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/108104140 (Fundamentals of Electric Drives)
2. https://nptel.ac.in/courses/108104011 (Advanced Electric Drives)

Mapping of COs - POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	-	-	1	-	-	-	-	2	-	2
2	3	2	2	-	-	1	-	-	-	-	2	-	2
3	3	2	2	-	-	1	-	-	-	-	2	-	2
4	3	2	2	-	-	1	-	-	-	-	2	-	2
5	3	2	2	-	-	1	-	-	-	-	2	-	2
6	3	2	2	-	-	1	-	-	-	-	2	-	2
AVG	3.00	2.00	2.00	-	-	1.00	-	-	-	-	2.00	-	2.00

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

Chairman - BoS

23EEJ601 **PROJECT WORK – PHASE I** **L T P C**
0 0 8 4

OBJECTIVES

- To develop knowledge to formulate a real world problem and projects goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

PROCESS DESCRIPTION

- For Project work out of 100 marks, the maximum marks for Continuous Internal Assessment is fixed as 60 and the End Semester Examination (project report evaluation and viva voce examination) carries 40 marks. Project work may be assigned to a single student or to a group of students, not exceeding 4 per group.
- The project work shall be undertaken by students either in industry or in the college.
- The total credit for project work in semester VI is 4.
- There shall be three reviews (Zeroth Review,(Review I and Review II, each 100 marks)) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee.
- The committee shall consist of the Supervisor, Project Coordinator and one of the faculty members.
- Sixty percentage of Project work to be completed in this Project Work - Phase I.
- The student(s) is expected to submit the project report on or before the last working day of the semester. The ESE for the project work shall consist of the evaluation of the final project report submitted by the student or students of the project group by an external examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner and an internal examiner (other than supervisor). The project coordinator shall be the internal examiner. The COE shall appoint the External Examiner for the ESE of the Project Work. The project report shall be submitted as per the approved guidelines given by Controller of Examinations.

OUTCOMES

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

- Formulate real-world problems.
- Design and express technical solutions using appropriate tools and techniques.
- Test and validate prototypes for efficiency and cost-effectiveness, and present their work effectively through reports and oral demonstrations.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Mapping outcome	3	3	3	3	3	3	3	3	3	3	3	3	3

1.-Low, 2-Medium, 3-High, "-" - No Correlation

Chairman - BoS

Professional Elective - I

23RMP501 ROBOTS AND SYSTEMS IN SMART MANUFACTURING **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the fundamentals of industrial robots and robotic material handling.
- To familiarize students with robot selection, performance testing, and robotization
- To focus on the principles and systems of material handling in industries.
- To enhance knowledge of robotic welding systems and programming methods.
- To develop understanding of robot applications in welding and allied manufacturing processes.

UNIT I INTRODUCTION 9

Types of industrial robots - Load handling capacity - general considerations in Robotic material handling-material transfer - machine loading and unloading - CNC machine tool loading - Robot centered cell

UNIT II SELECTION OF ROBOTS AND OTHER APPLICATIONS 9

Factors influencing the choice of a robot - robot performance testing - economics of robotisation - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting -assembly operation - cleaning - robot for underwater applications.

UNIT III MATERIAL HANDLING 9

concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - industrial trucks - monorails - rail guided vehicles - conveyor systems -cranes and hoists - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems(ASRS) - bar code technology - radio frequency identification technology

UNIT IV ROBOTIC WELDING 9

Robotic welding system, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding, Welding simulation, Welding sequences, Profile welding

UNIT V APPLICATIONS OF ROBOTS IN WELDING AND ALLIED PROCESSES 9

Application of robot in manufacturing: Exploration of practical application of robots in welding: Robots for car body's welding, robots for box fabrication, robots for microelectronic welding and soldering – Applications in nuclear, aerospace and ship building, case studies for simple and complex applications

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the knowledge of industrial robots in material handling, machine loading, and robot-centered cell operations.
- Analyze the factors influencing robot selection, performance testing, and the economics of robotization.

- Apply the principles and design considerations in conventional and advanced material handling systems.
- Apply robotic welding programming methods and operating modes in welding operations.
- Analyze the use of robots in welding and allied manufacturing processes across different industries.

TEXTBOOKS

1. Richard D Klafter, Thomas Achmielewski, MickaelNegin , "Robotic Engineering An integrated Approach", Prentice Hall India, New Delhi, 2020.
2. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, New York, 2019.

REFERENCES

1. Parmar R S , "Welding Processes and Technology", Khanna Publishers, Third Edition, 2020.
2. Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, AshishDutta , "Industrial Robotics (SIE): Technology, Programming and Applications", McGraw Hill Education, Fourth Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/112105249 – (Robotics)
2. https://archive.nptel.ac.in/courses/112/104/112104189/ - (Manufacturing System Technology)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	3	2	-	-	-	-	-	2	3	2
2	3	2	2	3	2	-	-	-	-	-	2	3	2
3	3	2	2	3	2	-	-	-	-	-	2	3	2
4	3	2	2	3	2	-	-	-	-	-	2	3	2
5	3	2	2	3	2	-	-	-	-	-	2	3	2
AVG	3.00	2.00	2.00	3.00	2.00	-	-	-	-	-	2.00	3.00	2.00

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

Chairman - BoS

23RMP502 **DRONE TECHNOLOGIES** L T P C
3 0 0 3

OBJECTIVES

- To introduce the history, terminology, and entrepreneurial impact of drone technology.
- To familiarize with UAV components, assembly techniques, and programming methods.
- To develop practical skills in drone flight operations, control systems, and sensor management.
- To enhance the ability to select and apply drone technology across various commercial sectors.
- To inculcate safety standards, aviation regulations, and awareness of future drone trends.

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and Employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the evolution, terminology, and entrepreneurial opportunities within the drone technology landscape.
- Construct a functional UAV by integrating hardware components and executing multi-rotor stabilization programs.
- Apply flight management tools and onboard sensor data to execute controlled drone operations.

- Classify various UAV types and configurations based on their specific commercial and industrial application requirements.
- Examine safety risks, aviation regulations, and the technical constraints of autonomous swarm systems.

TEXT BOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, Inc ,2021.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2019.

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2021.
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/101/104/101104083/ - (UAV Design)
2. https://nptel.ac.in/courses/101104073 - (Design of fixed wing Unmanned Aerial Vehicles)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	1	3	2	-	-	-	-	1	2	2
2	3	3	3	1	3	2	-	-	-	-	1	2	2
3	3	3	3	1	3	2	-	-	-	-	1	2	2
4	3	3	3	1	3	2	-	-	-	-	1	2	2
5	3	3	3	1	3	2	-	-	-	-	1	2	2
AVG	3.00	3.00	3.00	1.00	3.00	2.00	-	-	-	-	1.00	2.00	2.00

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

Chairman - BoS

23RMP503 **MICRO ROBOTICS** L T P C
3 0 0 3

OBJECTIVES

- To introduce the principles of Micro System Technology (MST), micro-fabrication, and the design criteria for micro-assembly platforms.
- To familiarize with scaling laws and the effects of miniaturization on the physical, electrical, and adhesive properties of materials.
- To focus on the mathematical formalisms of flexures and the operational mechanics of micro-actuators and sensors.
- To provide a comprehensive overview of micro-robot classifications based on size, mobility, and specific MEMS applications.
- To enhance the technical proficiency required to implement locomotive micro-devices, micro-tools, and multi-robot communication systems.

UNIT I INTRODUCTION TO MICROROBOTICS 9

Introduction to Micro robotics -MST (Micro System Technology) - Micromachining - Working principles of Microsystems Applications of Microsystems - Micro-fabrication principles- Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators

UNIT II SCALING LAWS AND MATERIALS FOR MEMS 9

Introduction - Scaling laws - Scaling effect on physical properties scaling effects on Electrical properties - scaling effect on physical forces - Physics of Adhesion - Silicon - compatible material system - Shape memory alloys - Material properties - Piezoresistivity, Piezoelectricity and Thermoelectricity

UNIT III FLEXURES, ACTUATORS AND SENSORS 9

Elemental flexures - Flexure systems - Mathematical formalism for flexures - Electrostatic actuators - Piezo-electric actuators - Magneto-strictive actuators - Electromagnetic sensors - Optical-based displacement sensors - Motion tracking with microscopes

UNIT IV MICRO- ROBOTS AND APPLICATION 9

Introduction - Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro- robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.

UNIT V IMPLEMENTATION OF MICROROBOTS 9

Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators - Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices - icrogrippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - Multi-robot system: Micro-robot powering, Micro-robot communication.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the fundamental principles of micro-machining, fabrication, and the structural integration of micro-assembly platforms.
- Compute the scaling effects on physical and electrical properties to determine material behavior in silicon-compatible and shape-memory systems.

- Analyze and design micro robotic systems using flexures, actuators, and sensors
- Categorize micro-robots according to their size, mobility, and fabrication technology to align them with specific industrial tasks.
- Examine the architecture of locomotive devices, micro-grippers, and multi-robot communication protocols in arrayed actuator systems.

TEXT BOOKS

1. Mohamed Gad-el-Hak , "The MEMS Handbook", CRC Press, Third Edition, 2019.
2. Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2020.

REFERENCES

1. NadimMaluf and KirtWilliams, "An Introduction to Microelectromechanical systems Engineering", Fourth Edition, Artech House, 2020.
2. Nicolas Chaillet, Stephane Rangier "Microrobotics for Micromanipulation", John Wiley & Sons, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/105/112105249/ - (Robot Kinematics)
2. https://archive.nptel.ac.in/courses/112/101/112101098/ - (Sensors and Controllers in Robots)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	2	-	-	-	-	-	1	2	2
2	3	2	1	1	2	-	-	-	-	-	1	2	2
3	3	2	1	1	2	-	-	-	-	-	1	2	2
4	3	2	1	1	2	-	-	-	-	-	1	2	2
5	3	2	1	1	2	-	-	-	-	-	1	2	2
AVG	3.00	2.00	1.00	1.00	2.00	-	-	-	-	-	1.00	2.00	2.00

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

Chairman - BoS

23RMP504 **AGRICULTURAL ROBOTICS AND AUTOMATION** L T P C
3 0 0 3

OBJECTIVES

- To introduce agricultural robotics evolution, precision farming scope, and UAV types.
- To familiarize students with LiDAR, vision sensors, and crop disease detection techniques.
- To focus on autonomous navigation, path planning, and localization in outdoor environments.
- To develop machine learning applications for automated weeding, spraying, and harvesting.
- To enhance knowledge of swarm robotics, IoT integration, and sustainable irrigation systems.

UNIT I INTRODUCTION TO AGRICULTURAL ROBOTICS 9

Evolution and scope of robotics in agriculture - Need for automation in modern farming - Types of agricultural robots (field robots, autonomous tractors, UAVs) - Challenges and opportunities in agricultural automation - Precision agriculture concepts and smart farming

UNIT II SENSING AND PERCEPTION TECHNOLOGIES 9

Sensors for agricultural robots: vision, LiDAR, ultrasonic, GPS - Image processing for crop monitoring and disease detection - Data acquisition and interpretation for field environment - Environmental sensing and crop condition assessment

UNIT III NAVIGATION AND CONTROL IN AGRICULTURAL ROBOTS 9

Autonomous navigation basics for unstructured outdoor environments - Path planning and obstacle avoidance - Control systems for robotic platforms and actuators - Localization methods (GPS, odometry, sensor fusion)

UNIT IV AUTOMATION AND MACHINE LEARNING 9

Automated tasks: planting, weeding, spraying, harvesting - Machine learning integration for decision making - Robot–crop interaction and adaptive behavior - Vision-based and AI-assisted robotic functions

UNIT V INDUSTRIAL AND FIELD APPLICATIONS 9

Robotic systems for irrigation and nutrient delivery - Drones/UAVs in agriculture- Autonomous harvesting systems-Future trends: swarm robotics, IoT integration, sustainability aspects

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain precision agriculture concepts and modern farming automation challenges.
- Apply sensing data and image processing to assess field and crop conditions.
- Implement path planning and sensor fusion for autonomous farm navigation.
- Categorize AI functions and ML models for specific robotic farming tasks
- Examine UAV and swarm deployments to evaluate agricultural sustainability and IoT.

TEXT BOOKS

1. Dan Zhang & Bin Wei , "Robotics and Mechatronics for Agriculture" , CRC Press (Taylor & Francis Group), First Edition, 2018..
2. Redmond R. Shamshiri & Ibrahim A. Hameed, "Mobile Robots for Digital Farming" CRC Press ,Second Edition , 2023.

REFERNCES

1. Sundaravadivazhagan Balasubramanian, "Intelligent Robots and Drones for Precision Agriculture", Springer Cham, Fourth Edition,2024.
2. Manoj Karkee & Qin Zhang, "Fundamentals of Agricultural and Field Robotics ", Springer Cham, First Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/112101098 - (Automation)
2. https://archive.nptel.ac.in/courses/126/105/126105009/ - (Farm Machinery)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	-	2	1	-	-	-	-	2	2	2
2	3	2	3	-	3	1	-	-	-	-	2	2	2
3	3	2	3	-	2	1	-	-	-	-	2	2	2
4	3	2	3	-	2	3	-	-	-	-	2	2	2
5	3	2	3	-	2	1	-	-	-	-	2	2	2
AVG	3.00	2.00	3.00	-	2.20	1.40	-	-	-	-	2.00	2.00	2.00

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

Chairman - BoS

23RMP505 **COLLABORATIVE ROBOTICS** L T P C
3 0 0 3

OBJECTIVES

- To introduce the properties of collaborative robotics and the challenges of modern mobile manipulators.
- To familiarize students with swarm behaviors, collective decision-making, and trajectory error compensation.
- To provide technical insight into modular robot representation, serial/parallel kinematics, and dynamics.
- To focus on naturally inspired collective motion and mathematical models for group decision processes.
- To enhance proficiency in reconfigurable formation control, self-assembly platforms, and swarm dynamics.

UNIT I INTRODUCTION TO COBOTICS 9

Collaborative Robotics- Properties - Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Robot Manipulators-Current Challenges.

UNIT II SWARM ROBOTICS 9

Introduction, mapping, kinematics and trajectory error compensation, state transitions, collective decision making and methodologies, swarm robot scenarios-aggregation, clustering dispersion, pattern formation, sorting, flocking and collective motion, shepherding, heterogeneous swarms, Error Detection and Security.

UNIT III MODULAR ROBOTICS 9

Module Designs - Modular Robot Representation -Modular Serial Robot Kinematics - Kinematic Calibration for Modular Serial Robots- Modular Serial Robot Dynamics - Modular Parallel Robot Kinematics

UNIT IV NATURALLY INSPIRED COLLABORATION 9

Collective Decision-Making. Group Decision Making in Animals, Collective Motion as Decision Process, Models for Collective Decision-Making Processes, Urn Models, Voter Model ,Majority Rule , Hegselmann and Krause , Kuramoto Model , Axelrod Model, Ising Model, Fiber Bundle Model, Sznajd Model, Bass Diffusion Model, Sociophysics and Contrarians .

UNIT V RECONFIGURABLE ROBOTS 9

V-Shaped Formation Control for Robotic Swarms Constrained by Field of View – formation of reconfigurable virtual linkage - Reconfigurable Formation Control of Multi-Agents - Self-Assembly Modular Robot Platform Based on Sambot - Swarm Dynamics Emerging from Asymmetry.

TOTAL: 45 PERIODS

OUTCOMES

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

- Summarize the core properties of collaborative robots and the evolving landscape of mobile manipulators.

- Apply trajectory compensation and state transitions to manage swarm scenarios like flocking and dispersion.
- Solve kinematic and dynamic equations to calibrate modular serial and parallel robot configurations.
- Analyze different types of natural models used in inspired collaboration.
- Examine reconfigurable virtual linkages and self-assembly platforms to evaluate multi-agent formation stability.

TEXT BOOKS

1. Guilin Yang, I-Ming Chen, "Modular Robots: Theory and Practice", Springer, Fourth Edition , 2022.
2. Giandomenico Spezzano, "Swarm Robotics", Applied Sciences, MDPI, 2019.

REFERENCES

1. Heiko Hamann, "Collective Decision-Making in Swarm Robotics: A Formal Approach", Springer, 2019.
2. A.De Moten and M. G. Garcia, "Collaborative Robots: A Practical Guide", Springer, Third Edition, 2023.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/107/112107289/ - (Robotics and Control)
2. https://archive.nptel.ac.in/courses/112/104/112104316/ - (Advanced Robotics)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	-	-	-	-	-	2	2	1	1
2	3	2	1	1	-	-	-	-	-	2	2	1	1
3	3	2	1	1	-	-	-	-	-	2	2	1	1
4	3	2	1	1	-	-	-	-	-	2	2	1	1
5	3	2	1	1	-	-	-	-	-	2	2	1	1
AVG	3.00	2.00	1.00	1.00	-	-	-	-	-	2.00	2.00	1.00	1.00

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

Chairman - BoS

23RMP506 **ROBOT OPERATING SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the ROS framework, computation graphs, and the basic programming syntax for nodes and services.
- To familiarize students with CAD modeling, URDF/Xacro tags, and the representation of 7-DOF robot arms.
- To enhance knowledge of Gazebo simulation, including transmission tags, state controllers, and differential wheeled robots.
- To provide an understanding of the V-REP multi-platform simulator, focusing on ROS interfaces and 3D vision sensors.
- To focus on MoveIt architecture for motion planning, self-collision matrices, and industrial pick-and-place behaviors.

UNIT I ROS ESSENTIALS 9

Introduction to ROS- Advantages and Disadvantages of ROS - ROS Framework- ROS package C++, Python – ROS computation Graph – nodes, Messages, topics, services, bags, ROS Master- ROS Community- Basic programming and Syntax overview in C++ and Python – start with ROS programming - Creating Environment - Services-Actions and Nodes-Simple Interaction with the Simulation environment

UNIT II BUILD YOUR OWN ROBOT ENVIRONMENT 9

CAD Tools for Robot Modelling – ROS Packages for robot modelling – Unified Robot Description Format and Tags- Kinematics and Dynamics Library – Create URDF Model - Robot Modelling using Unified Robot Description Format (URDF),-ROS parameter server and adding real-world object representations to the simulation environment _ Create Robot description using 7 DOF: joint number, name, type and angle limits – Xacro – Rviz – viewing of 7 DOF arm – creation of wheeled robot

UNIT III SIMULATION ROBOTS IN ROS WITH GAZEBO 9

Robot simulation - Gazebo –create simulation model at Gazebo- Adding colors, textures, transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS controllers-ROS controller interacts with Gazebo, interfacing state controller, simulation of moving the robot joints – simulation of differential wheeled robot in Gazebo.

UNIT IV ROS WITH VREP 9

V-REP is a multi-platform robotic simulator - Simulating the robotic arm using V-REP - Adding the ROS interface to V-REP joint - Simulating a differential wheeled robot, Adding a laser sensor , 3D vision sensor

UNIT V MAPPING, NAVIGATION AND MOTION PLANNINGROS WITH MOVEIT 9

Move it Instattion - Generating the Self-Collision matrix .virtual joints, planning groups, robot poses, robot end effector - MoveIt Architecture Diagram - Trajectory from RViz GUI executing in Gazebo - Planning scene overview diagram- Collision Checking - Motion Planning, Pick and Place Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB - ROS with Industrial

TOTAL: 45 PERIODS

OUTCOMES

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

- Develop ROS-based robotic systems using C++ and Python.
- Analyze ROS packages for robot modeling and simulation
- Apply ROS controllers and vision sensors to construct a realistic simulation of a differential wheeled robot in Gazebo.
- Compare sensor data acquisition (Laser, 3D Vision) between V-REP and Gazebo to analyze simulator fidelity.
- Examine the MoveIt planning scene and analyze self-collision matrices to execute safe industrial motion trajectories.

TEXT BOOKS

1. Lentin Joseph, "Mastering ROS for Robotics Programming", Packt Publishing, Third Edition, 2019.
2. Lloyd Brombach, "Practical Robotics in C++: Build your own robots using ROS, Arduino, and more", Packt Publishing, First Edition, 2021.

REFERENCES

1. Lentin Joseph, Aleena Johny, "Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy", Apress, Second Edition, 2022.
2. Lentin Joseph, "ROS Robotics Projects", Packt publishing, 2018.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/106/105/106105214/ - (Build CAD Tools for robot modeling)
2. https://archive.nptel.ac.in/courses/112/104/112104316/ - (Simulation in robots, create simulation)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	2	-	-	-	-	-	1	1	3	2
2	3	2	1	2	-	-	-	-	-	1	1	3	2
3	3	2	1	2	-	-	-	-	-	1	1	3	2
4	3	2	1	2	-	-	-	-	-	1	1	3	2
5	3	2	1	2	-	-	-	-	-	1	1	3	2
AVG	3.00	2.00	1.00	2.00	-	-	-	-	-	1.00	1.00	3.00	2.00

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

Chairman - BoS

Professional Elective - II

23RMP507	ROBOT AND MACHINE ELEMENTS DESIGN	L T P C 3 0 0 3

OBJECTIVES

- To introduce the factors influencing robot design and the core theories of failure under various loading conditions.
- To familiarize students with the design of flexible drives and the selection of bearings using Somerfield and Raimondi-Boyd graphs.
- To focus on the design of shafts, axles, and bolted joints based on strength, rigidity, and critical speed.
- To develop the technical skills to design gears and multi-speed gearboxes using ray diagrams and kinematic layouts.
- To enhance knowledge regarding the force analysis and mechanical design of robotic grippers for industrial and medical applications.

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to Robots - factors influencing robot design, selection of materials based on mechanical properties - Modes of failure -Factor of safety – stresses due to bending and torsion moment - Eccentric loading, Design against fluctuating loads - theories of failures.

UNIT II DESIGN OF FLEXIBLE ELEMENTS AND BEARINGS 9

Introduction to flexible elements, Design of belt drives – Flat, Vee, and Timing Belts, Design of chain drives - Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Somerfield Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings.

UNIT III DESIGN OF SHAFTS AND THREADED FASTENERS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity, and critical speed - Keys and splines, Threaded fasteners - Bolted joints – Simple and eccentrically loaded bolted joints.

UNIT IV DESIGN OF GEARS AND GEAR BOXES 9

Design of Gears (Spur, Helical and Bevel) - Geometric progression - Standard step ratio - Ray diagram, kinematic layout - Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications.

UNIT V DESIGN OF ROBOT GRIPPERS AND END EFFECTORS 9

Types of End Effectors and Gripper Mechanisms, Force analysis, Miniature Grippers and Micro Grippers, Compliance, Selected case studies - Sheet metal handling, pretension of cuboid / cylindrical / objects, coils, irregular surfaces and flexible objects, handling castings, and medical applications.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the key factors influencing robot design and the modes of failure in

mechanical components.

