ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.E. INSTRUMENTATION AND CONTROL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Bachelor of Instrumentation and Control Engineering curriculum is designed to prepare the graduates to acquire knowledge, skills and attitudes in order to:

- Succeed in their professional career and develop innovative products
- Intrigue in the life- long learning to get flourished with the upcoming state of art technologies.
- Demonstrate leadership capability and social responsibility.

PROGRAMME OUTCOMES (POs):

The graduates will have the ability to

1. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
2. Identify and formulate Instrumentation Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
3. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
4. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
5. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also being conscious of the limitations.
6. Understand the role and responsibility of the Professional Instrumentation Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
7. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for sustainable Development.
8. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
9. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
10. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
11. Demonstrate the knowledge and understanding of Engineering and Management principles and to apply these to one's own work as a member / leader in a team to manage Electronics / Instrumentation / Control and Automation projects.
12. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After completion of Electronics and Instrumentation Engineering program, students will gain core competency skills in domains such as Electronics, Instrumentation and Process Control

1. Exhibit the fundamental concepts of measurement and control to varied measurement systems, industrial processes and configuring industrial automation system.
2. Select and apply cutting-edge technologies and adapt towards the changing interdisciplinary technologies to endow with a achievable solution.
3. Understand and analyze control problem for the interdisciplinary applications and provide suitable state of art solutions.

PEO's – PO's& PSO's MAPPING

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	2	2	2	1	1	1	1	3	1	1
2	2	2	2	2	2								3	2	2
3	1	1	1	2	2									2	3

PROGRESS THROUGH KNOWLEDGE

ANNA UNIVERSITY, CHENNAI
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REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
B. E. INSTRUMENTATION AND CONTROL ENGINEERING
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER – I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
	GE3152	அறிவியல் தமிழ் / **Scientific Thoughts in Tamil**	HSMC	1	0	0	1	1
PRACTICALS								
7.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	GE3172	English Laboratory$	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER – II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3255	Physics for Instrumentation Engineering	BSC	3	0	0	3	3
4.	BE3255	Basic Civil and Mechanical Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.	EE3251	Electric Circuit Analysis	PCC	3	1	0	4	4
7.		NCC Credit Course Level1#	-	2	0	0	2	2#
	GE3252	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	EE3271	Electric Circuits Laboratory	PCC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language$	EEC	0	0	4	4	2
			TOTAL	**17**	**2**	**16**	**35**	**27**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3353	Transforms and Differential Equations	BSC	3	1	0	4	4
2.	EI3351	Analog Electronics	PCC	3	0	0	3	3
3.	EI3352	Digital System Design and Applications	PCC	2	1	0	3	3
4.	EI3353	Transducers Engineering	PCC	3	0	0	3	3
5.	EI3354	Linear Integrated Circuits and Applications	PCC	3	0	0	3	3
6.	CS3353	C Programming and Data Structures	PCC	3	0	0	3	3
PRACTICALS								
7.	EI3361	Semiconductor Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
8.	CS3362	C Programming and Data Structures Laboratory	PCC	0	0	3	3	1.5
9.	GE3361	Professional Development$	EEC	0	0	2	2	1
			TOTAL	**17**	**2**	**8**	**27**	**23**

$ Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI3451	Industrial Instrumentation	PCC	3	0	0	3	3
2.	IC3451	Automatic Control Systems	PCC	3	1	0	4	4
3.	IC3401	Modern Electronic Instrumentation	PCC	3	0	0	3	3
4.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
5.	IC3402	Embedded Systems and IoT	PCC	3	0	2	5	4
6.	IC3452	Electrical Machines and Drives	PCC	2	0	2	4	3
7.		NCC Credit Course Level 2#		3	0	0	3	3#
PRACTICALS								
8.	EI3461	Digital and Linear Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
9.	EI3462	Sensors and Signal Conditioning Circuits Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**16**	**1**	**10**	**27**	**22**

 # NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI3551	Process Control	PCC	3	0	0	3	3
2.	IC3501	Advanced Control Theory	PCC	3	0	0	3	3
3.		Professional Elective I	PEC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Professional Elective IV	PEC	3	0	0	3	3
7.		Mandatory Course-I[&]	MC	3	0	0	3	0
PRACTICALS								
8.	EI3561	Process Control and Instrumentation Laboratory	PCC	0	0	4	4	2
			TOTAL	**21**	**0**	**4**	**25**	**20**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI3651	Industrial Automation Systems	PCC	3	0	0	3	3
2.	EI3652	Introduction to Industrial Processes, Measurement and Control	PCC	3	0	0	3	3
3.		Open Elective – I*	OEC	3	0	0	3	3
4.		Professional Elective V	PEC	3	0	0	3	3
5.		Professional Elective VI	PEC	3	0	0	3	3
6.		Professional Elective VII	PEC	3	0	0	3	3
7.		Professional Elective VIII	PEC	3	0	0	3	3
8.		Mandatory Course-II[&]	MC	3	0	0	3	0
9.		NCC Credit Course Level[#]		3	0	0	3	3[#]
PRACTICALS								
10.	EI3661	Industrial Automation Systems Laboratory	PCC	0	0	4	4	2
			TOTAL	**24**	**0**	**4**	**28**	**23**

*** Open Elective – I shall be chosen from the emerging technologies**

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)

 # NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI3751	Industrial Data Communication	PCC	3	0	0	3	3
2.	EI3752	Applied Machine learning	PCC	3	0	0	3	3
3.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
4.		Elective – Management	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
			TOTAL	**20**	**0**	**0**	**20**	**20**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**
****Open Elective – II shall be chosen from the emerging technologies**
*****Open Elective III and IV (shall be chosen from the list of open electives offered by other Programmes).**

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IC3811	Project Work / Internship	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

TOTAL CREDITS RANGE :167

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

ELECTIVE - MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES : VERTICALS

Professional Elective	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII
	Automation	**Internet of Things**	**Advanced Control**	**Applied Instrumentation**	**Health Care Instrumentation**	**Semi conductor / Communication**	**Computer**
1.	PLC Programming	Industry IoT	Process Modeling and Simulation	Fiber Optics Instrumentation	Biomedical Instrumentation	Digital VLSI	Data Science
2.	Robotics and Automation	Sensor for IoT Application	Computer Control of Processes	Analytical Instrumentation	Bio Signal Processing	Semiconductor Manufacturing	Virtual / Augmented Reality
3.	Industry 4.0	IoT for Industry Automation	System Identification	Electric Vehicle Technology	Digital Image Processing	Automotive Electronics	Computer Architecture
4.	Intelligent Automation	Data Analytics for IoT	Non Linear Control	Thermal Power Plant Instrumentation	Medical Imaging	Green Electronics	Computer Vision
5.	Smart Manufacturing	IoT for Smart Agriculture	Adaptive Control	Instrumentation in Petrochemical Industry	Medical Robotics	Real Time Embedded Systems	Cloud and Edge computing
6.	Cyber Security	IoT Security	Model Based Control	Safety Instrumented Systems	Brain Control and Application	Solar PV Fundamental and Applications	Block Chain Technology
7.	Building Automation	IoT for Smart Cities	Optimal Control	Renewable Systems	Diagnosis and Therapeutic Equipment	Communication Systems	Deep and Reinforcement Learning
8.	Smart Farming	IoT and Edge computing	Machine Monitoring System	Automotive Instrumentation and Control	Physiological Control Systems	Wireless Sensor Networks	Java Programming

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I : AUTOMATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEI331	PLC Programming	PEC	3	0	0	3	3
2.	CEI332	Robotics and Automation	PEC	3	0	0	3	3
3.	CEI333	Industry 4.0	PEC	3	0	0	3	3
4.	CEI334	Intelligent Automation	PEC	3	0	0	3	3
5.	CEI335	Smart Manufacturing	PEC	3	0	0	3	3
6.	CEI336	Cyber Security	PEC	3	0	0	3	3
7.	CEI337	Building Automation	PEC	3	0	0	3	3
8.	CEI338	Smart Farming	PEC	3	0	0	3	3

VERTICAL II : INTERNET OF THINGS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEI339	Industry IoT	PEC	3	0	0	3	3
2.	CEI340	Sensor for IoT Application	PEC	3	0	0	3	3
3.	CEI341	IoT for Industry Automation	PEC	3	0	0	3	3
4.	CEI342	Data Analytics for IoT	PEC	3	0	0	3	3
5.	CEI343	IoT for Smart Agriculture	PEC	3	0	0	3	3
6.	CEI344	IoT Security	PEC	3	0	0	3	3
7.	CEI345	IoT for Smart Cities	PEC	3	0	0	3	3
8.	CEI346	IoT and Edge computing	PEC	3	0	0	3	3

VERTICAL III : ADVANCED CONTROL

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CIC331	Process Modeling and Simulation	PEC	3	0	0	3	3
2.	CIC332	Computer Control of Processes	PEC	3	0	0	3	3
3.	CIC333	System identification	PEC	3	0	0	3	3
4.	CIC334	Non linear Control	PEC	3	0	0	3	3
5.	CIC335	Adaptive Control	PEC	3	0	0	3	3
6.	CIC336	Model Based Control	PEC	3	0	0	3	3
7.	CIC337	Optimal Control	PEC	3	0	0	3	3
8.	CIC338	Machine Monitoring System	PEC	3	0	0	3	3

VERTICAL IV : APPLIED INSTRUMENTATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CIC339	Fiber optics instrumentation	PEC	3	0	0	3	3
2.	CIC340	Analytical Instrumentation	PEC	3	0	0	3	3
3.	CIC341	Electric Vehicle technology	PEC	3	0	0	3	3
4.	CIC342	Thermal Power Plant Instrumentation	PEC	3	0	0	3	3
5.	CIC343	Instrumentation in Petrochemical Industry	PEC	3	0	0	3	3
6.	CIC344	Safety Instrumented Systems	PEC	3	0	0	3	3
7.	CIC345	Renewable Systems	PEC	3	0	0	3	3
8.	CIC346	Automotive Instrumentation and Control	PEC	3	0	0	3	3

VERTICAL V : HEALTH CARE INSTRUMENTATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BM3491	Biomedical Instrumentation	PEC	3	0	0	3	3
2.	CBM335	Bio Signal Processing	PEC	3	0	0	3	3
3.	CBM372	Digital Image Processing	PEC	3	0	0	3	3
4.	CBM373	Medical Imaging	PEC	3	0	0	3	3
5.	CBM374	Medical Robotics	PEC	3	0	0	3	3
6.	CBM375	Brain Control and Application	PEC	3	0	0	3	3
7.	BM3591	Diagnosis and Therapeutic Instrumentation	PEC	3	0	0	3	3
8.	CBM376	Physiological Control Systems	PEC	3	0	0	3	3

VERTICAL VI : SEMI CONDUCTOR /COMMUNICATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC373	Digital VLSI	PEC	3	0	0	3	3
2.	CEC374	Semiconductor Manufacturing	PEC	3	0	0	3	3
3.	CEC375	Automotive Electronics	PEC	3	0	0	3	3
4.	CEC376	Green Electronics	PEC	3	0	0	3	3
5.	CEC377	Real Time Embedded Systems	PEC	3	0	0	3	3
6.	CEC378	Solar PV Fundamentals and Applications	PEC	3	0	0	3	3
7.	EC3491	Communication Systems	PEC	3	0	0	3	3
8.	CEC379	Wireless Sensor Network	PEC	3	0	0	3	3