- Analyze hydrodynamic journal bearings using Somerfield number and Raimondi & Boyd graphs.
- Apply the factors affecting the design of shafts and axies; including strength, rigidity, and critical speed, as well as the principles behind bolted joints.
- Analyze the kinematic layout of gearboxes and assess the performance of different gear designs in various applications.
- Classify different types of end effectors and gripper mechanisms used in robotic applications.

TEXT BOOKS

1. Bhandari. V.B, "Design of Machine Elements", Tata McGraw-Hill Education, Fifth Edition, 2020.
2. Joseph Edward Shigley, Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill, Twelfth Edition, 2021.

REFERENCES

1 Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, 2020.
2. Adam Morecki, JozeKnapczyk, "Basics of Robotics: Theory and Components of Manipulators and Robots", Springer, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/105/112105125/ - (Design of flexible elements and bearings).
2. https://archive.nptel.ac.in/courses/107/106/107106090/ - (Design of robot grippers and end effectors).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	1	2	-	-	-	-	1	2	2
2	3	2	1	1	1	2	-	-	-	-	1	2	2
3	3	2	1	1	1	2	-	-	-	-	1	2	2
4	3	2	1	1	1	2	-	-	-	-	1	2	2
5	3	2	1	1	1	2	-	-	-	-	1	2	2
AVG	3.00	2.00	1.00	1.00	1.00	2.00					1.00	2.00	2.00

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

Chairman - BoS

23RMP508 **LEAN MANUFACTURING** L T P C
3 0 0 3

OBJECTIVES

- To focus on the origins of lean manufacturing, the 3M concept, and the fundamental shift from traditional to pull-based production systems.
- To enhance knowledge of group technology, part families, and machine cell design.
- To develop proficiency in Value Stream Mapping (VSM) and Takt time calculations.
- To provide an understanding of 5S, Poka-Yoke, Jidoka, and visual management tools.
- To inculcate Total Productive Maintenance (TPM) pillars and OEE optimization techniques.

UNIT I INTRODUCTION 9

Origins and objectives of lean manufacturing – lean process,3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics– roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems – JIT manufacturing, Lean building blocks. LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination – seven types of waste – pull production-different models of pull production –the Kanban system-continuous flow-the continuous improvement process / Kaizen-Worker involvement.

UNIT II GROUP TECHNOLOGY AND CELLULAR LAYOUT 9

JIT with cell manufacturing – part families- production flow analysis – Composite part concept – machine cell design – quantitative analysis – case studies – single piece flow

UNIT III VALUE STREAM MAPPING 9

The value stream– benefits mapping process - the current state map–mapping icons – mapping steps.VSM exercises - Takt time calculations.

UNIT IV LEAN MANUFACTURING TOOLS AND METHODOLOGIES 9

Standardized work–standard work sequence timing and working progress .Quality at source - Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force

UNIT V TOTAL PRODUCTIVE MAINTENANCE 9

Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations. RECONCILING LEAN WITH OTHER SYSTEMS: Study of lean Six-sigma and lean design – lean and ERP- lean with ISO9001:2000 – administrative lean.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the role of continuous improvement and Kaizen in lean manufacturing concepts in industries

- Apply production flow analysis to build efficient cellular manufacturing layouts.
- Construct value stream maps to solve for Takt time and process flow.
- Analyze the benefits and limitations of standardized work and 5S technique
- Apply the total productive maintenance concepts in industries.

TEXT BOOKS

1. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing, 2019.
2. William M Feld, "Lean Manufacturing: Tools, Techniques and How to use them", APICS, 2020

REFERENCES

1. Richard B Chase "Production and Operations Management", McGraw Hill, Eleventh Edition, 2023.
2. Mahadevan B, "Operations Management", Pearson, Second Edition,2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/104/112104188/ - (Group technology and cellular layout).
2. https://archive.nptel.ac.in/courses/105/106/105106213/ - (Lean manufacturing tools and methodologies).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	1	2	-	-	-	-	1	1	2
2	3	2	1	1	1	2	-	-	-	-	1	1	2
3	3	2	1	1	1	2	-	-	-	-	1	1	2
4	3	2	1	1	1	2	-	-	-	-	1	1	2
5	3	2	1	1	1	2	-	-	-	-	1	1	2
AVG	3.00	2.00	1.00	1.00	1.00	2.00	-	-	-	-	1.00	1.00	2.00

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

Chairman - BoS

23RMP509 **COMPUTER INTEGRATED MANUFACTURING** L T P C
3 0 0 3

OBJECTIVES

- To provide a foundational understanding of the CIM wheel, production models, and the three-step implementation process.
- To enhance knowledge regarding automated production lines, AGVs, and the transition toward Industry 4.0 and digital manufacturing.
- To develop proficiency in Group Technology (GT) coding, rank order clustering, and FMS layout configurations.
- To inculcate knowledge of process planning and production management techniques for effective manufacturing resource utilization.
- To foster knowledge of industrial robot anatomy, classification, control systems, end effectors, sensors, accuracy, repeatability, applications, and robot programming.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM -Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – undamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – nsideration in material handling system design –Types of conveyors – Operations and features. Automated Guided Vehicle system smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS –Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method,

UNIT IV PROCESS PLANNING 9

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning - Master Production Schedule (MPS) – Material Requirement planning-I (MRP-I) – Capacity Planning- Control Systems-Shop Floor Control (SFC) -Inventory Control – Manufacturing Resource Planning-II (MRP-II) -Enterprise Resource Planning (ERP) .

UNIT V INDUSTRIAL ROBOTICS 9

Robot anatomy and related attributes – Classification of robots- Robot control systems – End effectors – Sensors in robotics – Robot accuracy and repeatability - Industrial robot applications –Robot part programming.

TOTAL: 45 PERIODS

OUTCOMES

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

- Build the structure and role of CAD/CAM/CIM in modern manufacturing.
- Apply the automated systems and digital tools in smart manufacturing.
- Classify parts, apply group technology, and design flexible manufacturing systems.
- Apply logical steps of CAPP, MPS, MRP-I, and shop floor control techniques for manufacturing planning and control.
- Examine industrial robot anatomy, classification, control systems, end effectors, sensors, accuracy, repeatability, and programming for manufacturing applications.

TEXT BOOKS

1. James A. Rehg and Herry W. Kraebber , "Computer Integrated Manufacturing", Pearson Education, Fourth Edition,2022
2. Shivanand H K, Benal M M and Koti V, " Flexible Manufacturing System", New Age, 2019.

REFERENCES

1. Alavudeen and Venkateshwaran, "Computer Integrated Manufacturingll", PHI Learning Pvt. Ltd., 2019.
2. Mikell P. Groover, Automation, "Production system and Computer integrated Manufacturing", Prentice Hall of India Pvt. Ltd., Fourth Edition, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/104/112104289/ - (Automated manufacturing systems.
2. https://archive.nptel.ac.in/courses/110/106/110106044/- (Process planning, group technology and fms.)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	2	-	-	-	1	-	1	2	1
2	3	2	2	1	2	-	-	-	1	-	1	2	1
3	3	2	2	1	2	-	-	-	1	-	1	2	1
4	3	2	2	1	2	-	-	-	1	-	1	2	1
5	3	2	2	1	2	-	-	-	1	-	1	2	1
AVG	3.00	2.00	2.00	1.00	2.00	-	-	-	1.00	-	1.00	2.00	1.00

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

Chairman - BoS

23RMP510 **ELECTRONICS MANUFACTURING TECHNOLOGY** L T P C
3 0 0 3

OBJECTIVES

- To develop a technical understanding of wafer fabrication, microlithography, and multi-layer PCB construction.
- To introduce electronic packaging types, comparing Through-Hole (THT) and Surface-Mount (SMT) interconnections.
- To provide comprehensive knowledge of SMT assembly, stencil printing, and reflow soldering profiles.
- To familiarize students with automated inspection (AOI/X-ray) and electrical functional testing methodologies.
- To enhance proficiency in PCB repair, thermal management, and Design for Manufacturability (DFM).

UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit board –fabrication, types, single sided, double sided, multi-layer and flexible printed circuit board

UNIT II COMPONENTS AND PACKAGING 9

Introduction to packaging, types-Through hole technology(THT) and Surface mount technology (SMT), Through hole components – axial, radial, multi leaded, odd form Surface-mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT III SURFACE MOUNT TECHNOLOGY 9

SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, solderingwave soldering, reflow process, process parameters, profile generation and control, adhesive, underfill and encapsulation process.

UNIT IV INSPECTION AND TESTING 9

Inspection techniques, equipment and principle- AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

UNIT V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES 9

Repair and rework of PCB- Coating removal, base board repair, conductor repair, thermomechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, reworkability, testing, reliability, and environment.

TOTAL: 45 PERIODS

OUTCOMES

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

- Classify the stages of wafer preparation and the structural differences between flexible and rigid PCBs.
- Apply interconnection standards to build chip-to-lead configurations using TAB and Flip-Chip.
- Solve process parameter challenges in reflow soldering to construct defect-free assemblies.
- Analyze inspection data to examine and correct soldering defects like bridging or tombstoning.
- Compare In-Circuit Testing (ICT) and functional testing to analyze the reliability of electronic modules.

TEXT BOOKS

1. Reza Malekzadeh "Surface Mount Technology: Principles and Practice" Springer,Second Edition, 2020.
2. Tummala R.R., "Fundamentals of microsystem packaging", Springer, 2020.

REFERENCES

1. Harper C.A., "Electronic Packaging and Interconnection Handbook" McGraw Hill Inc., N.Y., Second Edition, 2022,
2. Lee N.C., "Reflow Soldering Process and Trouble Shooting SMT, BGA, CSP and Flip Chip Technologies", Elsevier Science. United Kingdom, 2021.

E-RESOURCES

1. https:// nptel.ac.in/courses/112/107/112107219/-(components and packaging).
2. https://nptel.ac.in/courses/112105267/ - (Inspection and testing of robots).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	-	-	2	-	-	-	-	2	3	2
2	3	2	1	-	-	2	-	-	-	-	2	3	2
3	3	2	1	-	-	2	-	-	-	-	2	3	2
4	3	2	1	-	-	2	-	-	-	-	2	3	2
5	3	2	1	-	-	2	-	-	-	-	2	3	2
AVG	3.00	2.00	1.00	-	-	2.00	-	-	-	-	2.00	3.00	2.00

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

Chairman - BoS

23RMP511 **DIGITAL MANUFACTURING** L T P C
3 0 0 3

OBJECTIVES

- To introduce the development of AM technology, the ASTM/ISO 52900 classification, and global business opportunities.
- To focus on Design for Additive Manufacturing (DfAM) principles, including topology optimization and lattice structure generation.
- To develop technical knowledge of Vat Polymerization and Directed Energy Deposition (DED) processes like SLA and LENS.
- To provide a comprehensive understanding of Powder Bed Fusion (SLS/SLM) and Material Extrusion (FDM) mechanisms.
- To familiarize students with Binder Jetting, Material Jetting, and Sheet Lamination (LOM) techniques.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation –Design rules for Extrusion based AM.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 9

Photo polymerization: Stereo lithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) -Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery Materials -Benefits -Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the evolution of AM technology and its impact on industry
- Analyze the importance of each design rule in achieving part quality
- Examine the vat polymerization and direct energy deposition processes and its applications.
- Analyze knowledge on process and applications of powder bed fusion and material extrusion.
- Examine the advantages, limitations, and applications of binder jetting, material jetting, and sheet lamination processes.

TEXT BOOKS

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani ,"Additive manufacturing technologies", Springer Cham, Third Edition 2021.
2. Andreas Gebhardt and Jan-Steffen Hötter ,"Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, 2019.

REFERENCES

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, 2020.
2. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", CRC Press, Third Edition, 2021.

E-RESOURCES

1. https://onlinecourses.nptel.ac/courses/110/106/110106146/ - (Design for additive manufacturing)
2. https://archive.nptel.ac.in/courses/110/106/110106146/ - (Other additive manufacturing processes)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	3	-	2	-	-	-	-	2	3	2
2	3	2	1	3	-	2	-	-	-	-	2	3	2
3	3	2	1	3	-	2	-	-	-	-	2	3	2
4	3	2	1	3	-	2	-	-	-	-	2	3	2
5	3	2	1	3	-	2	-	-	-	-	2	3	2
AVG	3.00	2.00	1.00	3.00	-	2.00	-	-	-	-	2.00	3.00	2.00

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

Chairman - BoS

23RMP512 **COMPUTER AIDED INSPECTION AND TESTING** L T P C
3 0 0 3

OBJECTIVES

- To provide a strong foundation in measurement standards, error analysis, and the mechanical design of limits, fits, and tolerances.
- To develop proficiency in using linear and angular measuring instruments, including the inspection of gears, threads, and complex profiles.
- To focus on the integration of optoelectronics for monitoring tool wear and performing real-time, in-process surface roughness measurements.
- To enhance technical knowledge of laser interferometry and its applications in high-precision machine tool alignment and inspection.
- To familiarize students with modern metrology tools like Coordinate Measuring Machines (CMM), laser trackers, and the emerging field of nanometrology.

UNIT I FUNDAMENTALS AND CONCEPTS IN METROLOGY 9

Standards of Measurement – Analog and Digital Measuring Instruments - Comparators – Limits, Fits and Tolerances – Gauge Design –Surface Roughness – Form Errors and Measurements.

UNIT II INSPECTION AND GENERAL MEASUREMENTS 9

Linear Measuring Instruments – Evolution – Types – Classification – Limit Gauges – Gauge Design – Terminology – Procedure – Concepts of Interchange Ability and Selective Assembly – Angular Measuring Instruments – Types – Bevel Protractor Clinometers Angle Gauges, Spirit Levels Sine Bar – Angle Alignment Telescope – Autocollimator – Applications - Inspection of Gears And Threads – Tool Makers' Microscope – Universal Measuring Machine.

UNIT III OPTO ELECTRONICS IN ENGINEERING INSPECTION 9

Use of Optoelectronics in Tool Wear Measurements – Microhole Measurement and Surface Roughness – Applications in In-Process Measurement and On-Line Inspection.

UNIT IV LASER METROLOGY 9

Precision instrument based on Laser - Use of Lasers - Principle –Interferometers, Interference microscope -Optical flats - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer. Use of Laser Interferometer in Machine Tool Inspection – Uses of Laser in On-Line Inspection – Laser Micrometer – Laser Alignment Telescope.

UNIT V COMPUTER AIDED INSPECTION AND ADVANCES IN METROLOGY 9

Co-ordinate Measuring Machines - Constructional features - Types - Applications of CMM - CNC,CMM applications - Measurement arms, Laser tracker - Fundamentals of Computer Aided Inspection - Introduction to Nano metrology.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply standards and minimize errors in measurements.

- Apply basic and advanced metrology tools for dimensional measurement and inspection.
- Analyze opto-electronic measurement devices and their advantages.
- Examine laser-based measurement techniques for high precision.
- Classify the modern inspection methods and their role in improving accuracy and efficiency.

TEXT BOOKS

1. Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt. Ltd., 2020.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, Sixth Edition, 2020.

REFERENCES

1. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA,Fifth Edition, 2021.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, Thirteenth Edition, 2021.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/102/112102101/ - (Laser metrology)
2. https://archive.nptel.ac.in/courses/112/102/112102103/ - (Fundamentals concepts in metrology.)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	-	-	-	-	-	-	1	1	2
2	3	2	1	1	-	-	-	-	-	-	1	1	2
3	3	2	1	1	-	-	-	-	-	-	1	1	2
4	3	2	1	1	-	-	-	-	-	-	1	1	2
5	3	2	1	1	-	-	-	-	-	-	1	1	2
AVG	3.00	2.00	1.00	1.00	-	-	-	-	-	-	1.00	1.00	2.00

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

Chairman - BoS

Professional Elective - III

23RMP513	ELECTRIC AND HYBRID VEHICLES	L T P C 3 0 0 3

OBJECTIVES

- To introduce the comparative performance of EVs and ICE vehicles, focusing on design requirements like range, power, and chassis construction.
- To provide a deep understanding of battery chemistry, modeling, and management systems, alongside fuel cell and ultracapacitor characteristics.
- To enhance the specific applications and advantages of each type of motor, including DC motors, AC motors, PMSMs, BLDCs, and Switched Reluctance Motors.
- To develop technical proficiency in power converters, switching elements (IGBT/MOSFET), and four-quadrant motor drive operations.
- To focus on hybrid vehicle configurations, power-split devices, and control strategies for optimizing fuel economy and performance.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT II ENERGY SOURCES 9

Battery Parameters - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium onSodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT III MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations – operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the various resistances and power requirements essential for designing an efficient electric vehicle chassis.
- Apply the various energy source options like battery and fuel cell
- Examine electric motor for applications in hybrid and electric vehicles.
- Analyze the role of power electronics in hybrid and electric vehicles
- Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS

1. Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, Third Edition, 2020.
2. Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRCPress, Third Edition, 2019.

REFERENCES

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained "John Wiley & Sons, Second Edition , 2018.
2. Lino Guzzella, "Vehicle Propulsion System" Springer Publications, Fourth Edition, 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/103/108103009/ - (Introduction to Hybrid and Electric Vehicles)
2. https://nptel.ac.in/courses/108106170 - (Fundamentals of Electric vehicles: Technology & Economics)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	-	3	2	-	-	-	2	1	2
2	3	2	2	1	-	3	2	-	-	-	2	1	2
3	3	2	2	1	-	3	2	-	-	-	2	1	2
4	3	2	2	1	-	3	2	-	-	-	2	1	2
5	3	2	2	1	-	3	2	-	-	-	2	1	2
AVG	3.00	2.00	2.00	1.00	-	3.00	2.00	-	-	-	2.00	1.00	2.00

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

Chairman - BoS

23RMP514	EMBEDDED SYSTEM DESIGN	L T P C 3 0 0 3

OBJECTIVES

- To introduce the fundamental design metrics and the hardware-software co-design process essential for modern embedded product development.
- To familiarize students with Real-Time Operating System (RTOS) architectures, focusing on task management, semaphores, and message queues.
- To focus on the PIC microcontroller architecture, including its instruction set, interrupt logic, and specialized CCP modules.
- To enhance knowledge of embedded networking protocols such as CAN BUS, I2C, and wireless standards like Zigbee and GSM.
- To develop skills in embedded C programming for interfacing keypads, LCDs, and data converters (ADC/DAC).

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Overview of embedded systems, embedded system design process, challenges - common design metrics and optimizing them. Hardware - Software code sign embedded product development.

UNIT II REAL TIME OPERATING SYSTEM 9

Real time operating systems Architecture - Tasks and Task states - Tasks and Data – Semaphone and shared data - Message queues, mail boxes and pipes - Encapsulating semaphores and queues - interrupt routines in an RTOS Environment. Introduction to Vx works, RT Linux.

UNIT III PIC MICROCONTROLLER 9

Architecture - Instruction set - Addressing modes - Timers - Interrupt logic - CCP modules - ADC.

UNIT IV EMBEDDED NETWORKING 9

Introduction - CAN BUS - I2C - GSM - GPRS - Zig bee.

UNIT V EMBEDDED PROGRAMMING 9

I/O Programming ,Interrupts and Timer application ,Interfacing Keypad ,Interfacing LCD ,Interfacing ADC/DAC

TOTAL : 45 PERIODS

OUTCOMES

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

- Explain the need for embedded systems and their development procedures
- Apply the concepts involved in Real time operating systems.
- Analyze the construction, addressing modes and instructions sets of PIC micro controller.
- Analyze the features, advantages, and use cases of the Zigbee protocol for wireless networking in low-power embedded systems.
- Examine I /O programming techniques to manage and control peripheral devices in embedded systems.

TEXT BOOKS

1. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata Mc Graw Hill, Second Edition , 2019.
2. Jonathan W. Valvano, "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" Create Space Independent Publishing Platform, Fifth Edition , 2021.

REFERENCES

1. Steve Heath, 'Embedded System Design', Elsevier, Fourth Edition 2020.
2. Robert Foludi "Building Wireless Sensor Networks", O'Reilly, Second Edition, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/102/108102169/ - (Introduction to Embedded system).
2. https://archive.nptel.ac.in/courses/106/105/106105159/ - (Embedded systems design).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	-	3	2	-	-	-	-	3	2
2	3	2	2	1	-	3	2	-	-	-	-	3	2
3	3	2	2	1	-	3	2	-	-	-	-	3	2
4	3	2	2	1	-	3	2	-	-	-	-	3	2
5	3	2	2	1	-	3	2	-	-	-	-	3	2
AVG	3.00	2.00	2.00	1.00	-	3.00	2.00	-	-	-	-	3.00	2.00

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

Chairman - BoS

23RMP515 AUTOMOTIVE SYSTEM MODELLING AND SIMULATION L T P C
3 0 0 3

OBJECTIVES

- To develop technical expertise in the design and material selection of cylinders, pistons, and connecting rod assemblies.
- To provide a deep understanding of crankshaft design, valve train mechanisms, and 3D engine simulation techniques.
- To focus on torque capacity for clutches and the layout design of multi-speed gearboxes and bearing selection.
- To introduce stress analysis of vehicle frames and the design of leaf, coil, and torsion bar suspension systems.
- To enhance proficiency in designing propeller shafts, final drive gearings, and various rear axle configurations.

UNIT I DESIGN OF CYLINDER, PISTON AND CONNECTING ROD 9

Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on piston for car with Modelling and simulation.

UNIT II DESIGN OF CRANK SHAFT AND VALVES 9

Material for crankshaft, design of crankshaft under bending and twisting. Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam& camshaft. Design of rocker arm. Cam profile generation. 3D Engine simulation: Introduction to thermal and flow analysis in engine cylinder, modeling of cylinder and piston for combustion analysis

UNIT III DESIGN OF CLUTCHES AND GEARS 9

Design of single plate clutch, multiplate clutch and cone clutch assembly. Torque capacity of clutch. Design of clutch components. Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes. Modelling and simulation: braking system

UNIT IV DESIGN OF VEHICLE FRAME AND SUSPENSION 9

Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Case study on development of frame for ATV. Modelling and simulation of suspension system

UNIT V DESIGN OF FRONT AND REAR AXLE 9

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semifloating and three quarter floating rear shafts and rear axle housings. Analysis of loads-moments and stresses at different sections of front axle. Determination of optimum dimensions and proportions for steering linkages, Design of front axle beam.. Modelling and simulation of steering system, transmission system

TOTAL: 45 PERIODS

OUTCOMES

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

- Analyze the stress and strain imparted on automotive components.
- Apply the design and find the dimension of the vehicle components.
- Apply the optimal design solutions to real-world problems in compliance with industry standards.
- Analyze the design skill by creating new design strategy with the application of the knowledge
- Examine the modern system in vehicle and would help in developing the system with less impact to the environment.