VERTICAL VII :COMPUTER

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CCS377	Data Science	PEC	3	0	0	3	3
2.	CCS378	Virtual / Augmented Reality	PEC	3	0	0	3	3
3.	CCS379	Computer Architecture	PEC	3	0	0	3	3
4.	CCS338	Computer Vision	PEC	2	0	2	4	3
5.	CCS380	Cloud and Edge computing	PEC	3	0	0	3	3
6.	CCS381	Block Chain Technology	PEC	3	0	0	3	3
7.	CCS382	Deep and Reinforcement Learning	PEC	3	0	0	3	3
8.	CCS383	Java Programming	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVE I AND II

(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
3.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
4.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
5.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
6.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
7.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing	OEC	3	0	0	3	3

		Concepts						
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle Technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
23.	OCH351	Nano Technology	OEC	3	0	0	3	3
24.	OCH352	Functional Materials	OEC	3	0	0	3	3
25.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
26.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
27.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
28.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
29.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
30.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
31.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
32.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
33.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
34.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
35.	OEC351	Signals and Systems	OEC	3	0	0	3	3
36.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
37.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
38.	OBM352	Assistive Technology	OEC	3	0	0	3	3
39.	OMA352	Operations Research	OEC	3	0	0	3	3
40.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
41.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
3.	OMA356	Random Processes	OEC	3	0	0	3	3
4.	OMA357	Queuing and Reliability Modeling	OEC	3	0	0	3	3
5.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
6.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
7.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
8.	OME353	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
10.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
13.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
25.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3

27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OAE353	Drone Technologies	OEC	3	0	0	3	3
30.	OGI352	Geographical Information System	OEC	3	0	0	3	3
31.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
32.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
33.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
34.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
35.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
36.	OCH353	Energy Technology	OEC	3	0	0	3	3
37.	OCH354	Surface Science	OEC	3	0	0	3	3
38.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
39.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
40.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
41.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
42.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
43.	OTT355	Fibre Science	OEC	3	0	0	3	3
44.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
45.	OPE353	Industrial safety	OEC	3	0	0	3	3
46.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
47.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
48.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
49.	OEC353	VLSI Design	OEC	3	0	0	3	3
50.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
51.	OBM353	Wearable devices	OEC	3	0	0	3	3
52.	OBM354	Medical Informatics	OEC	3	0	0	3	3

Summary

	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1.	**HSMC**	4	3	-	-	-	-	5	-	12
2.	**BSC**	12	7	4	2	-	-	-	-	25
3.	**ESC**	5	9	-	-	-	-	-	-	14
4.	**PCC**	-	6	18	20	8	8	6	-	66
5.	**PEC**	-	-	-	-	12	12	-	-	24
6.	**OEC**	-	-	-	-	-	3	9	-	12
7.	**EEC**	1	2	1	-		-	-	10	14
	Total	**22**	**27**	**23**	**22**	**20**	**23**	**20**	**10**	**167**
8	Non-Credit/(Audit Course)					✓	✓			

Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other degree programmes)

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurship	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

PROGRESS THROUGH KNOWLEDGE

VERTICALS FOR MINOR DEGREE

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL I : FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II : ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV : BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V : ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

MA3353	TRANSFORMS AND DIFFERENTIAL EQUATIONS	L	T	P	C
	(FOR III - SEMESTER EIE AND ICE)	3	1	0	4

COURSE OBJECTIVES:

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9 +3

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear first order differential equations with constant coefficients - Method of undetermined coefficients.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 9 +3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT III FOURIER SERIES 9 +3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square values - Parseval's identity –Harmonic analysis.

UNIT IV LAPLACE TRANSFORMS 9 +3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 +3

Z-transforms - Elementary properties – Convergence of Z-transforms - Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Students able to

CO1 To acquaint the students with Differential Equations which are significantly used in engineering problems.

CO2 Understand how to solve the given standard partial differential equations

CO3 Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO4 Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

CO5 Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO6 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., ManicavachagomPillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PROGRESS THROUGH KNOWLEDGE

EI3351	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the structure, operation and applications of electronic devices.
- To familiarize biasing of BJT & JFET devices.
- To explore the frequency response of amplifiers in various configurations.
- To learn the function of power amplifiers and negative feedback amplifiers.
- To design RC and LC tuned oscillators for a given frequency.

UNIT I PN JUNCTION DEVICES(8+1 SKILL) 9

PN junction diode – structure, operation and V-I characteristics, Transition and Diffusion capacitances – Rectifiers – Half Wave and Full Wave Rectifier with capacitor filter. Zener diode – reverse characteristics – Zener as voltage regulator, Display devices – LED, Laser diode, Photo diode.

UNIT II BJT AND SMALL SIGNAL AMPLIFIERS(8+1 SKILL) 9

BJT - structure, operation of NPN and PNP transistor, Input and output characteristics of CE, CB and CC configurations. DC Load Line and operating point, Need for biasing – Bias stabilization -Fixed and Voltage divider biasing. Single stage BJT amplifiers – AC analysis of CE and CC amplifier with Voltage divider bias using h-parameters - Gain and frequency response.

UNIT III FIELD EFFECT TRANSISTORS AND THYRISTORS(8+1 SKILL) 9

JFET, MOSFET - structure, operation and characteristics, JFET Biasing - self and voltage divider biasing. FET small signal model - Analysis of CS,CG and Source follower. Thyristor - SCR operation and characteristics, UJT - operation and characteristics.

UNIT IV DIFFERENTIALAMPLIFIERSANDLARGESIGNALAMPLIFIERS(8+1 SKILL) 9

Cascade amplifier, BJT Differential amplifier – DC and AC analysis of common mode gain, differential mode gain and CMRR - Single tuned amplifier - construction, operation and frequency response. Power amplifiers – class A, class B and class C (Qualitative analysis only).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS(8+1 SKILL) 9

Feedback concepts, feedback topologies - voltage / current, series / shunt feedback - Transfer gain with feedback - effect of negative feedback on R_i and R_o – Condition for oscillations, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Data Sheet of transistors and diodes with respect to their Static and Dynamic Characteristics.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware
5. Introduction to other advanced logic circuits not covered in the above syllabus

COURSE OUTCOMES:

CO1 Explain the operation and characteristics of PN junction diode, Zener diode, LED and Laser diode. (L2)

CO2 Formulate the expression for voltage gain, current gain, input resistance and output resistance of a BJT CE and CC amplifier using h-parameter model. (L5)

CO3 Formulate the expression for voltage gain, input resistance and output resistance of FET amplifier under CS,CG and Source follower. (L5)

CO4 Explain the operation of cascade amplifier, differential amplifier, single tuned amplifier and power amplifiers. (L2)

CO5 Analyze the operation of negative feedback amplifiers and to design RC and LC tuned Oscillators for a given frequency range. (L4)

TEXT BOOKS:

1. Sedra and smith, "Micro electronic circuits", 8th ed., Oxford University Press 2020.
2. S. Salivahanan,N.SureshKumar,"Electronic Devices and Circuits",McGrawHill Education (India) Private Limited,4thEdition, 2017.
3. David A. Bell, "Electronic Devices and Circuits", Oxford University press higher education, 5th Edition,2008.