TEXT BOOKS

1. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Volume 1, Components Design", Springer International, Second Edition, 2020.
2. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, Twenty fifth Edition, 2022.

REFERENCES

1. Dr. K. Ramamritham ,"Design Data Hand Book", PSG College of Technology, 2019.
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design", Wiley, Eighth Edition, 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/107/112107214/ - (Modeling and simulation of Dynamic systems)
2. https://archive.nptel.ac.in/courses/107/106/107106088/ - (Fundamentals of Automotive systems)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	-	1	-	-	-	-	1	2	2
2	3	2	1	1	-	1	-	-	-	-	1	2	2
3	3	2	1	1	-	1	-	-	-	-	1	2	2
4	3	2	1	1	-	1	-	-	-	-	1	2	2
5	3	2	1	1	-	1	-	-	-	-	1	2	2
AVG	3.00	2.00	1.00	1.00	-	1.00	-	-	-	-	1.00	2.00	2.00

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

Chairman - BoS

23RMP516 **FIELD AND SERVICE ROBOTICS** L T P C
3 0 0 3

OBJECTIVES

- To introduce the history and future trends of service robotics, highlighting the specifications that distinguish them from conventional industrial robots.
- To develop a robot localization challenges, including Monte Carlo methods and probabilistic map representation.
- To provide a path planning strategies, such as cell decomposition and potential field methods for obstacle avoidance.
- To focus on the design and deployment of field robots in extreme environments, ranging from aerial and underwater missions to space exploration.
- To familiarize students with humanoid robotics, specifically legged locomotion, facial expressions, and human-activity recognition using multi-modal sensing.

UNIT I INTRODUCTION 9

History of service robotics – Present status and future trends – Need for service robots - applications- examples and Specifications of service and field Robots. Non conventional Industrial robots.

UNIT II LOCALIZATION 9

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

UNIT III PLANNING AND NAVIGATION 9

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning- Potential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

UNIT IV FIELD ROBOTS 9

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT V HUMANOIDS 9

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

TOTAL : 45 PERIODS

OUTCOMES

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

- Classify service and field robots based on their application-specific requirements and non-conventional industrial configurations.
- Apply probabilistic models and positioning beacon systems to build robust

localization solutions for mobile robots.

- Solve navigation problems by constructing efficient roadmaps and tiered robot architectures for complex environments.
- Analyze collision avoidance mechanisms to examine the operational safety of robots in agriculture, mining, and military sectors.
- Compare wheeled and legged locomotion to analyze the balance, manipulation, and emotional modeling capabilities of humanoid systems.

TEXT BOOKS

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, Fourth Edition 2023.
2. Riadh Siaer, "The future of Humanoid Robots- Research and applications", Intech Publications, 2019.

REFERENCES

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice Hall of India P Ltd., Second Edition, 2019.
2. Alonzo Kelly, Karl Iagnemma, Andrew Howard, "Field and Service Robotics ", Springer, Second Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/107106090 - (Introduction to Robotics)
2. https://archive.nptel.ac.in/courses/112/106/112106298/ (Wheeled mobile Robots)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	-	1	1	-	-	-	1	2	2
2	3	2	1	1	-	1	1	-	-	-	1	2	2
3	3	2	1	1	-	1	1	-	-	-	1	2	2
4	3	2	1	1	-	1	1	-	-	-	1	2	2
5	3	2	1	1	-	1	1	-	-	-	1	2	2
AVG	3.00	2.00	1.00	1.00	-	1.00	1.00	-	-	-	1.00	2.00	2.00

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

Chairman - BoS

23RMP517 **AUTOMATIC CONTROL SYSTEMS** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamental concepts of open and closed-loop control systems and their essential constituent elements.
- To focus on developing mathematical models and transfer functions for mechanical, electrical, thermal, and hydraulic physical systems.
- To impart comprehensive knowledge of time-domain and frequency-domain specifications to evaluate the performance of second-order systems.
- To enhance analytical skills in determining absolute and relative system stability using Routh-Hurwitz, Nyquist, and Root Locus techniques.
- To provide a solid foundation in state-space analysis and the application of MATLAB/Simulink tools for modern control system design.

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 tneory - 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:

- Build mathematical transfer functions for physical systems using block diagram reduction and Mason's gain formula.
- Analyze the time-domain performance and steady-state errors of second-order systems under various control modes.
- Sketch Bode and Polar plots to determine the frequency-domain specifications of minimum and non-minimum phase systems.
- Examine absolute and relative system stability using the Routh-Hurwitz and Nyquist stability criteria.
- Construct root loci and state-space models to evaluate the behavior of linear time-invariant systems.

TEXT BOOKS

1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, Tenth Edition , 2023.
2. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, Sixth Edition, 2020.

REFERENCES

1. Ogata K, "Modern Control Engineering", Pearson Education, Fifth Edition, 2019.
2. Benjamin C. Kuo, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, Tenth Edition, 2023.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/103/108103007 - (Introduction to advanced control systems)
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	PSO1	PSO2
1	2	1	1	1	2	-	-	-	-	-	1	2	2
2	2	1	1	1	2	-	-	-	-	-	1	2	2
3	2	1	1	1	2	-	-	-	-	-	1	2	2
4	2	1	1	1	2	-	-	-	-	-	1	2	2
5	2	1	1	1	2	-	-	-	-	-	1	2	2
AVG	2.00	1.00	1.00	1.00	2.00						1.00	2.00	2.00

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

Chairman - BoS

23RMP518 SMART MOBILITY AND INTELLIGENT VEHICLES **L T P C 3 0 0 3**

OBJECTIVES

- To provide an overview of automotive electronics evolution and the foundational concepts of intelligent vehicles.
- To familiarize with Radar, Lidar, and Camera sensor technologies along with their integration in smart mobility..
- To inculcate the fundamental principles of control system theory, ECU operations, and cyber-physical systems in automobiles.
- To develop a technical understanding of wireless networking, modulation techniques, and IoT applications for vehicle autonomy.
- To focus the applications of V2V/V2I connectivity and the associated moral, legal, and security challenges of driverless cars.

UNIT I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES **9**

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT II SENSOR TECHNOLOGY FOR SMART MOBILITY **9**

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III CONNECTED AUTONOMOUS VEHICLE **9**

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING **9**

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY **9**

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the concept of cyber-physical control systems
- Examine the techniques of remote sensing and the types.
- Analyze the fully autonomous vehicle.
- Apply the basic concepts of wireless communications and wireless data networks
- Analyze the concept of the connected vehicle and its role in automated vehicles

TEXT BOOKS

1. Asim Bhatti "Intelligent Transportation Systems and Connected and Automated Vehicles", Transportation Research Board, Fourth Edition, 2020.
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", Springer, 2019.

REFERENCES

1. Tom Denton, "Automobile Electrical and Electronic systems, Roult edge", Taylor & Francis Group, Fifth Edition, 2019.
2. Azim Eskandarian, Gianluca Masini, and Antonio M.L.M. Giannopoulos, "Handbook of Intelligent Vehicles" Springer International, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/105105204 -(Introduction to Smart Mobility)
2. https://nptel.ac.in/courses/108106170 - (Fundamentals of Electric vehicles: Technology & Economics)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1	-	1	-	-	-	-	1	2	1
2	3	2	1	1	-	1	-	-	-	-	1	2	1
3	3	2	1	1	-	1	-	-	-	-	1	2	1
4	3	2	1	1	-	1	-	-	-	-	1	2	1
5	3	2	1	1	-	1	-	-	-	-	1	2	1
AVG	3.00	2.00	1.00	1.00	-	1.00	-	-	-	-	1.00	2.00	1.00

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

Chairman - BoS

Professional Elective - IV

23RMP601 APPLIED SIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES

- To introduce students to fundamental CT and DT signal and system concepts.
- To develop CT system analysis skills using Fourier and Laplace methods.
- To impart DT signal analysis knowledge using DTFT, DFT/FFT, and Z-transform.
- To foster competence in designing IIR and FIR digital filters using standard techniques.
- To Impart knowledge of DSP architecture, programming, and applications in real-time signal processing.

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS 9

Elementary signals in continuous and discrete time – graphical and mathematical representation – Elementary operations and classification of continuous and discrete time signals – CT systems and DT systems – Properties of CT systems and DT systems Classification of systems

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS 9

The continuous time Fourier series – Fourier Transform properties – Laplace transform and properties – Impulse response – convolution integrals – Fourier and Laplace transforms in Analysis of CT systems – Frequency response of systems characterized by differential Equations

UNIT III ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS 9

Fourier Transform of discrete time signals (DTFT) Properties of DTFT - Discrete Fourier Transform - Fast Fourier Transform (FFT) - Z Transform and Properties – Impulse response - Convolution sum - System analysis from difference equation model - Stability of systems

UNIT IV DESIGN OF DIGITAL FILTERS 9

Review of design techniques for analog low pass filters - Frequency transformation – IIR filters - Properties - Design of IIR digital filters using bilinear transformation - FIR filters - Characteristics of FIR filters with linear phase - Design of FIR filters using Window functions

UNIT V DIGITAL SIGNAL PROCESSORS AND APPLCATIONS 9

Architecture of TMS320C54xx DSP - Addressing Modes - Instructions and Programming - Applications: Signal Compression - Sine wave generators - Noise generators – DTMF Tone Detection - Echo cancellation - Speech enhancement and recognition

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Explain fundamental CT and DT signal and system concepts.
- Analyze CT systems using Fourier and Laplace methods.
- Apply DTFT, DFT/FFT, and Z-transform techniques for DT signal analysis.
- Determine suitable IIR and FIR digital filters using standard techniques.
- Analyze the architecture and functional blocks of the TMS320C54xx DSP for signal processing applications.

TEXT BOOKS

1. Alan V Oppenheim, Alan S Willsky, Hamid Nawab S, "Signals and Systems",Phi Learning, New Delhi, Second Edition, 2015.
2. John G. Proakis Dimitris K Manolakis, "Digital Signal Processing",Pearson Education, New Delhi, Fifth Edition ,2021.

REFERENCES

1. Lonnie C Ludeman, "Fundamentals of Digital Signal Processing", Wiley & Sons, New Delhi, First Edition, 2014.
2. Vinay K Ingle, John G Proakis,"Digital Signal Processing using MATLAB", Cengage Learning, New Delhi, Fourth Edition, 2017.

E-RESOURSES

1. https://archive.nptel.ac.in/courses/108/101/108101174/ (Digital signal processing and its applications)
2. https://onlinecourses.nptel.ac.in/noc22_ee62/preview(Signal Processing Techniques)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	-	-	-	1	-	-	3	3
2	3	3	3	3	3	-	-	-	1	-	-	3	3
3	3	3	3	3	2	-	-	-	1	-	-	3	3
4	3	3	3	3	3	-	-	-	1	-	-	3	3
5	3	2	3	2	3	-	-	-	2	-	-	3	3
AVG	3.00	2.80	3.00	2.80	2.80	-	-	-	1.20	-	-	3.00	3.00

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

Chairman - BoS

23RMP602 MACHINE LEARNING FOR INTELLIGENT SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To inculcate Focus on machine learning concepts, evaluation methods, and AI applications in robotics.
- To enhance skills in clustering, segmentation, and dimensionality reduction for robotic applications.
- To develop knowledge of fuzzy logic and its applications in robotics.
- To impart knowledge of neural networks, neuro-fuzzy systems, and their applications in robotics.
- To foster the ability to analyze RNNs and reinforcement learning for robotic decision-making.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application.

UNIT IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the ML fundamentals and AI applications in robotics.

- Analyze clustering, KNN, and PCA techniques for segmentation and feature selection in robotic applications.
- Apply fuzzy logic principles for robotics, including fuzzy sets, membership functions, and rule-based systems.
- Construct ANN, multi-layer perceptrons, and neuro-fuzzy systems for robotics applications.
- Examine RNNs and reinforcement learning techniques for robotics applications.

TEXT BOOKS

1. Micheal Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", Addison Wesley, England, Third Edition, 2011.
2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Pearson, Delhi ,Third Edition, 2016.

REFERENCES

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", Springer, Second Edition, 2016.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley, Chichester, Sussex, Fourth Edition, 2011.

E-RESOURSES

1. https://archive.nptel.ac.in/courses/106/106/106106139/ (Introduction to machine learning)
2. https://nptel.ac.in/courses/108104049 (Intelligent Systems and Control)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	-	3	-	3	-	-	1	1	-	2	3	3
2	3	-	3	-	3	-	-	1	1	-	2	3	3
3	3	-	3	-	3	-	-	1	1	-	2	3	3
4	3	-	3	-	3	-	-	2	1	-	1	3	3
5	3	-	3	-	2	-	-	1	1	-	2	3	3
AVG	3.00	-	3.00	-	2.80	-	-	1.20	1.00	-	1.80	3.00	3.00

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

Chairman - BoS

23RMP603 SYSTEMS MODELLING AND SIMULATION METHODS L T P C
3 0 0 3

OBJECTIVES

- To introduce system modeling and basics of simulation, including discrete-event concepts.
- To teach modeling approaches using Petri nets, FSA, and model-checking techniques.
- To build understanding of queuing models and their real-time applications.
- To train students in simulation data handling, random number generation, verification, and output analysis.
- To discuss simulation techniques for computer, network, mobile, and manufacturing systems using NS2.

UNIT I INTRODUCTION TO SIMULATION 9

System definition - Types and characteristics - Need for modelling and simulation -Types of Simulation - Introduction to discrete event simulation - Single server – Multi server Exercises – System modelling - Simple Petrinets

UNIT II MODELLING APPROACHES 9

Modelling concurrent systems - Analysis of Petri nets - Finite state Automata and Regular Expressions - Relationship - FSA with silent transitions - Pumping lemma for regular sets – Analysis using DFS and model checking.

UNIT III QUEUING MODELS 9

Characteristics of queuing systems - Notations - Types of Queues - Markovian model – nonMarkovian model - Queuing Networks - Applications of queuing systems.

UNIT IV SIMULATION DATA 9

Methods for generating random numbers - Testing of random numbers - Methods of generating random variants - Problem formulation - input modelling -Verification and Validation - Output1ZX Analysis.

UNIT V SIMULATION OF REAL WORD SYSTEMS 9

NS2 - Simulation of Computer Systems - Simulation of Computer Networks - Simulation of Mobile Networks -Simulation of Manufacturing and Material Handling Systems

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the fundamentals of system modelling and discrete event simulation.
- Apply Petri nets, FSA, and model-checking for modelling systems.
- Analyze queuing models and their practical applications.
- Apply methods for random number generation, input modeling, and simulation output analysis.
- Examine real-world systems such as computer, network, mobile, and manufacturing systems using NS2.

TEXT BOOKS

1. Jerry Banks, "Discrete-event system simulation",Pearson Education, Harlow,Fifth Edition, 2014.
2. John Fitzgerald, Peter Gorm Larsen,"Modeling Systems;Practical Tools and Techniques in software development", Cambridge University Press, Second Edition ,2009.

REFERENCES

1. Hopcroft, John E, Motwani, Rajeev, Ullman, Seffrey D, "Introduction to Automata Theory, Languages, and Computation", Pearson / Dorling Kindersley, New Delhi, Third Edition , 2008.
2. Donald Gross and Carl M. Harris, "Fundamentals of Queuing theory", John Wiley and Sons, New York , Fifth Edition,2018.

E-RESOURSES

1. https://onlinecourses.nptel.ac.in/noc24_me14/preview (Modeling And Simulation Of Dynamic Systems)
2. https://www.youtube.com/watch?v=-gYcZt5iKPA (System modeling and simulation)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	-	-	-	-	-	2	-	1	3	3
2	3	2	2	-	-	-	-	-	2	-	2	3	3
3	3	2	2	-	-	-	-	-	2	-	2	3	3
4	3	2	2	-	-	-	-	-	2	-	2	3	3
5	3	2	2	-	-	-	-	-	2	-	3	3	2
AVG	3.00	2.00	2.00	-	-	-	-	-	2.00	-	2.00	3.00	2.80

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

Chairman - BoS

23RMP604 **OPTIMIZATION TECHNIQUES** L T P C
3 0 0 3

OBJECTIVES

- To formulate and solve linear programming problems using graphical methods in Operations Research.
- To discuss simplex methods and sensitivity analysis for solving linear programming
- problems.
- To develop skills in numerical methods for one- and multi-dimensional optimization.
- To impart knowledge of constrained and unconstrained optimization using KKT and Lagrange methods.
- To formulate solutions using evolutionary and hybrid optimization techniques for complex problems.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis - Computer programming linear methods

UNIT III ONE DIMENSIONAL AND MULTI-DIMENSIONAL 9

Introduction to descent methods – global convergence of decent algorithms – speed convergence – Fibonacci method- steepest descent - newton's method –polynomial approximation method- computer programming in one dimensional and multi-dimensional methods

UNIT IV UNCONSTRAINED OPTIMIZATION FOR CONSTRAINED PROBLEMS 9

Lagrange method-inequality constraints - KKT conditions – quadratic programming geometric programming- separable linear programming -sequential linear programming feasible direction method

UNIT V EVOLUTIONARY AND HYBRID OPTIMIZATION 9

Introduction to Genetic Algorithms (GA) -Fundamentals and Working Principles - Encoding Methods and Fitness Evaluation, Genetic Operators Hybrid and Integrated Evolutionary Techniques , Integration with Neural Networks and Fuzzy Systems , Other Evolutionary Optimization Techniques , Simulated Annealing (SA),Ant Colony Optimization – Particle Swarm Optimization .

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the formulation and graphical solution of linear programming problems in Operations Research.

- Apply simplex, dual simplex, and sensitivity analysis methods to solve linear programming problems.
- Apply one-dimensional and multi-dimensional optimization techniques to solve engineering problems.
- Analyze constrained and unconstrained optimization problems using Lagrange and KKT methods.
- Apply evolutionary and hybrid optimization techniques and integrate them with neural and fuzzy systems.

TEXT BOOKS

1. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India , Second Edition ,2010.
2. J. C. Pant, "Introduction to Optimization: Operations Research", Jain Brothers, Delhi, Seventh Edition ,2008

REFERENCES

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice",Wiley,Fourth Edition 2013.
2. David G.Luenberger, "Linear and Nonlinear Programming", Springer Publications, Seventh Edition, 2008.

E-RESOURSES

1. https://archive.nptel.ac.in/courses/111/105/111105039/ (Optimization Methods: Introduction and Basic Concepts)
2. https://www.youtube.com/watch?v=LL20TZGXp3Q (Introduction to Optimization)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	-	-	-	-	-	-	2	-	3	3
2	3	3	3	-	-	-	-	-	-	1	-	3	3
3	3	3	3	-	-	-	-	-	-	1	-	3	3
4	3	3	3	-	-	-	-	-	-	2	-	3	3
5	3	2	2	-	-	-	-	-	-	-	2	3	2
AVG	3.00	2.80	2.80	-	-	-	-	-	-	1.50	2.00	3.00	2.80

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

Chairman - BoS

23RMP605 MAINTENANCE AND SAFETY ENGINEERING SYSTEMS **L T P C 3 0 0 3**

OBJECTIVES

- To inculcate knowledge of industrial safety and its organizational aspects.
- To develop skills in accident prevention, first aid, and firefighting.
- To enable safety legislation, occupational health, and hazard control.
- To foster competence in maintenance planning and reliability analysis.
- To impart knowledge of maintenance policies, preventive maintenance, and TPM.

UNIT I INTRODUCTION TO INDUSTRIAL SAFETY **9**

History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, Role of management and role of Govt. in Industrial safety.

UNIT II ACCIDENT PREVENTIONS AND PROTECTIVE EQUIPMENTS **9**

Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Firefighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials.

UNIT III SAFETY ACTS **9**

Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act, Industrial hygiene, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety.

UNIT IV PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING **9**

Basic Principles of maintenance planning – Objectives, Sound Maintenance systems – Reliability and machine availability, Equipment Life cycle, Measures for Maintenance Performance: Equipments breakdowns, Mean Time Between Failures and Repair, Factors of availability, Maintenance organization and economics.

UNIT V MAINTENANCE POLICIES AND PREVENTIVE MAINTENANCE **9**

Maintenance categories –Merits of each category – Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply key aspects of industrial safety, safety committees, and the responsibilities of management and government.
- Apply accident prevention techniques, personal protective equipment, and safety measures in workplaces.
- Analyze safety acts, occupational health, ergonomics, and methods for controlling industrial hazards.

- Examine maintenance planning principles and reliability measures to enhance equipment performance.
- Apply preventive maintenance, lubrication practices, fault tree analysis, and total productive maintenance.

TEXT BOOKS

1. Laird Wilson and Doug McCutcheon, "Industrial Safety and Maintenance", CRC Press, First Edition, 2003.
2. Keith Mobley, "Maintenance Engineering Handbook", McGraw-Hill, Eighth Edition, 2017.

REFERENCES

1. C. Ray Asfahl, David W. Rieske, "Industrial Safety and Health Management", Pearson, Seventh Edition, 2010.
2. Seiichi Nakajima, "Total Productive Maintenance",Productivity Press, Fourth Edition, 2018.

E-RESOURSES

1. https://onlinecourses.nptel.ac.in/noc20_mg43/preview (Industrial Safety Engineering)
2. https://www.youtube.com/watch?v=LL20TZGXp3Q (Introduction to Optimization)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	3	-	-	1	-	-	2	1	3	3
2	3	3	3	3	-	-	2	-	-	2	2	3	3
3	3	2	3	3	-	-	2	-	-	-	2	3	3
4	3	2	3	3	-	-	1	-	-	2	2	3	3
5	3	2	3	2	-	-	-	-	-	2	2	3	3
AVG	3.00	2.20	3.00	2.80	-	-	1.50	-	-	2.00	1.80	3.00	3.00

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

Chairman - BoS

23RMP606 **MICRO ELECTRO MECHANICAL SYSTEMS** L T P C
3 0 0 3

OBJECTIVES

- To apply the basic concepts of MEMS, microfabrication processes, sensors, actuators, and MEMS materials.
- To impart knowledge of sensor characteristics, types, materials, and their applications in measuring pressure, flow, and tactile parameters.
- To apply the principles and applications of MEMS actuators, including electrostatic, thermal, magnetic, and shape memory alloy actuators
- To foster understanding of micromachining techniques and 3D MEMS assembly.
- To enhance awareness of MEMS applications in various domains and integration with AI and IoT.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators –Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices –Polymers in MEMS– Polyamide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon.

UNIT II SENSORS 9

Characteristics of sensors - Electrostatic sensors – Parallel plate capacitors – Piezoresistive sensors – Piezoresistive sensor materials - Stress and strain analysis – Flexural beam bending - Torsional deflection–Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials

UNIT III ACTUATORS 9

Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications –Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators -Actuation using Shape Memory Alloys

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching– Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antirestriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process

UNIT V APPLICATIONS OF MEMS 9

Applications of MEMS sensors, optical MEMS –Lenses and Mirrors -Actuators for Active Optical MEMS.– RF MEMS and Micro fluidics, MEMS in Consumer Electronics Integration with AI and IoT

TOTAL: 45 PERIODS

OUTCOMES

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

- Identify intrinsic characteristics, materials, sensors, actuators, and fabrication processes used in MEMS technology..
- Examine MEMS sensor characteristics, including stress-strain behavior and piezoelectric effects.
- Apply MEMS actuators such as comb drives, micro grippers, micro-motors, and thermal/magnetic actuators in practical systems.
- Analyze micromachining techniques and 3D MEMS fabrication processes for MEMS devices.
- Apply MEMS concepts to analyze applications in optical systems, RF devices, microfluidics, consumer electronics, and AI/IoT integration.

TEXT BOOKS

1. Chang Liu,"Foundations of MEMS", Pearson Education Inc., Pearson Education Inc., Second Edition, 2014.
2. Tai Ran Hsu, " MEMS & Micro systems Design and Manufacture" ,Tata McGraw Hill, New Delhi, First Edition , 2008.

REFERENCES

1. James J.Allen, " Micro Electro Mechanical System Design",CRC Press Publisher, First Edition ,2010.
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, First Edition, 2002.

E-RESOURSES

1. https://nptel.ac.in/courses/117105082(MEMS and Microsystems)
2. https://archive.nptel.ac.in/courses/112/108/112108092/ (Micro and smart systems)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	3	-	2	-	-	-	-	2	-	3
2	3	3	1	3	-	1	-	-	-	-	1	-	3
3	3	3	1	3	-	1	-	-	-	-	1	-	3
4	3	3	1	2	-	1	-	-	-	-	1	-	3
5	3	2	2	3	-	2	-	-	-	-	2	-	2
AVG	3.00	2.80	1.40	2.80	-	1.40	-	-	-	-	1.40	-	2.80

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

Chairman - BoS

Professional Elective – V

23RMP607	ROBOT PROGRAMMING AND SIMULATION	L T P C 3 0 0 3

OBJECTIVES

- To introduce robot programming fundamentals including teach pendant operation, coordinate systems, jogging, interpolation, operating modes, and safety features.
- To impart knowledge of robot programming languages and their applications in work cell design and robot operations.
- To nurture skills in RAPID programming, task-level control, path planning, and safe robot operation.
- To introduce robot simulation, including motion analysis, path planning, optimization, and simulation using ROS and V-REP.
- To introduce industrial robot simulation, including hands-on modeling, digital twins, and use of simulation tools like Robot Studio, Gazebo.

UNIT I ROBOT PROGRAMMING-INTRODUCTION 9

Flex pendent- Bendix Wrist Mechanism-Coordinate system of Robot-Jogging-Types, Interpolation-Interlock commands, Types and applications, case studies- Operating mode of robot- Off-line programming, Singularity error, Motion supervision

UNIT II ROBOT PROGRAMMING LANGUAGES 9

Robot programming Languages-Classifications, Structures, elements and functions- VAL-II programming with welding applications-Robot work cell design-Robot Interference with case studies- Robot cycle time analysis- Move master command language with applications.

UNIT III RAPID PROGRAMMING 9

Motion Instructions- Safety for robot cell -Task level programming-Evolution of Robot programming methods, Level of control-Path definition-Virtual Robot controller function-Subroutine, interruptsApplications of Rapid programming.

UNIT IV ROBOT SIMULATION 9

Introduction to Robot Simulation: Importance and advantages-Types of Simulation Motion-Velocity and acceleration motion analysis for robots- Robot path planning Optimization, Simulation Environments: ROS (Robot Operating System), Advanced ROS concepts and applications- Introduction to V-REP programming simulation.

UNIT V SIMULATION FOR INDUSTRIAL ROBOTS 9

Overview of simulation in different robotic field- Hands-on Simulation: Building and simulating robot painting models-Digital Twin Technology- Robot Studio® Suite 2022 for Virtual Robotics- Simulation tools Introduction-Gazebo, Robot DK, OCTOBUZ and Delfoi, Operating Procedures and Applications.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the functions of teach pendants and Bendix wrist mechanisms.

- Classify the various robot programming languages, their classifications, structures, elements, and functions.
- Apply task-level programming and path definition in robot operations.
- Analyze robot motion, path planning, and optimization using simulation tools like ROS and V-REP.
- Apply simulation tools and digital twin technology to model, plan, and optimize industrial robot operations.

TEXTBOOKS

1. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", John Wiley & Sons / Wiley & Sons Ltd, Second Edition ,2020.
2. S. R. Deb and Sankha Deb, "Robotics Technology and Flexible Automation" McGraw Hill Education, Second Edition,2017.

REFERENCES

1. Quigley .M, Gerkey .B & William .D, "Programming Robots with ROS: A Practical Introduction to the Robot Operating System", O'Reilly Media, Inc., First Edition, 2015.
2. Mikell P. Groover, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill Co, Third Edition,2014.

E – RESOURCES

1. https://nptel.ac.in/courses/112107289 (Robot and Control)
2. https://rsl.ethz.ch/education-students/lectures/ros.html (Programming for robotics)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	-	3	3	2	2	-	-	1	1	3	3
2	3	3	-	3	3	2	-	-	-	-	1	3	3
3	3	3	-	3	3	2	-	-	-	-	1	3	3
4	3	3	-	3	3	2	-	-	-	-	1	3	3
5	3	3	-	2	2	2	-	-	-	-	1	3	2
AVG	3.00	3.00	-	2.80	2.80	2.00	2.00	-	-	1.00	1.00	3.00	2.80

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

Chairman - BoS

23RMP608 **VIRTUAL INSTRUMENTATION** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamentals and history of Virtual Instrumentation (VI).
- To familiarize with creating and using subVIs for modular programming.
- To impart knowledge on acquiring and controlling analog and digital signals using DAQ systems in VI.
- To familiarize with instrument interfaces, communication standards, data acquisition devices, and motion control systems
- To enhance the ability to design virtual instrumentation applications for biomedical signal analysis and visualization.

UNIT I INTRODUCTION 9

History of Virtual Instrumentation (VI), advantages, block diagram and architecture of a virtual instrument, Programming paradigms – Virtual Instrumentation – Lab VIEW software Lab VIEW basics – Lab VIEW environment

UNIT II VI USING LABVIEW 9

Creating, Editing and debugging a VI in Lab VIEW – Creating a sub VI – Loops and charts Case and sequence structures – File I/O – VI customization.

UNIT III DATA ACQUISITION AND CONTROL IN VI 9

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems

UNIT IV INSTRUMENT INTERFACES 9

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V APPLICATION OF VI IN BIOMEDICAL ENGINEERING 9

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality & 3D graphical modeling, Virtual Prototyping.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply virtual instrumentation concepts and LabVIEW tools to develop basic virtual instruments.
- Construct functional VIs using loops, charts, case, and sequence structures.
- Apply LabVIEW techniques for data acquisition and control using DAQ boards.
- Apply VISA and IVI standards in implementing image processing and motion control applications.
- Analyze requirements and design considerations for virtual biomedical measurement and monitoring systems

TEXTBOOKS

1. Jerome, Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, Fourth Edition, 2019.
2. Sanjay Gupta and Joseph John, "Virtual Instrumentation using Lab VIEW", Tata McGraw – Hill Publishing Company Limited, New Delhi, Second Edition, 2019.

REFERENCES

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newness, First Edition, 2020.
2. S. Gupta, J.P. Gupta, "PC Interfacing for Data Acquisition and Process Control", ISA, Second Edition, 2019.

E – RESOURCES

1. https://archive.nptel.ac.in/courses/108/105/108105101/(Scanning multiple analog channels)
2. https://archive.nptel.ac.in/courses/108/105/108105101/(Organization of the DAQ VI System)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	-	-	3	-	1	-	1	-	1	1	3
2	3	3	-	-	3	-	1	-	1	-	1	1	3
3	3	3	-	-	3	-	-	-	1	-	-	1	3
4	3	3	-	-	3	-	-	-	1	-	-	1	3
5	3	3	-	-	2	-	1	-	1	-	2	1	2
AVG	3.00	3.00	-	-	2.80	-	1.00	-	1.00	-	1.33	1.00	2.80

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

Chairman - BoS

23RMP609 **FARM AUTOMATION** L T P C
3 0 0 3

OBJECTIVES

- To impart basics of electronics and microprocessors for farm automation.
- To enhance understanding of precision farming techniques using sensors, remote sensing, GPS, GIS, and crop production modeling.
- To familiarize hitching, traction, and tractor testing for efficient machinery operation.
- To inculcate basic knowledge of using sensors with Arduino UNO and Raspberry Pi for simple IoT-based automation applications.
- To foster smart farming methods including irrigation, greenhouses, and drones.

UNIT I INTRODUCTION 9

Fundamental of electronics Passive devices -semiconductor devices – transistors – diode circuits -amplifier circuits. Integrated circuits and operational amplifier – logic gates – flip flop – counters digital to analog – analog to digital converters- microprocessor.

UNIT II PRECISION FARMING 9

Precision farming -Ground based sensors- Remote sensing- GPS, GIS and mapping software-Yield mapping systems-Crop production modelling.

UNIT III TRACTION AND TESTING 9

Hitching- Principles of hitching, Types of hitches, Hitching and weight transfer, Control of hitches, Tires and Traction models, Traction predictor spread sheet, Soil Compaction, Traction Aids, Tractor Testing

UNIT IV INSTRUMENT INTERFACES 9

Automation Using IoT Use of different sensors – Temperature and humidity sensor – Soil Moisture Sensor – Water Level Depth Detector, Raspberry Pi Arduino UNO

UNIT V AUTOMATION OF AGRICULTURE OPERATION 9

Automation of agricultural operations using IoT based systems – Smart Irrigation System Automation in Greenhouse – Drones. Case Study- Automation of greenhouse / farm operations.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain fundamental electronic components and circuits used in farm automation.
- Apply precision farming concepts, GPS, GIS, and remote sensing techniques in agricultural applications.
- Analyze tractor performance, weight transfer, and tire traction using models and spreadsheets.
- Classify various sensors (temperature, humidity, soil moisture, water level) and their applications in agriculture.
- Develop the ability to implement IoT-based automation in agriculture, including smart irrigation, greenhouse, and drone systems.

TEXTBOOKS

1. Nagrath, I.J. and Kothari, D.P., "Electronics: Analog and Digital", PHI Learning, Second Edition, 2024
2. Ajit K. Srivastava, "Engineering Principles of Agricultural Machines", Amer Society of Agricultural , Second Edition ,2015.

REFERENCES

1. Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices", CRCPress, First Edition, 2019.
2. Rajesh Singh, Anita Gehlot, "Internet of Things (IoT) Enabled Automation in Agriculture", CRC Press (Taylor & Francis), First Edition, 2023.

E – RESOURCES

1. https://onlinecourses.nptel.ac.in/noc26_ag02/preview (Precision Agriculture)
2. https://onlinecourses.nptel.ac.in/noc23_ee95/preview (Sensor Technologies: Physics, Fabrication, and Circuits)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	-	-	1	1	-	1	-	1	1	3
2	3	3	3	-	-	2	2	-	1	-	1	2	3
3	3	3	3	-	-	1	1	-	1	-	-	1	3
4	3	3	2	-	-	2	2	-	1	-	-	2	3
5	3	3	3	-	-	2	1	-	1	-	2	2	3
AVG	3.00	3.00	2.80	-	-	1.60	1.40	-	1.00	-	1.33	1.60	3.00

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

Chairman - BoS

23RMP610 **MOTION CONTROL SYSTEM** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamentals of motion control systems, including components and applications.
- To impart knowledge on motion controllers, their features, I/O standards, and drive integration.
- To enable students to understand the operation and application of motion control drives in automation systems.
- To Inculcate understanding of intelligent motors and drives, their control loops, programming, and applications in robots and portable systems.
- To develop the ability to program and implement control strategies for CNC machines and robot.

UNIT I INTRODUCTION 9

Introduction to Motion Control System - Dynamic System Modeling - Control System Design Fundamentals – Parameters in Control – Actuators and Measurement in Motion Control Systems -Multi-Body Dynamics – Need for Motion Controller – Specification of Motion Control

UNIT II ARCHITECTURE OF MOTION CONTROL SYSTEM 9

Introduction to Motion Controller – Programmable Automation Controllers – Features & Specification of Motion Controllers – Digital I/O – Analog I/O – Standards in I/O – I/O Specific to Sensors – Modular and Expansion Concepts - Drives

UNIT III MOTION CONTROL DRIVES 9

Programmable Automation Controllers – Features & Specification of Motion Controllers – Digital I/O – Analog I/O – Standards in I/O – I/O Specific to Sensors – Modular and Expansion Concepts – Drives

UNIT IV INTELLIGENT MOTORS WITH INTEGRATED DRIVE 9

Intelligent motors – intelligent drives – features of drives – programmable I/Os-communication protocols – features – Software - Programming – current, position and speed loops – Application in robots and portable system

UNIT V PROGRAMMING OF MOTION CONTROLLER 9

IEC 61131 standards and Its Programming Languages overview- CoDeSys Platform - status Diagram – PLC Open - Motion Planer - PID - Servo Tuning – Position- velocity, Acceleration and Torque Profiling – CAM Profiling – Multi- Axis Motion Controllers – CNC Machines – Robot case study

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the fundamentals of motion control systems, dynamic modeling, control parameters, actuators, and motion controller specifications.
- Analyze the features and specifications of programmable automation controllers (PACs) and their integration with digital and analog I/Os.
- Apply knowledge of motion controllers and drives to configure, troubleshoot, and

optimize motion control systems.

- Analyze and implement intelligent motor and drive systems for automation applications.
- Examine servo tuning and motion controller performance to optimize efficiency and accuracy in automated systems.

TEXTBOOKS

1. M. Nakamura .S. Gata& N. Kyura, "Mechatronic Servo System Control", Springer, First Edition, 2019.
2. Sabanovic Asif, "Motion Control Systems", John Wiley & Sons Inc, Second Edition, 2020

REFERENCES

1. Rashid G. O., "Industrial Motion Control: Fundamentals and Practice", CRC Press, First Edition, 2016.
2. Benjamin W. Williams, "Programmable Logic Controllers and Motion Control", Pearson, Third Edition, 2020.

E – RESOURCES

1. https://archive.nptel.ac.in/courses/126/105/1050201104/ (Electric drives and controller)
2. https://archive.nptel.ac.in/courses/126/105/1050201103/ (Programming of motion controller)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	1	1	1	-	-	-	1	-	-	3	3
2	3	3	-	1	-	-	-	-	1	-	-	3	3
3	3	3	2	-	-	-	-	-	1	1	-	3	3
4	3	3	-	-	-	-	-	-	1	2	2	3	3
5	3	3	-	-	-	-	-	-	1	2	2	3	2
AVG	3.00	3.00	1.50	1.00	1.00	--	-	-	1.00	1.67	2.00	3.00	3.00

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

Chairman - BoS

23RMP611 **MATERIALS FOR ROBOTICS** L T P C
3 0 0 3

OBJECTIVES

- To apply the basic concepts of composite materials, fibers, matrices, and lamina constitutive equations.
- To familiarize with stress-strain relations, laminate constitutive equations, and types of laminated composites.
- To apply the properties, transformations, mechanisms, and applications of Shape Memory Alloys (SMA) in engineering systems.
- To focus on smart materials used in robotics and their fabrication techniques, including SMAs, piezoelectric materials, MEMS, and additive manufacturing.
- To foster awareness of the role of composites and smart materials in robotics for mobility, manipulation, and sensing applications.

UNIT I INTRODUCTION 9

Definition - Need-General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices -Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions -Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case.

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants- Strain Displacement relations-Basic Assumptions of Laminated anisotropic plates- Laminate Constitutive Equations – Coupling Interactions- Balanced Laminates-Symmetric Laminates-Angle Ply Laminates- Cross Ply Laminates. Laminate Structural Moduli.-Evaluation of Lamina Properties from Laminate Tests.

UNIT III SHAPE MEMORY MATERIALS 9

Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – martensitic transformations – austenitic transformations – thermo elastic martensitic transformations– classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA – SMA memorization process (Satellite Antenna Applications)

UNIT IV SMART MATERIAL MANUFACTURING PROCESS 9

Definition and Types of Smart Materials Used in Robotics: Shape Memory Alloys (SMAs) ,Piezoelectric Materials ,Role of Smart Materials in Robotic Systems ,Fabrication of Piezoelectric Ceramics: Sol-gel, Sintering, Tape Casting, MEMS-based smart material fabrication, Additive Manufacturing for smart material composites.

UNIT V APPLICATIONS OF MATERIALS FOR ROBOTICS 9

Introduction to Material Selection in Robotics, Structural and Functional Materials in Robotics Composites: Carbon fiber, Glass fiber – for high strength-to-weight structures Shape Memory Alloys (SMA) – self-actuating grippers, robotic arms, Role of materials in mobility, manipulation, and sensing

TOTAL: 45 PERIODS

OUTCOMES

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

- Analyze the properties of fibers and matrices, and analyze lamina constitutive equations for composite materials..
- Apply stress-strain relations and laminate constitutive equations to evaluate different types of laminated composites.
- Analyze the properties, transformations, mechanisms, and applications of Shape Memory Alloys in engineering systems.
- Analyze fabrication techniques for piezoelectric ceramics including sol-gel, sintering, and tape casting processes.
- Examine the application of Shape Memory Alloys in self-actuating grippers and robotic arms.

TEXT BOOKS

1. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, CRC press in progress, Second Edition, 2020.
2. M. V. Gandhi and B. S. Thompson, "Smart Materials and Structures", Chapman and Hall, London, First Edition, 2021.

REFERENCES

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, Second Edition, 2019.
2. Rogers, C. A., Smart Materials, "Structures and Mathematical issues", Technomic Publishing Co., U.S.A, First Edition, 2020.

E – RESOURCES

1. https://archive.nptel.ac.in/courses/112105153/ (Flat plate laminates)
2. https://archive.nptel.ac.in/courses/102/101/102101086/ (Applications in blood vessels)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	-	3	3	1	-	-	1	-	1	3	3
2	3	2	-	3	3	-	-	-	1	-	-	3	3
3	3	2	-	3	3	-	-	-	1	-	-	3	3
4	3	2	-	3	3	-	-	-	1	-	-	2	3
5	3	3	-	2	2	2	-	-	1	-	-	3	2
AVG	3.00	2.20	-	2.80	2.80	1.50	-	-	1.00	-	1.50	2.80	2.80

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

Chairman - BoS

23RMP612 **DIGITAL TWIN AND INDUSTRY5.0** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamentals, evolution, and industrial applications of Digital Twin technology and its enabling systems.
- To familiarize learners with Digital Twin use in discrete industries, focusing on product twins, digital threads, and automation.
- To enhance skills in automation simulation within digital enterprises.
- To apply Industry 5.0 concepts, smart manufacturing, IoT, industrial gateways, communication, and cognitive systems in industrial applications
- To impart knowledge of digital twin applications for quality and efficiency improvement.

UNIT I INTRODUCTION TO DIGITAL TWIN 9

Digital twin – Definition- types of Industry and its key requirements- Importance-Application of Digital Twin in process-product, service industries-History of Digital Twin- DTT role in industry innovation-Technologies / tools enabling Digital Twin – Virtual CAD Models – control Parameters- Real time systems – control Parameters – Handshaking Through Internet – cyber physical systems

UNIT II DIGITAL TWIN IN A DISCRETE INDUSTRY 9

Overview of discrete industry and its trends - Control system requirements in discrete industries- Digital Twin of a product- Digital Thread in discrete industry - Data collection and analysis for product and production improvements - Automation simulation and digital enterprise.

UNIT III DIGITAL TWIN IN A PROCESS INDUSTRY 9

Basics of Process Industry- Trends in the process industry- control system requirements in a process industry- Digital Twin of a plant- Digital Thread in process Industry- Data collection and analysis for process improvements- process safety- Automation simulation- Digital Enterprise.

UNIT IV INDUSTRY 5.0 9

Industrial Revolutions- Industry 5.0 – Definition, principles-Application of Industry 5.0 in process and discrete industries-Benefits of Industry 5.0- challenges in Industry 5.0- Smart manufacturing- Internet of Things 5.0, Industrial Gateways-Basics of Communication requirements – cognitive systems 5.0.

UNIT V ADVANTAGES OF DIGITAL TWIN 9

Enhancement of product quality, production process-process Safety-identify bottlenecks and improve efficiency- achieve flexibility in production- continuous prediction and tuning of production process through Simulation-reducing the time to market.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the concept, types, and applications of Digital Twin, along with its

enabling technologies and its role in industrial innovation.

- Analyze the digital twin of a product and digital thread in discrete industries for data collection, production improvement, and automation simulation.
- Apply the role of Digital Twin and Digital Thread in process industries for process improvement, safety, and automation simulation.
- Apply Industry 5.0 principles, IoT 5.0, and cognitive systems to smart manufacturing in process and discrete industries.
- Examine the impact of Digital Twin on product quality, process safety, production efficiency, flexibility, and time-to-market.

TEXTBOOKS

1. Uthayan Elangovan, Industry 5.0: "The Future of the Industrial Economy", CRC Press, First Edition, 2022.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A Press. First Edition,2020.

REFERENCES

1. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies", Springer, First Edition ,2019.
2. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0", Springer, Second Edition, 2019.

E – RESOURCES

1. https://archive.nptel.ac.in/courses/110/106/110106146/ (The future of manufacturing business, role of digital technologies)
2. https://archive.nptel.ac.in/courses/110/106/110106146/ (Manufacturing and IOT.)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	1	-	2	-	-	1	-	-	3	3
2	3	3	3	1	-	-	-	-	2	-	-	3	3
3	3	3	3	1	-	-	-	-	2	1	-	3	3
4	3	3	3	1	2	-	-	-	1	2	2	3	2
5	3	2	3	1	2	1	-	-	1	2	2	2	3
AVG	3.00	2.80	3.00	1.00	2.00	1.50	-	-	1.40	1.67	2.00	2.80	2.80

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

Chairman - BoS

Professional Elective – VI

23RMP613 **ROBOTIC VISION AND INTELLIGENCE** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce robot vision and image acquisition, covering sensors, illumination, and image representation techniques.
- To impart knowledge on the fundamentals of digital image processing, covering enhancement, segmentation, feature extraction, and object recognition.
- To foster skills in object recognition and feature extraction, including segmentation, boundary and region descriptors, and recognition methods.
- To enhance understanding of collision fronts algorithms, including object skeletons, gradients, propagation, and thinning techniques.
- To apply image processing and robot vision techniques for navigation, depalletizing, line tracking, and automatic part recognition.

UNIT I IMAGE ACQUISITION **9**

The Nature of Vision- Robot vision – Need, Applications – image acquisition – Physics of Light – Interactions of light – Refraction at a spherical surface – Thin Lens Equation – Illumination techniques – linear scan sensor, planar sensor, camera transfer characteristic, Raster scan, Image capture time, volume sensors, Image representation, picture coding techniques.

UNIT II IMAGE PROCESSING FUNDAMENTALS **9**

Introduction to Digital Image Processing – Image sampling and quantization – Image enhancement: Gray Value Transformations, Radiometric Calibration, Image Smoothing – Geometric transformation – Image segmentation – Object Recognition and Image Understanding – Feature extraction: Region Features, Gray Value Features, Contour Features – Morphology – Edge extraction – Fitting and Template matching.

UNIT III OBJECT RECOGNITION AND FEATURE EXTRACTION **9**

Image segmentation – Edge Linking – Boundary detection – Region growing-Region splitting and merging – Boundary Descriptors – Freeman chain code – Regional Descriptors – recognition structural methods – Recognition procedure, mahalanobic procedure.

UNIT IV COLLISON FRONTS ALGORITHM **9**

Introduction, skeleton of objects.- Gradients, propagation, Definitions, propagation algorithm, Thinning Algorithm, Skeleton lengths of Top most objects.

UNIT V ROBOT VISION APPLICATION **9**

Case study-Automated Navigation guidance by vision system – vision based de palletizing – line tracking – Automatic part Recognition. Image processing techniques implementation through Image Processing software.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the principles of robot vision, image acquisition, and representation techniques.
- Apply image processing techniques for enhancement, segmentation, feature

extraction, and object recognition.

- Examine image segmentation and feature extraction methods for object recognition.
- Compute and analyze skeleton lengths of topmost objects for shape measurement.
- Apply robot vision and image processing techniques for automated navigation, part recognition, and line tracking.

TEXTBOOKS

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, 2021.
2. Emanuele Trucco, Alessandro Verri, "Introductory Techniques for 3D Computer Vision", First Edition, 2020.

REFERENCES

1. Yi Ma, Jana Kosecka, Shankar Sastry, "An Invitation to 3-D Vision From mages to Models", Springer New York, First Edition, 2019.
2. Fu .K.S, Lee . C.S.G, "Robotics Control Sensing, Vision and Intelligence", Tata McGraw-Hill Education, First Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/112105249 (Robotics)
2. https://archive.nptel.ac.in/courses/112/105/112105249/ (Introduction to Robots and Robotics.)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1	1	-	-	1	1	-	-	-	3	2	3
2	3	1	1	-	-	1	1	-	-	-	3	2	3
3	3	1	1	-	-	1	1	-	-	-	3	2	3
4	3	1	1	-	-	1	1	-	-	-	3	2	3
5	3	1	1	-	-	1	1	-	-	-	3	2	3
AVG	3.00	1.00	1.00	-	-	1.00	1.00	-	-	-	3.00	2.00	3.00

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

Chairman - BoS

23RMP614 **WIRELESS SENSOR NETWORKS FOR ROBOTICS** L T P C

3 0 0 3

OBJECTIVES

- To introduce the overview, challenges, and enabling technologies of Wireless Sensor Networks.
- To impart knowledge of sensor node and network architectures, and gateway concepts.
- To foster understanding of sensor networking, including transceiver design, MAC protocols, addressing, and energy-efficient routing.
- To enhance knowledge of WSN infrastructure, covering topology control, clustering, synchronization, localization, and sensor tasking.
- To introduce sensor node hardware, software platforms, simulators, programming challenges, and state-centric programming techniques..

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT III NETWORKING SENSORS 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT 9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the challenges, and enabling technologies of wireless sensor networks.
- Apply sensor node architectures, operating environments, and network structures in wireless sensor network applications.
- Construct energy-efficient routing strategies, MAC protocols, and addressing schemes for wireless sensor networks.
- Apply topology control, clustering, time synchronization, localization, and sensor tasking in wireless sensor networks.

- Analyze sensor node hardware, software platforms, and simulation tools for designing and implementing wireless sensor networks.

TEXTBOOKS

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons. Second Edition, 2007.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, Second Edition 2007

REFERENCES

1. Kazem Sohraby, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, First Edition, 2019.
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, First Edition, 2021.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/106/105/106105160/ (Wireless Ad Hoc and Sensor Networks)
2. https://www.youtube.com/watch?v=5ZFfqhdf0QI (Wireless Sensor Networks and Its Applications

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2		1	-	1	-	-	-		3	1	3
2	3	2	-	1	-	1	-	-	-	-	3	1	3
3	3	2	-	1	-	1	-	-	-	-	3	1	3
4	3	2	-	1	-	1	-	-	-	-	3	1	3
5	3	2	-	1	-	1	-	-	-	-	3	1	3
AVG	3.00	2.00	-	1.00	-	1.00	-	-	-	-	3.00	1.00	3.00

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

Chairman - BoS

23RMP615 **INTEGRATED PRODUCT DEVELOPMENT** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamentals of product development, including trends analysis, product life cycle, and development methodologies.
- To impart knowledge on requirement engineering, system design, modeling, and subsystem/interface specifications.
- To enhance skills in design, prototyping, testing, and system integration.
- To familiarize with product verification, validation, maintenance, and end-of-life management processes.
- To focus engineering services industry processes, product development strategies, and intellectual property considerations.

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends-Economic Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and services - Types of Product Development - Overview of Product Development methodologies- Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - System Design & Modeling -Introduction to System Modeling - System Optimization - System Specification - Sub-System design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines – Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EOL – Obsolescence Management – Configuration Management - EOL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain global trends, product types, and product development methodologies for effective planning and management.
- Construct system models and design specifications by analyzing requirements, subsystem components, and interfaces..
- Apply concept evaluation, component design, and prototype testing for developing integrated product systems.
- Construct strategies for maintenance, validation, and end-of-life management of products.
- Classify product development processes, system integration methods, and IP management practices in the engineering services industry.

TEXTBOOKS

1. Karl T. Ulrich, Steven D. Eppinger, Maria C. Yang, "Product Design and Development", McGraw-Hill Education, Eighth Edition, 2022.
2. Giando menico Spezzano, "Swarm Robotics", MDPI – Multidisciplinary Digital Publishing Institute, First Edition, 2019.

REFERENCES

1. Phillip A. Laplante & Mohamad Kassab, "Requirements Engineering for Software and Systems", Routledge / Taylor & Francis, Fourth Edition, 2022.
2. John Stark, "Product Lifecycle Management (PLM): 21st Century Paradigm for Product Realisation", Springer Cham, Fifth Edition 2022.

E-RESOURCES

1. https://nptel.ac.in/courses/112107217 (Product Design and Development)
2. https://onlinecourses.nptel.ac.in/noc26_me49/preview (Product Design and Manufacturing)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1	2	–	–	–	–	–	1	3	–	3	3
2	3	2	2	–	–	–	–	–	2	3	–	3	3
3	3	2	2	–	–	–	–	–	2	3	–	3	3
4	3	2	2	–	–	–	–	–	2	3	–	3	2
5	3	2	2	–	–	–	–	–	2	2	2	2	3
AVG	3.00	1.80	2.00	–	–	–	–	–	1.80	2.80	2.00	2.80	2.80

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

Chairman - BoS

23RMP616 **NAVIGATION AND COMMUNICATION SYSTEM** L T P C
3 0 0 3

OBJECTIVES

- To introduce the principles, components, and algorithms of inertial navigation systems and error compensation techniques.
- To impart knowledge of radio and satellite navigation systems, GPS principles, and their integration with INS for precise navigation.
- To familiarize with radio transmitter and receiver operations, components, and modulation techniques.
- To familiarize with aircraft communication systems (VHF, HF, satellite).
- To impart knowledge of weather radar systems and DME, including types, components, operation, and safety aspects.

UNIT I INERTIAL NAVIGATION SYSTEMS 9

Introduction to navigation – Types -INS components- transfer function and errors - Earth in inertial space - Coriolis Effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning – compensation errors - Gimbal lock - Initial calibration and Alignment Algorithms

UNIT II RADIO NAVIATION & SATELLITE NAVIGATION 9

Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations - LORAN, DECCA and Omega – TACAN. Introduction to GPS -system description -basic principles -position and velocity determination signal Structure -DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

UNIT III RADIO TRANSMITTERS AND RECEIVERS 9

Functions of a Radio transmitter, Microphones, types, Block diagram explanation of a Radio transmitter, Modulation and its types and Antenna, Antenna couplers, Qualities of a good Radio receiver, Block diagram of a simple radio receiver and super heterodyne receiver.

UNIT IV AIRCRAFT COMMUNICATION SYSTEMS 9

Basics of aircraft communication system, types Very High Frequency Communication system, Description, Principle, Operation of VHF Communication system and its layout on aircraft, High Frequency communication system, Description, Principle and operation of High Frequency communication system and its layout on aircraft. Satellite communication system, Description, Operation and its layout on aircraft.

UNIT V WEATHER RADAR SYSTEM AND DME 9

Introduction, Description and types of Radar, Primary and Secondary Radar, Weather Radar Description, Analog radar Principal units of Analog radar system. Aircraft weather radar, transmitter-receiver, Indicator, Control panel, Antenna, Radome and wave guide. Radome maintenance and radar safety.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the fundamentals, types, and components of inertial navigation systems.
- Apply radio and satellite navigation, GPS, and INS integration for accurate positioning.
- Analyze the functions, block diagrams, and components of radio transmitters and receivers.
- Examine the principles, operation, and layouts of VHF, HF, and satellite communication systems in aircraft.
- Analyze the types, components, and operational principles of weather radar systems, DME, and their layouts in aircraft.

TEXT BOOKS

1. James Powell, "Aircraft Radio system", Sterling book house, Mumbai, Second Edition, 2006.
2. Mike Tooley and David Wyatt, Reed Elsevier, "Aircraft Communications and Navigation systems", India, Noida, Second Edition, 2017.

REFERENCES

1. Thomas K Eismin, "Aircraft Electricity and electronics", McGraw- Hill Book Co ,Seventh Edition, 2019.
2. Myron Kayton & Walter R. Fried, "Navigation, and Communication Systems", Wiley-Interscience, Second Edition,1997.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/105/107/105107194 (Navigation Systems)
2. https://archive.nptel.ac.in/courses/108/104/108104091 (Wireless Sensor Networks)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	-	-	3	1	2	-	-	-	1	3	3
2	3	3	-	-	3	1	-	-	-	-	-	3	3
3	3	3	-	-	3	-	1	-	-	-	-	3	3
4	3	3	-	-	3	-	-	2	3	-	-	3	3
5	3	3	-	-	2	2	-	-	-	-	-	3	2
AVG	3.00	3.00	-	-	2.80	1.33	1.50	2.00	3.00	-	1.00	3.00	2.80

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

Chairman - BoS

23RMP617 **DESIGN OF UAV SYSTEMS** L T P C
3 0 0 3

OBJECTIVES

- To introduce the history, classification, system composition, models, and applications of Unmanned Aerial Vehicles (UAVs).
- To impart knowledge on UAV system design, aerodynamic configurations, aircraft characteristics, and international regulatory standards.
- To enhance understanding of UAV avionics hardware, including sensors, actuators, processors, integration, and testing.
- To foster understanding of UAV system development, including navigation, ground control, testing, and emerging trends.
- To familirize UAV system development, including navigation, ground control, testing, and future trends.

UNIT I INTRODUCTION TO UAV 9

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.

UNIT II DESIGN OF UAV SYSTEMS 9

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe Design for Stealth--control surfaces-specifications.

UNIT III AVIONICS HARDWARE 9

Autopilot-AGL-pressure-sensors-servos-accelerometer-gyros- actuators power supply processor, integration, installation, configuration, and testing.

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS 9

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT V DEVELOPMENT OF UAV SYSTEMS 9

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the UAV classifications, models, and system components.
- Apply design principles considering aerodynamics, stealth, and control surfaces.
- Construct and integrate UAV avionics hardware systems, including sensors, actuators, processors, and perform configuration and testing.
- Analyze UAV communication payloads, control systems, telemetry, and perform simulation, testing, and troubleshooting.
- Examine UAV system development, including waypoints navigation, ground and in-flight testing, and future challenges and prospects.

TEXTBOOKS

1. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, Fifth Edition, 2022.
2. Reg Austin,"Unmanned Aircraft Systems UAV design, development and deployment", Wiley, First Edition, 2010.

REFERENCES

1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, First Edition, 2001.
2. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, First Edition, 2007.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/101/104/101104073 - (Design of UAV Systems)
2. https://onlinecourses.nptel.ac.in/noc20_ae04/preview-(Development of UAV Systems)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	-	1	3	-	-	-	1	-	2	3	3
2	3	3	1	1	3	-	1	2	-	1	2	3	3
3	3	3	-	1	3	-	-	-	-	-	2	3	3
4	3	3	1	1	3	-	1	2	3	-	1	3	2
5	3	3	1	1	2	-	1	-	1	1	3	3	3
AVG	3.00	3.00	1.00	1.00	2.80	-	1.00	2.00	1.67	1.00	2.00	3.00	2.80

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

Chairman - BoS

23RMP618 **HUMANOID ROBOTICS** **L T P C**

3 0 0 3

OBJECTIVES

- To provide an understanding of humanoid robots, their evolution, types, design principles, like ASIMO, NAO, Atlas, Pepper, and Sophia.
- To impart knowledge on kinematics and dynamics of humanoid robots, including motion modeling, stability, and walking pattern generation.
- To familiarize with actuators and sensor systems in humanoid robots, including integration, sensor fusion, and balance control.
- To inculcate understanding of control architectures and AI in humanoid robots, including control methods, machine learning, and cognitive functions.
- To discuss humanoid robot applications, ethical considerations, and real-world case studies in various domains.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Definition, evolution, and types of humanoid robots.-Human biomechanics vs. robotics-anthropomorphism, DoF.-Overview of prominent humanoids: ASIMO, NAO, Atlas, Pepper, Sophia.-Key design aspects: mechanical structure, actuation systems, power supply.

UNITII KINEMATICS AND DYNAMICS 9

Forward and Inverse Kinematics for Humanoid Arms and Legs - Denavit–Hartenberg (D-H) method for multi-link humanoid limbs - Dynamics modeling: Newton–Euler and Lagrangian approaches.-Locomotion stability: Zero Moment Point (ZMP), Center of Pressure (CoP) - Generation of walking and motion patterns.

UNIT III ACTUATION AND SENSOR SYSTEMS 9

Types of actuators: electric, hydraulic, pneumatic, series elastic actuators - Sensor integration: IMUs, force/torque sensors, encoders, tactile, vision - Sensor fusion techniques and real-time feedback loops - Balance control and posture regulation in dynamic scenarios.

UNIT IV CONTROL ARCHITECTURES AND AI 9

Control architectures: hierarchical, reactive, hybrid - Classical control: PID, trajectory tracking; advanced methods: MPC - Machine learning for behavior imitation and perception - Cognitive capabilities: SLAM, gesture/speech recognition, social interaction.

UNIT V APPLICATIONS, ETHICS, AND CASE STUDIES 9

Humanoids in Healthcare, Education, Search and Rescue, and Elderly Assistance - Socially Assistive Robots (SARs): principles and design aspects -Ethical, safety, and regulatory considerations in humanoid implementation - Case studies: NAO in education, Atlas in disaster response, Sophia in HRI-Current research trends and challenges.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the evolution, design principles, and structural features of humanoid robots.

- Apply kinematic and dynamic modeling techniques to humanoid limbs and walking systems.
- Construct control architectures and AI models for humanoid robot behavior and interaction.
- Analyze control architectures and AI techniques for humanoid robot perception, learning, and interaction.
- Examine the applications, ethical issues, and case studies of humanoid robots in diverse domains.

TEXTBOOKS

1. Eiichi Yoshida & Abderrahmane Kheddar, "Humanoid Robotics: A Reference", Springer, First Edition ,2019.
2. Bruno Siciliano & Lorenzo Sciavicco, "Robotics: Modelling, Planning and Control", Springer, Third Edition,2009.

REFERENCES

1. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson, Fourth Edition, 2022.
2. Rolf Pfeifer & Josh Bongard, "How the Body Shapes the Way We Think", MIT Press, First Edition,2006.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/105/112105249/(Robotics)
2. https://archive.nptel.ac.in/courses/112/107/112107289//- (Robotics and Control)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	-	-	-	-	1	-	-	2	3	3
2	3	3	2	-	-	-	-	1		-	2	3	3
3	3	3	2	-	-	-	-	1	-	-	2	3	3
4	3	3	2	-	-	-	-	2	--	-	3	3	3
5	3	3	2	-	-	-	-	2	3	2	3	2	2
AVG	3.00	3.00	2.00	-	-	-	-	1.40	3.00	2.00	2.40	2.80	2.80

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

Chairman - BoS

Open Elective – I

23CEO607 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT **LT P C 3 0 0 3**

OBJECTIVES

- To explore the Rio principles of environmental impact assessment.
- To enhance the screening and scoping in EIA.
- To develop the environmental monitoring plan and EIA report preparation.
- To inculcate the baseline monitoring of socio economic environment.
- To instruct the EIA case studies pertaining to infrastructure projects.

UNIT I INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework.

UNIT II ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise, flora and fauna - Matrices – Networks Checklist Methods - Mathematical models for Impact prediction.

UNIT III ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Public Hearing- Environmental Clearance.

UNIT IV SOCIO ECONOMIC ASSESSMENT 9

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis.

UNIT V CASE STUDIES 9

EIA case studies pertaining to Infrastructure Projects – Roads and Bridges – Mass Rapid Transport Systems- Airports - Dams and Irrigation projects - Power plants.

TOTAL: 45 PERIODS

OUTCOMES

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

- Examine the impacts of development on environment.
- Analyze the scoping and screening of developmental projects for environmental and social assessments.
- Construct the environmental management plans and EIA reports.
- Apply the economic valuation of environmental impacts and cost benefit analysis.
- Identify the EIA case studies pertaining to Infrastructure Projects.

TEXT BOOKS

1. Canter, R.L, "Environmental impact Assessment ", Second Edition, McGraw Hill Inc, New Delhi,1995.

2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, First Edition, 2009.

REFERENCES

1. Becker H. A., Frank Vanclay,"The International handbook of social impact assessment" Conceptual and Methodological Advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.

E-RESOURCES

1. https://nptel.ac.in/courses/124107160 - (Environmental Impact Assessment)
2. https://onlinecourses.nptel.ac.in/noc25_ch24/preview - (Environmental Quality Monitoring & Analysis)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	2	–	2	3	–	–	–	–	-	-
2	3	3	2	2	–	2	3	–	–	–	–	-	-
3	3	3	3	2	2	2	3	–	–	–	2	-	-
4	3	3	2	2	–	2	3	–	–	–	3	-	-
5	3	3	3	2	2	3	3	–	–	–	2	-	-
AVG	3.00	3.00	2.40	2.00	2.00	2.20	3.00	–	–	–	2.33	-	-

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

Chairman - BoS

23CSO610 **INTRODUCTION TO DRONE TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES

- To impart fundamental knowledge of drone technology, including its concepts, terminology, historical evolution, and emerging applications.
- To develop students' understanding of UAV architecture, drone components, fabrication techniques, and programming methodologies.
- To train students in drone flight operations, navigation systems, sensors, data acquisition, and UAV management tools.
- To enable students to explore commercial applications of drones in sectors such as agriculture, logistics, inspection, surveillance, and aerial imaging.
- To familiarize students with drone safety regulations, licensing requirements, and emerging technologies including autonomous and swarm-based UAV systems.

UNIT I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept-Vocabulary Terminology-History of drone-Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses-Drone business through entrepreneurship-Opportunities/applications for entrepreneurship and Employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program – Install program on computer-Running Programs-Multi rotor stabilization-Flight modes-Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity-Removable storage devices-Linked mobile devices and applications.

UNIT IV DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application-Drones in the insurance sector-Drones in delivering mail, parcels and other cargo-Drones in agriculture-Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

.

UNIT V FUTURE DRONES AND SAFETY **9**

The safety risks-Guidelines to fly safely –Specific aviation regulation and standardization-Drone License-Miniaturization of drones-Increasing autonomy of drones-The use of drones in swarms.

Total: 45 PERIODS

OUTCOMES

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

- Explain the fundamental concepts, terminology, classifications, history, and applications of drone technology.

- Design a multirotor drone by selecting appropriate hardware appropriate components and tools.
- Apply flight control principles, navigation methods, onboard sensors, and UAV management tools for drone flight operations.
- Analyze the drone technologies for commercial applications such as aerial imaging, agriculture, logistics, infrastructure inspection, and surveillance
- Analyze drone safety regulations, licensing requirements, and emerging technologies including autonomous drones and swarm intelligence for future UAV applications.

TEXTBOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, First Edition, 2021.
2. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones, Maker Media,Inc.", Sheroff Publishers and Distributors Pvt Ltd,First Edition, 2015.

REFERENCES

1. John Baichtal,"Building Your Own Drones:A Beginners' Guide to Drones, UAVs, and ROVs",Que Publishing, First Edition,2016.
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer,First Edition, 2018.

E-RESOURCES

1. http://www.digimat.in/nptel/courses/video/101108661/L50.html (Fundamentals of Drone Technologies)
2. http://www.digimat.in/nptel/courses/video/101108661/L38.html (Drone Technology Commercial Application)

Mapping of COs-POs &PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	3	-	-	-	-	-	3	-	-
2	3	3	3	2	3	-	-	-	-	-	3	-	-
3	3	3	2	2	3	-	-	-	-	-	3	-	-
4	2	3	2	2	3	-	-	1	-	-	2	-	-
5	2	3	3	2	3	-	-	2	-	-	2	-	-
Avg	2.60	2.80	2.40	1.80	3.00	-	-	1.50	-	-	2.60	-	-

1-Low, 2-Medium, 3-High, "-" – No Correlation

Chairman - BoS

23ECO602 **FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS** L T P C
3 0 0 3

OBJECTIVES

- To introduce fundamental knowledge of semiconductors and devices and its applications.
- To discuss the operation and characteristics of Bipolar Junction Transistor.
- To expose the various types of oscillators and FET.
- To inculcate the operation of power semiconductor devices.
- To impact knowledge on optoelectronic devices and wave shaping circuits.

UNIT I SEMICONDUCTOR AND DIODES 9

Semiconductor - Definition, classification, intrinsic and extrinsic N type & p type – drift current &diffusion current diodes – PN junction diode – forward and reverse bias characteristics –specification – zener diode construction & working Principle -characteristics - zener break down - avalanche break down.

Rectifier – introduction-classification of rectifiers-half wave rectifier-full wave Rectifier (center tapped, bridge) - (no mathematical equations) – comparison – Applications - filters-C, LC and PI filters.

UNIT II BIPOLAR JUNCTION TRANSISTOR 9

Transistor – NPN and PNP transistor – operation-transistor as an amplifier- transistor as a switch – CB,CE,CC configurations – characteristics - comparison between three configurations in terms of input impedance, output impedance, current gain, voltage gain – negative feedback Concept, effect of negative feedback – types of negative feedback connections.

UNIT III TRANSISTOR OSCILLATORS AND FET 9

Transistor oscillators – Classifications – Condition for oscillations (Barkhausen criterion) – General form of Hartley Oscillator – Colpitts Oscillator – RC Phase shift oscillator.

Field Effect Transistor – construction – working principle of FET – difference Between FET and BJT – classification of FET – characteristics of FET – Applications.

UNIT IV SCR, DIAC, TRIAC 9

SCR – introduction – working – VI-characteristics -comparison between SCR and transistor – SCR as a switch, controlled rectifier. TRIAC working principle, Characteristics –DIAC – characteristics –DIAC as bi- directional switch. Applications of SCR,TRIAC and DIAC.

UNIT V OPTOELECTRONIC DEVICES AND WAVE SHAPING CIRCUITS 9

Classification of optoelectronic devices – symbols, Characteristics, working of LDR, LED, 7 segment LED and LCD– opto coupler - Photo transistor. Clipper, Clamper Circuits and waveforms only – Astable, Monostable Multivibrators and Schmitt trigger using transistors.

TOTAL : 45 PERIOD

OUTCOMES

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

- Understand the concept of semiconductor, diodes and its applications.
- Discuss the various biasing circuits using BJT.
- Explain the oscillator circuits and Field Effect Transistor.

- Analyze the operation of power semiconductor devices and its applications.
- Explain the operation of optoelectronic devices and wave shaping circuits.

TEXT BOOKS

1. Robert L. Boylestad, Louis Nashelsky "Electronic Devices and Circuits Theory", Prentice Hall Publications, Tenth Edition, 2009.
2. S.Salivahanan,N.Suresh kumar, , "Electronic Devices and Circuits", McGraw Hill, Fifth Edition, 2022.

REFERENCE

1. G.S.N. Raju, "Electronic Devices and Circuits", I.K. International Publications, New Delhi, First Edition, 2006
2. A.P Godse, U.A Bakshi , "Electronic Devices and Circuits", Technical Publications, 2010.

E-RESOURCES

1. https://nptel.ac.in/courses/108108122 - (Fundamentals of Semiconductor Devices).
2. https://onlinecourses.nptel.ac.in/noc21_ee86 - (Microelectronics: Devices To Circuits).

Mapping of COs - POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	2	-	-	-	-	3	-	-
2	3	3	3	3	2	3	-	-	-	-	2	-	-
3	3	3	3	3	3	2	-	-	-	-	3	-	-
4	3	3	3	3	3	2	-	-	-	-	2	-	-
5	3	3	3	3	3	3	-	-	-	-	2	-	-
AVG	3.00	3.00	3.00	3.00	2.80	2.40	-	-	-	-	2.40	-	-

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

Chairman - BoS

23EEO603 **ELECTRIC VEHICLE TECHNOLOGY** L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on the basic concepts and working of electric vehicles.
- To familiarize with battery types, parameters, and battery pack design for electric vehicles.
- To instruct on DC and AC electrical machines used in electric vehicle applications.
- To develop understanding of electric vehicle drive train components and regenerative braking.
- To foster awareness of hybrid electric vehicle types, configurations, and component sizing.

UNIT I ELECTRIC VEHICLES 9

Introduction - Components - Vehicle mechanics - Roadway fundamentals - Vehicle kinetics Dynamics of vehicle motion Propulsion System Design

UNIT II BATTERY 9

Basics - Types - Parameters Capacity, Discharge rate, State of charge, state of discharge, Depth of discharge - Technical characteristics - Battery pack design Properties of batteries

UNIT III DC & AC ELECTRICAL MACHINES 9

Motor and engine rating - Requirements - DC machines - Three phase AC machines- Induction machines - Permanent magnet machines - BLDC Motor Switched reluctance machines

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN 9

Transmission configuration - Components - Gears - Differential - Clutch - Brakes Regenerative braking - Motor sizing

UNIT V HYBRID ELECTRIC VEHICLES 9

Types - Series - Parallel and series - Parallel configuration - Design - Drive train Sizing of components.

TOTAL: 45 PERIODS

OUTCOMES

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

- Analyze the basic concepts and working of electric vehicles.
- Apply the battery types, parameters inbattery pack design.
- Explain the DC and AC electrical machines used in electric vehicles.
- Identify the electric vehicle drive train components and regenerative braking.
- Examine the hybrid electric vehicle types, configurations, and component sizing.

TEXT BOOKS

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, Second Edition, 2017.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management

Strategies", Springer, First Edition, 2015.

REFERENCES

1. Iqbal Hussain, "Electric & Hybrid Vehicles - Design Fundamentals", CRC press, Second Edition, 2011.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, Second Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/108103009 - (Hybrids and Electric Vehicle)
2. http://nptel.ac.in/courses/108103009/ - (Electric Vehicle)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	-	-	-	-	-	2	-	-
2	3	3	3	3	3	-	-	-	-	-	2	-	-
3	3	3	3	3	3	-	-	-	-	-	2	-	-
4	3	3	3	3	3	-	-	-	-	-	2	-	-
5	3	3	3	3	3	-	-	-	-	-	2	-	-
AVG	3.00	3.00	3.00	3.00	3.00	-	-	-	-	-	2.00	-	-

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

Chairman - BoS

23EEO604 **RENEWABLE ENERGY SYSTEMS** L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on renewable energy sources and their role in sustainable energy development.
- To familiarize with the working and applications of wind energy systems.
- To develop understanding of solar photovoltaic and solar thermal energy systems.
- To instruct on biomass, geothermal, and hydroelectric energy systems.
- To get knowledge on other renewable energy sources and energy storage systems.

UNIT I RENEWABLE ENERGY SOURCES 9

Environmental consequences of fossil fuel use - Importance of Renewable Sources (RE) of energy - Sustainable design and development - Types of RE sources - Limitations of RE sources - Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 9

Power in the wind - Types of wind power plants(wpps) - Components of wpps - Working of wpps - Siting of wpps - Grid integration issues of wpps.

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar radiation - Radiation measurement - Solar thermal power plant - Central receiver power plants - Solar ponds - Thermal energy storage system with pcm - Solar photovoltaic systems - Basic principle of spv conversion - Types of pv systems -Maximum power point tracking - Best free solar pv system simulation.

UNIT IV BIOMASS ENERGY 9

Introduction - Bio mass resources - Energy from bio mass - Conversion processes - Biomass cogeneration - Environmental benefits - Geothermal energy - Basics - Direct use - Geothermal electricity - Mini/micro hydro power - Classification of hydropower schemes - Classification of water turbine - Turbine theory - Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES 9

Tidal energy - Energy from the tides - Barrage and non barrage tidal power systems - Wave energy - Energy from waves - Wave power devices - Ocean thermal energy conversion (OTEC) - Hydrogen production and storage - Fuel cell - Principle of working - Various types - Construction and applications - Energy storage system - Hybrid energy systems.

TOTAL : 45 PERIODS

OUTCOMES

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

- Explain the importance and types of renewable energy sources.
- Analyze the working and components of wind energy systems.
- Discuss how solar photovoltaic and solar thermal systems work.
- Determine biomass, geothermal, and hydroelectric energy systems.

- Examine tidal, wave, ocean thermal, fuel cell, and hybrid energy systems.

TEXT BOOKS

1. Scott Grinnell, "Renewable Energy & Sustainable Design", Cengage Learning, USA, Second Edition, 2016.
2. Richard A. Dunlap, "Sustainable Energy", Cengage Learning India Private Limited, Second Edition, 2015.

REFERENCES

1. ShobhNath Singh, "Non-conventional Energy resources", Pearson Education India, Second Edition, 2015.
2. Bradley A. Striebig, Adebayo A.Ogundipe and Maria Papadakis, "Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, First Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/108/108/108108078/ - (Renewable Energy Systems)
2. https://nptel.ac.in/courses/108/105/108105058/-(Non-Conventional Energy resources)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	1	1	-	1	-	2	-	-
2	3	3	3	3	3	1	1	-	1	-	2	-	-
3	3	3	3	3	3	1	1	-	1	-	2	-	-
4	3	3	3	3	3	1	1	-	1	-	2	-	-
5	3	3	3	3	3	1	1	-	1	-	2	-	-
AVG	3.00	3.00	3.00	3.00	3.00	1.00	1.00		1.00		2.00		

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

Chairman - BoS

23MEO601 **INTRODUCTION TO INDUSTRIAL ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

- To enable students to grasp the fundamental concepts, scope, and role of Industrial Engineering in manufacturing and service systems.
- To expose students to plant location, facility layout, and production planning concepts relevant to real-world industries.
- To develop analytical ability to apply work study, method study, and ergonomics principles in industrial environments.
- To equip students with foundational knowledge of statistical quality control and its application in process improvement.
- To prepare the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages

UNIT I INTRODUCTION **9**

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

UNIT II PLANT LOCATION AND LAYOUT **9**

Factors affecting Plant location – Objectives of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

UNIT III WORK SYSTEM DESIGN & ERGONOMICS **9**

Need – Objectives – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Time Study –Work sampling- Ergonomics and its areas of application in the work system - Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing.

UNIT IV STATISTICAL QUALITY CONTROL **9**

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling- O.C curve –Single sampling plan- Double sampling plan.

UNIT V PRODUCTION PLANNING AND CONTROL **9**

Forecasting –Techniques – Types of production – Process planning – Economic Batch Quantity– Loading – Scheduling and control of production.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the concepts of productivity and productivity measurement approaches.
- Examine appropriate location models for various facility types and design various

facility layouts.

- Analyze and conduct method study and time study to improve the efficiency of the system.
- Examine the quality of processes using control charts in manufacturing/service industries.
- Apply knowledge and skills for planning strategies and preparing a Material Requirement Plan (MRP).

TEXTBOOKS

1. Martand Telsang,2016, "Industrial Engineering and Production Management", S. Chand and Company.
2. Khanna O. P., and Sarup A., "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2020,
3. George Kanwaty, "Introduction to Work Study ", ILO, Geneva, 2016,

REFERENCES

1. Ravi Shankar, 2019, "Industrial Engineering and Management", Galgotia Publications & Private Limited.
2. Norberd Lloyd Enrick., "Industrial Engineering Manual for Textile Industry", Wiley Eastern (P) Ltd., New Delhi, 2018,
3. Enrick N. L., "Time study manual for Textile industry", Wiley Eastern (P) Ltd.,2019,

E-RESOURCES

1. https://nptel.ac.in/courses/112107292 (Principles of Industrial Engineering)
2. https://onlinecourses.nptel.ac.in/noc25_me181/preview- (Industrial Engineering and Operations Research)

Mapping of COs-POs &PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	-	-	-	-	-	-	-	2	-	-
2	3	3	2	-	-	-	-	-	-	-	2	-	-
3	3	3	2	-	-	-	-	-	-	-	2	-	-
4	3	3	2	-	-	-	-	-	-	-	2	-	-
5	3	3	2	-	-	-	-	-	-	-	2	-	-
AVG.	3.00	3.00	2.00	-	-	-	-	-	-	-	2.00	-	-

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

Chairman - BoS

23MEO605 **CNC MACHINING TECHNOLOGY** L T P C
3 0 0 3

OBJECTIVES

- To introduce students to the fundamentals of computer graphics, CAD systems, geometric transformations, and viewing techniques used in computer-aided design.
- To provide knowledge on geometric modeling techniques, assembly modeling, graphics standards, and product data exchange standards used in CAD applications.
- To explain the construction, components, control systems, and operational features of CNC machines and advanced machining centres.
- To familiarize students with manual and computer-aided CNC part programming techniques using APT, CAM packages, and canned cycles.
- To develop an understanding of Computer-Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), manufacturing planning and control, automation, lean production, and Just-in-Time (JIT) manufacturing concepts.

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle - Design process - sequential and concurrent engineering - Computer-aided design - CAD system architecture - Computer graphics - coordinate systems - 2D and 3D transformations homogeneous coordinates - Line drawing - Clipping - viewing transformation.

UNIT II GEOMETRIC MODELING 9

Geometric Modeling - types - Wireframe, surface and solid modeling - Boundary Representation, constructive solid geometry - Graphics standards - assembly modeling - use of software packages - Data exchange standards - IGES, STEP, CALS, etc. - communication standards.

UNIT III CNC MACHINES 9

NC, CNC & DNC - types of CNC - constructional features - drives and control systems - feedback devices - Interchangeable tooling system - preset & qualified tools - ISO specification - Machining center - Turning center - CNC EDM - CNC wire cut EDM.

UNIT IV CNC PROGRAMMING 9

Manual part programming - steps involved - sample program in lathe & milling. - Computer-aided part programming - APT - CAM package - canned cycles - Programming.

UNIT V FUNDAMENTALS OF CAM 9

Brief introduction to CAM - Manufacturing Planning, Manufacturing control - Concurrent Engineering - CIM concepts - Computerized elements of CIM system - Types of production Basic Elements of an Automated system - Levels of Automation - Lean Production and Just-In-Time Production.

TOTAL: 45 PERIODS

OUTCOMES

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

- Analyze the principles of computer graphics, CAD system architecture, coordinate systems, geometric transformations, and viewing techniques used in computer-aided design.
- Examine geometric modeling techniques, assembly modeling approaches, graphics standards, and data exchange standards for engineering design applications.
- Compare the constructional features, control systems, tooling arrangements, and operational characteristics of CNC machines and advanced machining centres.
- Classify CNC programming techniques, including manual part programming, computer-aided part programming, APT, CAM packages, and canned cycles for manufacturing applications.
- Differentiate the concepts of CAM, CIM, manufacturing planning and control, automation, lean production, and Just-in-Time (JIT) production in modern manufacturing systems.

TEXTBOOKS

1. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson Education", Fifth Edition, 2023.
2. Ibrahim Zeid, "Mastering CAD/CAM", McGraw-Hill Education, Third Edition, 2021.
3. P. N. Rao, "CAD/CAM: Principles and Applications", McGraw-Hill Education (India), Fourth Edition, 2022.

REFERENCES

1. M. P. Groover and Emory W. Zimmers Jr., "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson Education, Second Edition (Reprint), 2020
2. M. P.Groover,"Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley & Sons, Eigth Edition, 2025
3. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM: Theory and Practice", McGraw Hill Education, Second Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/112102103 (Overview of CNC machines)
2. http://www.digimat.in/nptel/courses/video/112104289/L20.html - (CNC Part Programming)

Mapping of COs-POs &PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	2	3	-	-	-	-	-	1	-	-
2	3	3	2	2	3	-	-	-	-	-	1	-	-
3	3	3	2	2	3	-	-	-	-	-	1	-	-
4	3	3	2	2	3	-	-	-	–	-	1	–	–
5	3	3	2	2	3	-	-	-	-	-	1	-	-
AVG.	3.00	3.00	2.00	2.00	3.00	-	-	-	-	-	1.00	-	-

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

Chairman - BoS

23MDO611 **HOSPITAL MANAGEMENT** L T P C
3 0 0 3

OBJECTIVES

- To familiarize students with the fundamentals of hospital administration and management.
- To impart knowledge on human resource management practices in healthcare organizations.
- To explore marketing research processes and consumer behavior in healthcare services.
- To introduce hospital information systems and supportive healthcare services.
- To inculcate awareness of quality assurance, accreditation standards, and patient safety practices.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management..

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department– Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

OUTCOMES

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

- Examine the principles and functions of hospital administration in healthcare organizations.
- Analyze human resource management practices and their role in hospital operations.
- Apply marketing research techniques for healthcare service management.
- Utilize hospital information systems and supportive services for decision-making.
- Develop quality assurance and patient safety strategies in healthcare settings.

TEXT BOOKS

1. Gupta Joydeep Das, "Hospital Administration and Management: A Comprehensive Guide", Third Edition, 2023.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management", TMH, New Delhi, Fifth Edition,Reprint 2018.

REFERENCES

1. Bruce J. Fried and Myron D.Fottler, "Human Resources in Healthcare Managing for Success", Fourth Edition, 2020.
2. James R. Langabeer, "Handbook on Health Care Operations Management",Jones & Bartlett Publishers, 2020.

E-RESOURCES

1. https://www.youtube.com/watch?v=2J-F4Fi2VRQ –(Introduction to Human Resource Management in Healthcare Settings)
2. https://www.youtube.com/watch?v=dXHJemWm1xI&pp=ygUVI2hvc3BpdGFsX2luZm9ybWF0aW9u – (Hospital Information Management Software (HIMS))

Mapping of COs - POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	3	1	-	-	2	1	-	-	1	1	-	-
2	1	2	2	1	-	1	2	1	1	2	1	-	-
3	1	2	3	1	1	1	1	-	1	2	1	-	-
4	1	2	2	2	3	1	1	-	1	1	2	-	-
5	1	3	2	2	2	3	2	1	1	2	2	-	-
AVG.	1.00	2.40	2.00	1.50	2.00	1.60	1.40	1.00	1.00	1.60	1.40	-	-

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

Chairman - BoS

23RAO609 **FUNDAMENTALS OF ROBOTICS** L T P C

3 0 0 3

OBJECTIVES

- To introduce the basics of robots, including anatomy, types, specifications, and applications.
- To impart knowledge on robot kinematics, including forward/inverse kinematics and transformation matrices for manipulators.
- To familiarize with robot drive systems and end effectors, including types, features, applications, and design considerations.
- To discuss sensors in robotics, including force, tactile, proximity, and their applications and safety aspects.
- To enhance understanding of robot programming and its applications in industrial and specialized fields.

UNIT I BASICS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT II ROBOT KINEMATICS 9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effectors Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

OUTCOMES

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

- Identify robot types, anatomy, specifications, and applications.

- Illustrate forward and inverse kinematics of manipulators using transformation matrices.
- Analyze and select appropriate drive systems and end effectors for robotic applications.
- Apply sensor technologies and safety systems to robotic cells for reliable detection, hazard prevention, and compliant operation.
- Apply robot programming techniques and analyze their applications in industrial and specialized fields.

TEXTBOOKS

1. Ganesh.S.Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, Second Edition, 2015.
2. Mikell.P.Groover, "Industrial Robotics–Technology, Programming and applications", McGraw Hill, Second Edition , 2017.

REFERENCES

1. Fu K.S. Gonalz R.C. and ice C.S.G.,"Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co., Second Edition, 2007.
2. John. J.Craig, "Introduction to Robotics: Mechanics and Control", Fourth Edition, 2022.

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_me37/preview- (Fundamentals of Robotics)
2. https://archive.nptel.ac.in/courses/112/108/112108298 (Basics of Robotics)

Mapping of COs-POs& PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	-	3	3	-	1	-	2	-	1	-	-
2	3	2	-	3	3	-	-	-	2	-	2	-	-
3	3	2	-	3	3	-	-	2	2	2	2	-	-
4	3	2	-	3	3	2	-	2	2	2	2	-	-
5	3	2	-	2	3	2	-	2	2	3	3	-	-
AVG	3.00	2.00	-	2.80	3.00	2.00	1.00	2.00	2.00	2.33	2.00	-	-

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

Chairman - BoS

23CSO612 **CYBER FORENSICS AND ETHICAL HACKING** **L T P C**
3 0 0 3

OBJECTIVES

- To impart knowledge about the cyber crime and forensics.
- To acquire knowledge about forensic tools used for evidence acquisition and analysis.
- To familiarize with skills to collect, analyse, and present digital evidence following accepted forensic procedures and legal requirements.
- To impart the fundamental concepts, principles, and scope of ethical hacking in cyber security.
- To acquire the ethical hacking principles and security best practices to identify, analyze, and mitigate vulnerabilities in web applications

UNIT I INTRODUCTION TO CYBER CRIME AND FORENSICS **9**

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Role of ECD and ICT in Cybercrime - Classification of Cyber Crime. The Present and future of Cybercrime - Cyber Forensics -Steps in Forensic Investigation - Forensic Examination Process - Types of CF techniques - Forensic duplication and investigation - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II FORENSICS TOOLS **9**

Processing Crime and Incident Scenes – Digital Evidence - Sources of Evidence -Working with File Systems. - Registry - Artifacts - Current Computer Forensics Tools: Software/ Hardware Tools - Forensic Suite - Acquisition and Seizure of Evidence from Computers and Mobile Devices - Chain of Custody- Forensic Tools

UNIT III VALIDATING FORENSICS DATA **9**

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics - Analysis of Digital Evidence - Admissibility of Evidence - Cyber Laws in India.

UNIT IV ETHICAL HACKING **9**

Introduction to Ethical Hacking – Foot printing and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing – Email Tracking .

UNIT V ETHICAL HACKING IN WEB **9**

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

.TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the basics of cyber crime and computer forensics
- Apply the forensic tools for acquiring, preserving, and analyzing digital evidence
- Analyze and validate digital evidence by applying standard forensic procedure
- Apply ethical hacking methodologies to perform reconnaissance, scanning, enumeration, and vulnerability

- Analyze the security vulnerabilities in web applications, wireless networks, and mobile platform.

TEXT BOOKS

1. Bill Nelson, Amelia Phillips, Christopher Steuart, — Guide to Computer Forensics and Investigations ǁ, Cengage Learning, India Sixth Edition, 2019.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, Version 11, 2021.
3. Dejey, S. Murugan - Cyber Forensics, Oxford University Press, India, 2018

REFERENCES

1. John R.Vacca, "Computer Forensics ", Cengage Learning, 2005
2. Marjie T.Britz, "Computer Forensics and Cyber Crime: An Introduction Third Edition, Prentice Hall, 2013.
3. AnkitFadia " Ethical Hacking, Second Edition", Macmillan India Ltd, 2006
4. Kenneth C.Brancik "Insider Computer Fraud", Auerbach Publications, Taylor &Francis Group– 2008.

E-RESOURCES

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_ge10
2. https://nptel.ac.in/courses/106105217

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	1	1	-	-	-	1	-	-
CO2	3	2	1	2	3	1	2	1	1	-	2	-	-
CO3	3	3	1	3	3	2	3	1	2	-	2	-	-
CO4	3	3	2	2	3	2	2	1	1	-	2	-	-
CO5	3	3	3	2	3	2	3	1	2	1	3	-	-
AVG	3.00	2.60	1.75	2.25	2.60	1.60	2.20	1.00	1.50	1.00	2.00	-	-

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

Chairman - BoS

23PMO608 **PHARMACEUTICAL NANOTECHNOLOGY** **L T P C 3 0 0 3**

OBJECTIVES

- To introduce the evolution, principles, and applications of nanotechnology in drug delivery.
- To familiarize students with the principles of biopharmaceutics and pharmacokinetics.
- To provide knowledge of the principles, preparation, characterization, evaluation, and pharmaceutical applications of closed bilayered drug delivery systems.
- To develop a comprehensive understanding of programmed drug delivery systems, drug targeting strategies,
- To enhance understanding of the interactions of nanomaterials with biological systems, nanotoxicity.

UNIT I FUNDAMENTALS OF NANOTECHNOLOGY IN DRUG DELIVERY **9**

Nanotechnology in Drug Delivery- Past, Present and Future- Conventional delivery of pharmaceuticals and its limitations, Significance of nano-size in Pharmacy, biotechnology and medicine, Physicochemical Principles of nano-sized Drug Delivery Systems, Biopharmaceutical, Physiological, and Clinical Considerations for Nanotechnology in Drug Delivery.

UNIT II PHARMACOKINETICS AND BIO DISTRIBUTION **9**

Introduction- Definitions, concepts of Absorption, Distribution, Metabolism and excretion, concentration time profile, Bioavailability, bio pharmaceutics and pharmacokinetics in drug research. Biotransformation of drugs- Drug metabolizing enzymes, chemical pathways of Drug transformation, Phase-I and Phase-II reactions, Factors affecting drug transformation Prodrugs- Application of produg design.

UNIT III NANO CARRIERS FOR DRUG DELIVERY **9**

Closed bilayered system- Introduction, structural aspects, preparation, characterization, evaluation and applications of liposomes, niosomes, erythrosomes. Polymeric Nanoparticles- Introduction, preparation, characterization, evaluation and pharmaceutical applications.

UNIT IV CONTROLLED AND TARGETED DRUG DELIVERY **9**

Programmed Drug Delivery Systems- principles of sustained, controlled, pulsatile and triggered release of drug from nanoparticles. Concept of targeting- Targeting Approaches, Transport Across Biological Barriers, mechanisms of drug targeting, Ideal carrier system and approach Disease-Related Approaches by Nanotherapeutics- nanoparticles for Cancer, Skin Diseases, Bacterial, Diseases, Parasites Diseases and Inflammatory Disease.

UNIT V NANO TOXICOLOGY AND REGULATORY ISSUES **9**

Human health and safety- Interaction of nanomaterials with biological systems, Toxicology of nanoparticles- in-vitro and in-vivo, Complications with Nanotoxicity studies, environmental impact of nano-materials, Regulatory Toxicology.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the physicochemical principles governing nano-sized drug delivery systems.
- Explain the role of biopharmaceutics and pharmacokinetics in drug discovery, development, and therapeutic optimization.
- Analyze the physicochemical properties and performance of liposomes, niosomes, erythrosomes, and polymeric nanoparticles for pharmaceutical applications.
- Explain the principles of programmed drug delivery systems, including sustained, controlled, pulsatile, and triggered drug release from nanoparticles.
- Apply appropriate approaches to assess the toxicological effects and safety of nanomaterials using in-vitro and in-vivo studies.

TEXT BOOKS

1. Padma Devarajan, Sanyog Jain, "Targeted Drug Delivery: Concepts and Design", Springer publisher, First Edition , 2015.
2. M. A. Mateescu P. Ispas-Szabo E. Assaad, "Controlled Drug Delivery", Woodhead Publishing , Second Edition, 2014

REFERENCES

1. Michael E. Aulton ,"Pharmaceutics", Churchill Livingstone Publisher , Second Edition, 2013.
2. Philippe Houdy, Marcel Lahmani, "Nanoethics and Nanotoxicology", Springer-Verlag Publisher, Second edition, 2011.

E-RESOURCES

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9783527800681
2. https://www.scribd.com/document/742651789/Nano-Technology-1

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	2	3	2	2	-	-	-	-	2	-	-
2	2	2	2	3	2	1	2	-	-	-	2	-	-
3	2	2	2	2	2	2	3	-	-	-	2	-	-
4	2	3	3	3	3	2	1	-	-	1	2	-	-
5	3	3	3	3	3	2	2	1	-	-	3	-	-
AVG.	2.40	2.60	2.40	2.80	2.40	1.80	2.00	1.00	-	1.00	2.20	-	-

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

Chairman - BoS

23MAO606 **GRAPH THEORY** L T P C
3 0 0 3

OBJECTIVES

- To introduce the fundamental concepts of graph theory.
- To explain the properties of trees, spanning trees, and fundamental circuits.
- To explain the concepts of connectivity and planarity.
- To provide knowledge of graph coloring, covering and partitioning.
- To introduce the concepts of directed graphs and Euler digraphs.

UNIT I INTRODUCTION, PATHS AND CIRCUITS 9

Graphs introduction – Finite and Infinite graphs – Incidence and degree – Isolated vertex, Pendant vertex and Null graph – Isomorphism – Sub graphs – Walks, Paths and Circuits – Connected graphs, disconnected graphs and components – Euler graphs – Hamiltonian paths and circuits.

UNIT II TREES AND FUNDAMENTAL CIRCUITS 9

Trees – Properties of trees – Pendant vertices in a tree – Distance and centers in tree – Rooted and binary trees – Spanning trees – Fundamental circuits – Spanning trees in a weighted graph

UNIT III CONNECTIVITY AND PLANARITY 9

Connectivity and separability – Network flows – 1-isomorphism – 2-isomorphism – Combinational and geometric graphs – Planer graphs – Kuratowski's two graphs – Different representation of a planer graph.

UNIT IV COLORING, COVERING AND PARTITIONING 9

Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four color problem

UNIT V DIRECTED GRAPH 9

Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler digraphs

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the fundamental concepts of graphs, paths, circuits, Euler and Hamiltonian graphs.
- Apply tree properties and fundamental circuits to solve engineering problems.
- Analyze graph connectivity, network flows and planar graphs for modeling real-world systems.
- Apply graph coloring, matching, covering, and partitioning techniques to optimization and scheduling problems.
- Analyze directed graph and Euler digraphs in engineering applications.

TEXT BOOKS

1. Narsingh Deo., "Graph theory with applications to engineering and computer Science ", Prentice-Hall of India Pvt.Ltd, Fifth Edition, 2016.
2. L.R.Foulds , "Graph Theory Applications", Springer LTD, Seventh Edition, 2016

REFERENCES

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill Education (India) Private Ltd., Seventh Edition,, 2011.
2. Ralph P Grimaldi and B.V Ramana., "Discrete and Combinatorial Mathematics", Pearson Education limited, Fifth Edition, 2014.

E-RESOURCES

1. https://nptel.ac.in/courses/111106102 (Graph theory)
2. https://nptel.ac.in/courses/128106001 (Graph theory)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	1	-	-
2	3	3	2	-	-	-	-	-	-	-	1	-	-
3	3	3	2	1	-	-	-	-	-	-	1	-	-
4	3	3	3	1	-	-	-	-	-	-	2	-	-
5	3	3	2	1	-	-	-	-	-	-	2	-	-
AVG	3.00	2.80	2.25	1.00	-	-	-	-	-	-	1.40	-	-

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

Chairman - BoS

GENERAL ELECTIVES

23NCCL01 **NCC AIR FORCE LEVEL-1** **L T P C**

(Common to All UG Programme NCC Students) **3 0 0 3**

OBJECTIVES

- To familiarize students with the organizational structure of the National Cadet Corps (NCC), the duties and responsibilities of cadets, the incentives offered, and the significance of various NCC camps.
- To impart knowledge on personality development by enhancing communication skills, self-awareness, creative thinking, critical thinking, and leadership qualities.
- To introduce students to the qualities of effective leadership through the study of eminent leaders, their contributions, and the values required for responsible citizenship.
- To inculcate a sense of social responsibility by encouraging active participation in community service activities and promoting awareness of the role of youth in nation-building.
- To provide an understanding of the importance of health, hygiene, yoga, environmental cleanliness, and obstacle training while motivating students to contribute towards the vision of a Clean India.
- To provide practical training in foot drill, rifle drill, ceremonial drill, and social service activities for developing discipline, teamwork, leadership, and a sense of community responsibility.

UNIT I NCC GENERAL 7

Aims, objectives and Organization of NCC - incentives - duties of NCC Cadets - NCC camps - types - conduct.

UNIT II PERSONALITY DEVELOPMENT 7

Personality Development – Factors - Self Awareness - Communication skills –Empathy - Critical and Creative thinking - Decision making.

UNIT III LEADERSHIP 7

Leadership Capsule - Traits - Case studies - Leaders like APJ Abdul Kalam, RatanTata, shivaji, Tipu Sultan, Rabindranath Tagore, N Narayana murthy

UNIT IV SOCIAL SERVICE 7

Social Service Capsule – Basics - Rural development programmes – NGOs -Contribution of Youth - Swatch Bharath Abhiyan, Social evils - Drug Abuse - Digital Awareness - Waste Management - Women Health and Sanitation - Tree Plantation -Traffic Awareness - Pollution.

UNIT V HEALTH AND HYGIENE 7

Hygiene and sanitation – First Aid – Introduction to Yoga – Adventure – Environmental awareness and conservation – Obstacle Training – Adventure.

PRACTICAL COMPONENT 10

S.No	Name of the Experiment	CO Mapping	RBT
1	Foot Drill	CO1	Apply
2	Rifle Drill	CO1	Apply
3	Ceremonial Drill	CO2	Understand
4	Social Service and Community Development	CO4	Understand

TOTAL: 35+10= 45 PERIODS

OUTCOMES

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

- Explain the organizational structure of the NCC, the roles and responsibilities of cadets, and the significance of various NCC camps.
- Apply communication, self-awareness, and creative and critical thinking skills to demonstrate personality development and confidence.
- Analyze the leadership qualities and contributions of eminent leaders to develop effective leadership skills and responsible citizenship.
- Demonstrate social responsibility by participating in community service activities and promoting awareness of national development initiatives.
- Apply the principles of health, hygiene, yoga, environmental cleanliness, and obstacle training to maintain personal well-being and develop physical fitness.
- Demonstrate proficiency in foot drill, rifle drill, ceremonial drill, and social service activities by applying discipline, teamwork; leadership, and community service skills in practical situations.

TEXT BOOKS

1. Cadet Hand Book(Common Subjects),published by DG NCC.
2. Cadet Hand Book(Specialized Subjects),published by DG NCC.
3. ANO Handbook

REFERENCE BOOKS

1. Grooming tomorrow's Leaders, published by DG NCC.
2. Youth in Action, published by DGNCC.
3. The Cadet, Annual Journal of the NCC.
4. Précis Issued by respective Service Head quarters on specialized subject available to PI Staff as reference material.

E-RESOURCES

1. https://www.indiancc.nic.in
2. https://www.indiancc.mygov.in
3. https://www.play.google.com/MY_IAF
4. https://www.play.google.com/DGNCC_Training

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	–	–	–	3	3	2	2	–	2	–	–
2	2	3	2	–	–	3	2	3	3	3	2	–	–
3	2	3	2	2	–	3	3	2	2	2	2	–	–
4	3	2	2	2	–	3	3	2	3	2	2	–	–
5	3	2	2	2	2	3	3	2	–	–	2	–	–
6	2	2	3	–	–	3	3	3	3	2	2	–	–
AVG	2.50	2.33	2.20	2.00	2.00	3.00	2.83	2.33	2.60	2.25	2.00	–	–

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

Chairman - BoS

23NCCL03	NCC ARMY WING LEVEL-3	L TP C
	(Common to All UG Programme NCC Students)	3 0 0 3

COURSE PREREQUISITES: 75% Attendance in First Year of NCC Course

OBJECTIVES

- To learn the basic structure of NCC and its organization,Incentives,duties of Cadets; imbibe the knowledge of various types of Camp.
- To motivate the cadets as confidence leaders by refining theirpersonality andself-awareness, with the help of Communication skills andaware of creative, critical thinking abilities.
- To create an awareness on MilitaryHistoryand great heroes of India and to know about the important military operations
- To inspire the cadets to take part in the Social Service Activities and also to learn about the infantry battalion
- To acquire knowledge about the basics of health and hygiene, yoga, environment cleanliness and motivate young Indians towards the path of clean India and acquaint about obstacle training.
- To develop discipline, confidence, alertness, and coordination through the practice of basic foot drill movements and commands.

UNIT I NCC GENERAL 7

Aims, objectives and Organization of NCC-incentives-duties of NCC Cadets-NCC camps-types - conduct.

UNIT II PERSONALITY DEVELOPMENT 7

Personality Development -Factors-Self Awareness-Communication skills-Empathy-Critical and Creative thinking-Decision making.

UNIT III MILITARY HISTORY 7

Military History-Biographies, Heroes Study of Battle so fIndo-PakWar 1965,1971- Operation Meghdoot and Kargil.

UNIT IV SOCIAL SERVICE& INFANTRYBATALLION 7

Social Service Capsule-Basics-Rural development programmes-NGOs-Contribution of Youth - Swatch BharathAbhiyan, Social evils-Drug Abuse-Digital Awareness-Waste Management-Women Health and Sanitation-Organisation of Infantry,characteristics

UNIT V HEALTH AND HYGIENE 7

Hygiene and sanitation – First Aid – Introduction to Yoga – Adventure – Environmental awareness and conservation – Obstacle Training -Adventure

TOTAL: 35 PERIODS

OUTCOMES

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

- Understand the basic organization of NCC and roles, responsibilities of cadets for the smooth functioning of all camps
- Develop the cadets personality and to think divergently to break functional fixedness

- Identify the Leadership traits of military heroes and learn about their organization
- Understand the concept and important of Social service and evolution of infantry battalion
- Practice healthy practices to improve the personal sanitation and hygiene and get into the adventurous activities
- Execute drill procedures effectively while maintaining military etiquette, discipline, and coordination during parades.

TEXT BOOKS

1. Cadet Hand Book (Common Subjects), published by DGNCC.
2. Cadet Hand Book (Specialized Subjects), published by DGNCC.
3. ANO Handbook

REFERENCE BOOKS

1. Grooming tomorrow's Leaders, published by DG, NCC.
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4. https://www.play.google.com/DGNCC_Training

LIST OF DRILLS

(Common to All UG Programme NCC Students)

1. Foot Drill
2. Rifle Drill
3. Ceremonial Drill
4. Social Service and Community Development

TOTAL = 10 PERIODS

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	-	-	-	2	-	3	2	2	1	-	-
2	-	2	-	-	-	2	-	2	3	3	2	-	-
3	2	2	-	-	-	3	-	3	3	2	3	-	-
4	-	2	2	-	-	3	3	3	2	2	2	-	-
5	2	2	-	-	-	3	3	2	2	1	2	-	-
6	2	2	3	-	-	2	-	2	3	2	2	-	-
AVG	2.00	2.00	2.50	-	-	2.50	3.00	2.50	2.50	2.00	2.00	-	-

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

Chairman - BoS

MANDATORY COURSES I

23MDC501 INTRODUCTION TO WOMEN AND GENDER STUDIES L T P C 3 0 0 0

OBJECTIVES

- To introduce foundational concepts of sex, gender, masculinity, femininity, and socialization.
- To examine structural systems including patriarchy, essentialism, binaryism, power, and hierarchy.
- To study major theoretical frameworks of feminism
- To examine the history and evolution of global, national, and local women's movements.
- To analyze how gender is constructed and represented across language, popular visual media, and social media.

UNIT I CONCEPTS

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS:

Global, National and Local Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE

Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

OUTCOMES

- Identify and articulate concepts of socialization, binaryism, essentialism, and hegemony in social structures.
- Differentiate among various feminist theories and explain their core ideological foundations.
- Illustrate the milestones of women's rights movements in Europe, America, and India.
- Deconstruct linguistic forms and literary narratives to expose implicit gender biases.
- Assess media representations of gender roles in advertising and alternative media critically.

Chairman - BoS

23MDC502 **ELEMENTS OF LITERATURE** L T P C 3 0 0 0

OBJECTIVES

- To explain students aware of the finer sensibilities of human existence through art.
- To develop students' appreciation of different literature forms as modes of human expression.
- To enhance reading, critical thinking, discussion, and writing skills through literary studies.
- To familiarize students with the essential elements, modes, and patterns of fiction and narrative perspective.
- To explore the representational, theatrical, and rhetorical elements of drama and poetry.

.UNIT I RELEVANCE OF LITERATURE

Enhances Reading, thinking, discussing and writing skills. Develops finer sensibility for better human relationship. Increases understanding of the problem of humanity without bias. Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION

Fiction, fact and literary truth, Fictional modes and patterns. Plot character and perspective.

UNIT III ELEMENTS OF POETRY

Emotions and imaginations. Figurative language. (Simile, metaphor, conceit, symbol, pun and irony).Personification and animation. Rhetoric and trend

UNIT IV ELEMENTS OF DRAMA

Drama as representational art, Content mode and elements, Theatrical performance, Drama as narration, mediation and persuasion, Features of tragedy, comedy and satire.

READINGS:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

OUTCOMES

- Demonstrate enhanced reading, thinking, and writing skills by engaging with literary texts.
- Develop finer interpersonal sensibilities and an unbiased understanding of human issues.
- Experience catharsis and emotional reconciliation through literary analysis.
- Identify key figurative devices (metaphor, simile, irony, conceit) and emotional dimensions in poetry.
- Analyze dramatic performance, features of tragedy, comedy, satire, and narrative structures.

Chairman - BoS

23MDC503 **FILM APPRECIATION** L T P C
3 0 0 0

OBJECTIVES

- To introduce the development of film as an art and entertainment form.
- To explore the century-long evolution of film language, movement, and form.
- To instruct students on how to read a film text and appreciate its structural nuances.
- To examine technical components including equipment, screenplays, roles, and the filmmaking process.
- To guide students in studying film theory, criticism, and visual storytelling joyfully.

Theme – A: The Component of Films
A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making... structure of a film
Theme – B: Evolution of Film Language
B-1: Film language, form, movement etc.
B-2: Early cinema... silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies
Theme – C: Film Theories And Criticism/Appreciation
Theme – D: Development of Films
D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system
Theme - E: Indian Films
E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING: A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

OUTCOMES

- Explain the roles of materials, crew members, screenplays, and directors in film production.
- Trace the historical transition from silent cinema and early French films to talkies and feature films.
- Apply visual and auditory cinematic language to "read" films as complex texts.
- Evaluate film theories and engage in critical film appreciation.
- Demonstrate an understanding of storytelling structure and narrative techniques in modern cinema.

Chairman - BoS

23MDC504 **DISASTER RISK REDUCTION AND MANAGEMENT** L T P C
3 0 0 0

OBJECTIVE

- To impart knowledge on core concepts of hazards, vulnerability, resilience, and disaster risks.
- To familiarize students with international frameworks (Sendai Framework) and community-based risk reduction strategies.
- To explain the legislative, policy, and institutional frameworks governing disaster management in India.
- To introduce tools, technology, and early warning systems used in preparedness and damage assessment.
- To build practical response skills using case studies, field work, and mock drills.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India

UNIT II DISASTER RISK REDUCTION (DRR)

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES

Discussion on selected case studies to analyze the potential impacts and actions in the contest of disasters-Landslide Hazard Donation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies;

Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

OUTCOMES

- Categorize natural, human-induced, and climate-related disasters and assess India's vulnerability profile.
- Formulate disaster risk reduction measures using structural, non-structural, and indigenous methods.
- Understand institutional roles (NDMA, SDMA, DDMA) and legal provisions under the Disaster Management Act (2005).
- Apply GIS, information technology, and standard operating procedures for risk assessment and relief planning.
- Perform damage assessments and participate in mock drills, practical response plans, and field interventions.

Chairman - BoS

23MDC505 **CONSTITUTION OF INDIA** L T P C
3 0 0 0

OBJECTIVES

The main objective of this course is to:

- Understand the meaning of the Constitution law and Constitutionalism.
- Realize the fundamental rights.
- Understand the execution powers of union and states bout.
- Be aware of the Constitutional powers.
- Acquaint with other Constitutional functionaries

UNIT I INTRODUCTION

Meaning of the Constitution law and constitutionalism - Historical perspective of the Constitution of India - Preamble - Salient features and characteristics of the Constitution of India - Citizenship.

UNIT II FUNDAMENTAL RIGHTS

Scheme of the fundamental rights - The scheme of the fundamental duties and its legal status - The directive principles of state policy - Its importance and implementation.

UNIT III UNION AND STATE EXECUTIVE

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary form of Government in India - The Constitution powers and status of the President of India - Governor - Appointment, powers and functions.

UNIT IV CONSTITUTIONAL POWERS

Amendment of the Constitutional powers and procedure - The historical perspectives of the Constitutional amendments in India - Emergency provisions: National emergency, President rule, financial emergency.

UNIT V OTHER CONSTITUIONAL FUNCTIONARIES

Election Commission of India: Organization, powers and functions, Union Public Service Commission, State Public Service Commission - Local Self Government.

OUTCOMES

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

- Understand the salient features and characteristics of the Constitution of India.
- Analyze the scheme of the fundamental rights and duties.
- Evaluate in detail the powers between the Union and the States.
- Know the concept of Constitutional powers.
- Recognize other Constitutional functionaries.

Chairman - BoS

MANDATORY COURSES II

23MDC601	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDH	L T P C 3 0 0 0

OBJECTIVES

- To enjoy life happily with fun filled new style activities that help to maintain health.
- To adapt a few lifestyle changes that will prevent many health disorders.
- To be cool and handbill every emotion very smoothly in every walk of life.
- To learn to eat cost effective but healthy foods that are rich in essential nutrients.
- To develop immunity naturally that will improve resistance against many health disorders.

UNIT I HEALTH AND ITS IMPORTANCE

Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain -. Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath

UNIT II DIET

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

OUTCOMES

- Identify and explain the ten types of health, including physical, mental, emotional, spiritual, and environmental health.
- Analyze the role of a balanced diet and its 7 components in preventing lifestyle disorders like diabetes, hypertension, and arthritis.
- Understand the principles of Siddha and Ayurveda systems, including the Five Element Theory, Tri-Dosha Theory, and daily/seasonal regimens (Dinacharya/Ritucharya).
- Apply stress management techniques, sleep hygiene practices, and emotion-regulation strategies to enhance mental wellness.
- Demonstrate basic yogasanas and understand the Eight Limbs of Yoga for health disorder prevention and cure.

Chairman - BoS

23MDC602 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA L T P C
3 0 0 0

OBJECTIVES

- To enjoy life happily with fun filled new style activities that help to maintain health also.
- To adapt a few lifestyle changes that will prevent many health disorders.
- To be cool and handle every emotion very smoothly in every walk of life.
- To learn to eat cost effective but healthy foods that are rich in essential nutrients.
- To develop immunity naturally that will improve resistance against many health disorders.

UNIT-I CONCEPTS AND PERSPECTIVES

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT-II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT-III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT-IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT-V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

Science and Technology In A Post-Independent India

Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology.

COURSE OUTCOMES

- Explain the concepts, perspectives, and significance of history, science, and technology in India.
- Examine the contributions of major historians to the historiography of science and technology in India.

- Analyze the development of science and technology in Ancient and Medieval India and their societal contributions.
- Analyze the influence of colonial rule on scientific progress and institutional development in India.
- Evaluate the advancements in science and technology in post-independent India and their impact on development and globalization.

Chairman - BoS

23MDC603	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	L T P C 3 0 0 0

OBJECTIVES

- To Define key historical concepts like determinism, relativism, causation, and historical positivism as applied to science and technology.
- To Recognize the historiographical contributions of scholars such as D.D. Kosambi, Dharampal, and Debiprasad Chattopadhyay.
- To Explain the technological advancements made during ancient and medieval Indian history, including interactions with Arabic sciences.
- To Evaluate the growth of techno-scientific institutions and the Indian response to Western science during the colonial period.
- To Assess the social implications of emerging technologies and science policy decisions in post-independent and globalizing India.

COURSE TOPICS:

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. **(9 lectures, 1 hour each)**
(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(5 lectures)**
(Refs: Adam smith, J S Mill)
Fascism and totalitarianism. World war I and II. Cold war. (**2 lectures)**
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.
(Refs: Marx, Lenin, Mao, M N Roy) (**5 lectures)**
Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. (6 lectures)
(Refs: M K Gandhi, Schumacher, Kumarappa)
Essential elements of Indian civilization. **(3 lectures)**
(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)
Technology as driver of society, Role of education in shaping of society.
Future directions. **(4 lectures)**
(Refs: Nandkishore Acharya, David Dixon, Levis Mumford)
Conclusion **(2 lectures)**

OUTCOMES

- Understand the core considerations required for a humane society and achieving harmony across self, society, and nature.
- Compare the theoretical foundations and historical implementations of free-market capitalism, imperialism, and communism.
- Analyze the relation between human desires, empowerment, satisfaction, and the mechanisms of a welfare state.

- Apply Gandhian economic and political thought (Swaraj, decentralized polity) to contemporary societal and environmental challenges.
- Evaluate future directions for society by considering technology as a driver and education .

Chairman - BoS

23MDC604 **STATE, NATION BUILDING AND POLITICS IN INDIA** L T P C
3 0 0 0

OBJECTIVES

- To provide an understanding of the state, its main organs (Executive, Legislature, Judiciary), separation of powers, and the concept of sovereignty.
- To acquaint students with the legacies of the national movement and constitutional development in India.
- To explain the reasons for adopting a Parliamentary-federal system and the broad philosophy of the Constitution of India.
- To examine the changing nature of the Indian political system, new social movements, and challenges to nation-building.
- To discuss issues concerning national integration and nation-building with the aim of developing a future vision for better governance.

TOPICS:

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world. 183 Organs of State – Executive, Legislature, Judiciary. Separation of powers forms of government unitary-federal, Presidential-Parliamentary, and The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies.

Constitution making and the Constitution of India.

Goals, objective and philosophy. Why a federal system? National integration and nation-building

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?

OUTCOMES

- Understand the theoretical aspects of the state, its organs, operationalization, and sovereignty in a globalized world.
- Explain the historical background, philosophy, goals, and objectives behind the founding of the Indian Constitution.
- Analyze the rationale behind adopting a federal-parliamentary system and the broad streams of national integration.
- Identify major challenges to nation-building, social movements, and institutional difficulties within the democratic setup.
- Devise perspectives for active participation in the system to improve governance and delivery for the common citizen.

Chairman - BoS

23MDC605 **INDUSTRIAL SAFETY** L T P C
3 0 0 0

OBJECTIVES

- To understand the introduction and basic terminologies of safety.
- To enable the students to learn about the important statutory regulations and standards.
- To enable students to conduct and participate in various safety activities in the industry.
- To have knowledge about workplace exposures and hazards.
- To assess various hazards and consequences through various risk assessment techniques

UNIT I SAFETY TERMINOLOGIES

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment-Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY Noise hazard- Particulate matter-musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA-Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis-Event Tree Analysis Qualitative and Quantitative Risk Assessment- 217 Checklist Analysis-Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

COURSE OUTCOMES

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

Chairman - BoS

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

SCHEME

MINOR DEGREE / HONOURS

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DEPARTMENT OF ROBOTICS AND AUTOMATION

REGULATIONS 2023

MINOR DEGREE / HONOURS

INDUSTRIAL ROBOTICS

CURRICULUM AND SYLLABI

Estd. 2001

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 Process Automation	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23RMIP01	Project Work	EEC	0	0	12	6	60	40	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 familiarize students with robot anatomy, classification, and industrial automation strategies.
- To introduce robotic gripper design and the integration of sensing and vision systems.
- To provide knowledge on drive types, transmission systems, and closed-loop control architectures.
- To impart proficiency in programming methods and languages from VAL to ROS
- To inculcate awareness of AI techniques, safety standards, and the economic impacts of 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;

- Explain the 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
- Develop knowledge of AI techniques in the area of robotic technology.

TEXT BOOKS

1. S.K.Saha, "Introduction to Robotics", TATA Mc Graw Hills Education, Second Edition, 2021.
2. Asitava Ghoshal," Robotics": Fundamental concepts and analysis, Oxford University Press, First Edition, 2019.

REFERENCES

1. S. B. Niku," Introduction to Robotics" – Analysis, Control, Applications, Third 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. 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/107/106/107106090/ - (Introduction to robotics)
2. https://archive.nptel.ac.in/courses/107/106/107106090/Robot – (Kinematics and anatomy)

Mapping of COs-POs &PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1	1	2	-	-	-	-	-	1	2	2
2	2	1	1	1	2	-	-	-	-	-	1	2	2
3	2	1	1	1	2	-	-	-	-	-	1	2	2
4	2	1	1	1	2	-	-	-	-	-	1	2	2
5	2	1	1	1	2	-	-	-	-	-	1	2	2
AVG	2.00	1.00	1.00	1.00	2.00	-	-	-	-	-	1.00	2.00	2.00

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

Chairman - BoS

SEMESTER IV

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

OBJECTIVES

- To impart knowledge on the history, elements, and hierarchical levels of industrial automation systems.
- To introduce the principles of fluid power systems and the application of Boolean algebra in logic gates.
- To familiarize students with material handling equipment, AGVs, and automated assembly machine configurations.
- To provide an understanding of PLC hardware architecture, I/O modules, and Human Machine Interface (HMI).
- To develop awareness of microprocessor integration, feedback devices, and the fundamentals of SCADA.

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;

- Develop the process 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.
- Apply the concepts of programming logic controller units for industrial applications.
- Apply the techniques 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, Fourth Edition, 2021.
2. Frank. D.Petruzella, "Programmable Logic Controllers", Tata McGraw-Hill Education, Fourth Edition, 2021.

REFERENCES

1. M.P.Groover, Automation, Production systems and Computer Integrated Manufacturing, PHI Learning, Fifth Edition, 2020.
2. Geoffrey Boothroyd, Assembly Automation and Product design, Taylor and Francis Publishers, Third Edition, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/112/105/112105249/ - (Fluid power and fluid systems)
2. https://archive.nptel.ac.in/courses/112/105/112105249/ - (Industrial Automation)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2	2	-	2	-	1	-	-	-	1	3	1
CO 2	3	2	2	-	2	-	1	-	-	-	1	3	1
CO 3	3	2	2	-	2	-	1	-	-	-	1	3	1
CO 4	3	2	2	-	2	-	1	-	-	-	1	3	1
CO 5	3	2	2	-	2	-	1	-	-	-	1	3	1
AVG	3.00	2.00	2.00	-	2.00	-	1.00	-	-	-	1.00	3.00	1.00

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

Chairman - BoS

SEMESTER V

23RMIT03	APPLIED AND INDUSTRIAL ROBOTICS	L T P C 3 0 0 3

OBJECTIVES

- To impart knowledge on robot-centered cell design, assembly configurations, and vision-based inspection systems.
- To familiarize students with robot performance testing, safety barriers, and industrial selection criteria.
- To introduce the principles of cooperative manipulation, multi-agent systems, and swarm robotic algorithms.
- To provide an understanding of field robots in agriculture, construction, and hazardous search-and-rescue missions.
- To develop awareness of medical robotic systems, rehabilitation aids, and smart prosthetic technologies.

UNIT I ROBOT MATERIAL HANDLING 9

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 9

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 9

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
- Explain the concepts of various cooperative and SWARM robots and its applications.
- Analyze robotic configurations and specifications for field and service applications.
- Develop the core concepts of robots in medical applications.

TEXT BOOKS

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics Technology, Programming and Applications", TataMc Graw Hill Book company, Fourth Edition, 2021.
2. Bernard Hodges," Industrial Robotics", Jaico Publishing House, Second Edition, 2020.

REFERENCES

1. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2018.
2. LMarques,AdeAlmeida,Mo Tokhi,GSVirk, "Advances in Mobile Robotics", World Scientific Publishing Co. Pvt. Ltd. 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/120108004 - (Environment Management)
2. https://archive.nptel.ac.in/courses/112/105/112105249/ - (Industrial robots and its application)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	-	2	-	-	1	-	-	1	3	1
2	3	2	2	-	2	-	-	1	-	-	1	3	1
3	3	2	2	-	2	-	-	1	-	-	1	3	1
4	3	2	2	-	2	-	-	1	-	-	1	3	1
5	3	2	2	-	2	-	-	1	-	-	1	3	1
AVG	3.00	2.00	2.00	-	2.00	-	-	1.00	-	-	1.00	3.00	1.00

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

Chairman - BoS

SEMESTER VI

23RMIE01	ROBOTIC PROCESS AUTOMATION (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To impart RPA architecture, SDLC differences, and business case standardization.
- To introduce tool interfaces, variable management, and advanced control flow logic.
- To focus on the advanced automation and its techniques.
- To enhance the level of handling, debugging and logging operations.
- To impart deploy and maintain the software bot.
- To develop the practical skills the basics of fundamentals of robotics systems.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

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 9

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 ADVANCED AUTOMATION CONCEPTS & TECHNIQUES 9

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.

UNIT V 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

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

TOTAL = 45+15 = 60 PERIODS

OUTCOMES

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

- Explain the basics of RPA and its applications.
- Apply basic RPA tools and control flow activities.
- Apply advanced RPA techniques for process automation.
- Analyze events and handle exceptions in RPA.
- Apply techniques to deploy and maintain RPA bots.
- Apply robotic concepts, kinematics, grippers, configurations, and industrial robot operations to demonstrate and analyze robotic systems.

TEXT BOOKS

1. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, Second Edition, 2019.
2. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, First Edition, 2018.

REFERENCES

1. Frank Casale, Rebecca Dilla, Heidi Jayne's, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, First Edition, 2019.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, First Edition, 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/107/106/107106090/ -(Introduction to automation process.)
2. https://nptel.ac.in/courses/107/106/107106090/-(Robotic Process Automation).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	2	2	-	-	1	-	1	1	3	2
2	3	3	3	2	2	-	-	1	-	1	1	3	2
3	3	3	3	2	2	-	-	1	-	1	1	3	2
4	3	3	3	2	2	-	-	1	-	1	1	3	2
5	3	3	3	2	2	-	-	1	-	1	1	3	2
6	3	3	3	3	-	-	-	-	3	3	1	3	2
AVG	3.00	3.00	3.00	2.17	2.00	-	-	1.00	3.00	1.33	1.00	3.00	2.00

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

Chairman - BoS

23RMIP01

SEMESTER VII
PROJECT WORK

L T P C
0 0 12 6

OBJECTIVES

- To develop knowledge to formulate a real world problem and projects goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

PROCESS DESCRIPTION

- For Project work out of 100 marks, the maximum marks for Continuous Internal Assessment is fixed as 60 and the End Semester Examination (project report evaluation and viva voce examination) carries 40 marks. Project work shall be assigned to a single student.
- The project work shall be undertaken by students either in industry or in the college.
- The total credit for project work is 6.
- There shall be three reviews (Zeroth Review,(Review I and Review II, each 100 marks)) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee.
- The committee shall consist of the Supervisor, Project Coordinator and one of the faculty members.
- The student(s) is expected to submit the project report on or before the last working day of the semester. The ESE for the project work shall consist of the evaluation of the final project report submitted by the student or students of the project group by an external examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner and an internal examiner (other than supervisor). The project coordinator shall be the internal examiner. The COE shall appoint the External Examiner for the ESE of the Project Work. The project report shall be submitted as per the approved guidelines given by Controller of Examinations.

OUTCOMES

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

- Formulate real-world problems.
- Design and express technical solutions using appropriate tools and techniques.
- Test and validate prototypes for efficiency and cost-effectiveness, and present their
- work effectively through reports and oral demonstrations.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Mapping outcome	3	3	3	3	3	3	3	3	3	3	3	3	3

1-Low, 2-Medium, 3-High, "-" - No Correlation

Chairman - BoS

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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	60	40	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	LT P C 3 0 0 3

OBJECTIVES

- To impart knowledge on robot anatomy, joints, links, and various drive system architectures.
- To introduce mechanical gripper mechanisms, force analysis, and feedback control devices like LVDT.
- To familiarize students with kinematic transformations, homogeneous coordinates, and robotic sensing technologies.
- To provide an understanding of work cell design, mobile robots, and micro/nano-robotics fabrication.
- To develop proficiency in robot programming types, coordinate systems, and controller motion commands.

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 the end effectors types and Robot Controls.
- Apply the concepts of Robot Transformations and Sensors.
- Explain about the Robot Cell Design.
- Apply the Robot Programming concepts and types of languages in robot systems.

TEXT BOOKS

1. Craig. J. J. "Introduction to Robotics mechanics and control", Pearson Education Fourth Edition, 2019.
2. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education, Second Edition, 2019.

REFERENCES

1. Mikell. P. Groover, "Industrial Robotics Technology", Tata McGraw Hill Co, Third Edition, 2020.
2. Klafter. R.D, Chmielewski.T.A. and Noggin"s., "Robot Engineering : An Integrated Approach", Prentice Hall of Indiaz Pvt. Ltd., Second Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/107106090 - (controls and systems.)
2. https://archive.nptel.ac.in/courses/112/101/112101099/-(Robot end effectors and gripper systems).

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	-	2	-	-	1	-	-	1	3	1
2	3	2	2	-	2	-	-	1	-	-	1	3	1
3	3	2	2	-	2	-	-	1	-	-	1	3	1
4	3	2	2	-	2	-	-	1	-	-	1	3	1
5	3	2	2	-	2	-	-	1	-	-	1	3	1
AVG	3.00	2.00	2.00	-	2.00	-	-	1.00	-	-	1.00	3.00	1.00

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

Chairman - BoS

SEMESTER IV

23RMAT02	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE FOR ROBOTICS	LT P C 3 0 0 3

OBJECTIVES

- To introduce the fundamentals of Artificial Intelligence, including its history, cognitive processes, and intelligent agents.
- To impart knowledge on problem formulation and the application of uninformed and informed search strategies for effective problem solving.
- To focus on AI programming using LISP and PROLOG, and symbolic logic with non-deductive inference methods.
- To inculcate knowledge of AM potentials, complex geometries, and customization strategies.
- To familiarize students with AI applications in robotics, including perception, mapping, motion control, and ethical considerations.

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 basics of AI, human cognitive emulation, and the structure of intelligent agents.
- Identify and apply appropriate problem-solving and search strategies.
- Analyze AI programs in LISP and PROLOG and evaluate symbolic logic and non-deductive inference methods.
- Apply additive manufacturing concepts for complex geometries and customized parts.
- Examine AI applications in robotics, including perception, mapping, motion control, and ethical considerations.

TEXT BOOKS

1. Russell Stuart, Norvig Peter, "Artificial Intelligence Modern Approach", Pearson Education series in AI, Third Edition, 2020.
2. Dan.W.Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI Learning, Second Edition, 2021.

REFERENCES

1. Donald.A.Waterman, "A guide to Expert Systems", Pearson, First Edition, 2020.
2. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution",Crabtree Publishing Company, Second Edition, 2019.

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/1011080470040/ - (Search methods in robots.)
2. https://onlinecourses.nptel.ac.in/1011080470040/ - (Programming languages in robots.)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	1	1	-	-	1	2	3	3
2	3	3	3	3	2	-	1	-	-	-	1	3	3
3	3	3	3	3	3	1	1	1	-	1	1	3	3
4	3	3	2	3	3	-	1	-	-	-	1	3	3
5	3	2	3	2	3	-	1	-	-	-	1	3	2
AVG	3.00	2.80	2.80	2.80	2.80	1.00	1.00	1.00	-	1.00	1.20	3.00	2.80

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

Chairman - BoS

SEMESTER V

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

OBJECTIVES

- To impart knowledge on machine learning varieties, input-output functions, and performance evaluation metrics.
- To introduce foundational supervised models including decision trees, k-nearest neighbors, and logistic regression.
- To familiarize students with gradient descent, support vector machines, and probabilistic Naïve Bayes modeling.
- To provide an understanding of dimensionality reduction, K-means clustering, and expectation-maximization algorithms.
- To develop proficiency in neural network representations, backpropagation, and AI-driven robotic navigation case studies.

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:

- Classify machine learning types based on training regimes and performance evaluation metrics.

- Build supervised models using decision trees and logistic regression for binary classification.
- Analyze linear models and Support Vector Machines (SVM) using gradient descent techniques.
- Compare K-means and hierarchical clustering methods to address the curse of dimensionality.
- Construct feed-forward neural networks to solve robotic obstacle avoidance and navigation tasks.

TEXT BOOKS

1. Sebastian Thrun,"Machine Learning for Robotics" Cambridge University Press, Second Edition, 2022.
2. Gonzalez-Brenes, "Machine Learning for Autonomous Robotics" , Springer , Second Edition, 2022.

REFERENCES

1. Dragos Crisan, "Machine Learning in Robotics: Methods and Applications", IntechOpen , Second Edition, 2022.
2. Peter Corke, "Robotics, Vision & Control: Fundamental Algorithms in MATLAB", Springer, Third Edition, 2020.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/106/106/106106202/ -(Introduction to machine learning)
2. https://www.youtube.com/watch?v=QlhHqMnd9Wo - (Introduction to neural networks)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	2	-	-	-	-		2	3	1
2	3	2	2	1	2	-	-	-	-	-	2	3	1
3	3	2	2	1	2	-	-	-	-	-	2	3	1
4	3	2	2	1	2	-	-	-	-	-	2	3	1
5	3	2	2	1	2	-	-	-	-	-	2	3	1
AVG	3.00	2.00	2.00	1.00	2.00	-	-	-	-	-	2.00	3.00	1.00

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

Chairman - BoS

SEMESTER VI

23RMAE01	ADVANCED CONTROL SYSTEMS DRIVERS FOR ROBOTS	LT P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

- To develop knowledge of digital control systems and discrete-time signals.
- To impart knowledge of stability methods for discrete systems.
- To enhance skills in modeling digital control systems and designing compensators.
- To impart knowledge on control system analysis using state variable methods, including state equations, eigenvalues, controllability, and observability.
- To enhance understanding of state variable analysis in digital control systems, including pulse transfer functions, state equations, controllability, and observability.
- To inculcate fundamental knowledge of sampling, reconstruction, and basic discrete-time signals in digital control systems.

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.

LIST OF EXPERIMENTS

1. Simulation of Sampling and Reconstruction in Digital Control Systems
2. Generation and Analysis of Basic Discrete-Time Signals
3. Stability Analysis of Digital Control System Using z-Plane Methods
4. Modeling and Simulation of Digital Position Control System
5. State-Space Modeling and Analysis of Robotic Actuator
6. State-Space Analysis of Digital Control System for Stepper Motor

TOTAL: 45+15 =60PERIODS

OUTCOMES

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

- Explain the configuration, sampling operations, and basic discrete-time signals in digital control systems

- Apply Routh, Jury, and Schur-Cohn methods to determine system stability.
- Construct models of digital control systems and compensators.
- Apply state variable methods to analyze digital control systems.
- Analyze digital control systems using state variable models, and evaluate controllability, observability, and system responses.
- Illustrate and simulate sampling, reconstruction, and discrete-time signals in digital control systems.

TEXT BOOKS

1. M.Gopal, "Digital Control and State Variable Methods", Tata Mc-Graw-Hill., Second Edition, 2017.
2. K.Ogata, "Discrete Time Control Systems", Pearson Education, Second Edition, 2015.

REFERENCES

1. I.J. Nagrath and M. Gopal, "Control Systems Engineering" New Age International Publishers, Eighth Edition, 2019 .
2. K.K. Aggarwal, "Control System Analysis and Design", Khanna Publishers, Sixth Edition,2014

E-RESOURCES

1. https://nptel.ac.in/courses/108103008 (Digital Control System)
2. https://nptel.ac.in/courses/108103007 (Advanced Control Systems)

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3	1	1	1	2	1	1	3	3
2	3	3	3	3	3	-	-	1	2	1	1	3	3
3	3	3	3	2	3	1	1	2	3	2	2	3	3
4	3	3	2	3	3	-	-	2	2	1	2	3	3
5	3	3	3	3	3	1	1	2	3	2	2	3	3
6	3	3	3	3	2	-	1	1	2	1	1	3	3
AVG	3.00	3.00	2.83	2.83	2.83	1.00	1.00	1.50	2.33	1.33	1.50	3.00	3.00

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

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SEMESTER VII

23RMAP01 **PROJECT WORK** **L T P C**
0 1 2 6

OBJECTIVES

- To develop knowledge to formulate a real world problem and projects goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

PROCESS DESCRIPTION

- For Project work out of 100 marks, the maximum marks for Continuous Internal Assessment is fixed as 60 and the End Semester Examination (project report evaluation and viva voce examination) carries 40 marks. Project work shall be assigned to a single student.
- The project work shall be undertaken by students either in industry or in the college.
- The total credit for project work is 6.
- There shall be three reviews (Zeroth Review,(Review I and Review II, each 100 marks)) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee.
- The committee shall consist of the Supervisor, Project Coordinator and one of the faculty members.
- The student(s) is expected to submit the project report on or before the last working day of the semester. The ESE for the project work shall consist of the evaluation of the final project report submitted by the student or students of the project group by an external examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner and an internal examiner (other than supervisor). The project coordinator shall be the internal examiner. The COE shall appoint the External Examiner for the ESE of the Project Work. The project report shall be submitted as per the approved guidelines given by Controller of Examinations.

OUTCOMES

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

- Formulate real-world problems.
- Design and express technical solutions using appropriate tools and techniques.
- Test and validate prototypes for efficiency and cost-effectiveness, and present their work effectively through reports and oral demonstrations.

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Mapping outcome	3	3	3	3	3	3	3	3	3	3	3	3	3

1-Low, 2-Medium, 3-High, "-" - No Correlation

Chairman - BoS

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(AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
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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