REFERENCES:

1. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall,10th Edition,2017.
2. Robert Boylestadand Louis Nashelsky.,"Electron Device and Circuit Theory"PrenticeHall Private Limited,11thedition, 2017.
3. Jacob Millman, Christos C Halkias, SatyabrataJit, 'Electronic Devices and circuits',McGraw Hill education, 4th edition, 2015.
4. Balbir Kumar,Shail.B.Jain,"Electronic devices and circuits"PHIlearning private limited,2nd Edition2014.
5. SedhaR.S, "AText Book of Applied Electronics", S.Chand&companyLtd.,Revised edition, 2013.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/117101105.
2. https://www.google.com/url?sa=t&source=web&rct=j&url=https://picture.iczhiku.com/resource/eetop/WhkgDOyuhiJsYvMv.pdf&ved=2ahUKEwiLzOTqhuj4AhX_-TgGHefXBp0QFnoECAgQAQ&usg=AOvVaw0RFLaVzmh0NUl_3W3zqwzU
3. https://nptel.ac.in/courses/117106030
4. https://nptel.ac.in/courses/117102012
5. https://nptel.ac.in/courses/117106093
6. https://www.google.com/url?sa=t&source=web&rct=j&url=http://in.ncu.edu.tw/ncume_ee/harvardes154/lect_20_stability.pdf&ved=2ahUKEwjjnISXiOj4AhWqSWwGHRGkDxMQFnoECAMQAQ&usg=AOvVaw3YU37qK9qkYUf-ptaeD4D0

EI3352	DIGITAL SYSTEM DESIGN AND APPLICATIONS	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To study various number systems and basic theorems of Boolean algebra and gate level minimization and implementation.
- To outline the formal procedures for the analysis and design of combinational circuits
- To analyze and design synchronous sequential circuits.
- To introduce the concept of asynchronous sequential circuits, PLCs and Logic Families.
- To introduce digital simulation techniques for development of application oriented logic circuit.

UNIT I BOOLEAN ALGEBRA AND GATE LEVEL MINIMIZATION (8+1 SKILL) 9

Review of number systems, types and conversion, binary codes, error detection and correction codes (Parity and Hamming code). Boolean theorems and properties – Boolean functions - Logic gates – Gate Level Minimization using Karnaugh Map, SOP & POS simplification, Don't Care conditions. Implementations of Logic Functions using gates-NAND–NOR implementations.

UNIT II COMBINATIONAL LOGIC (8+1 SKILL) 9

Design of adders, subtractors, Multiplexers - Combinational logic design using Multiplexers - Demultiplexers and their use in combinational logic design –2 bitMagnitude comparator, Code Converters - BCD to Binary and Binary to BCD, Encoder, Priority Encoder - Decimal to BCD, Octal to Binary, Decoders- BCD to Decimal and BCD to Seven Segment displaydecoder.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC (8+1 SKILL) 9

Sequential logic - SR, JK, JKMS, D and T flip flops – characteristics and excitation table - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS, MEMORY AND LOGIC FAMILIES (8+1 SKILL) 9

Asynchronous sequential logic circuits - Transition and flow table - race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits. Memories: PROM, PLA – PAL, CPLD - FPGA. Digital Logic gate realization and characteristics of TTL, ECL, CMOS families.

UNIT V VHDL (8+1 SKILL) 9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Data Sheet of all logic gates.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
3. Design and verification of simple signal conditioning circuit thro simulation.

4. Realization of signal conditioning circuit in hardware.
5. Introduction to other advanced logic circuits not covered in the above syllabus.

COURSE OUTCOMES:

CO1 Convert various types of codes and number system & gate level implementation of Boolean functions.(L2)
CO2 Apply K –Map for simplification and implementation of combinational logic circuit (L3)
CO3 Design the synchronous Sequential logic circuits namely counters, registers etc, (L5)
CO4 Analyze the asynchronous sequential circuits and explain the operation of memories and digital logic families (L4)
CO5 Design the VHDL coding for combinational logic and Sequential circuits. (L5)

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog" Pearson India, 6th Edition, 2018.
2.Comer "Digital Logic & State Machine Design, Oxford,3rd Edition, 2016.

REFERENCES:

1. D.P.Kothari, J.S.Dhillon "Digital Circuits and Design" Pearson Education, 2016
2. Mandal,"Digital Electronics Principles & Application, McGrawHill,2013.
3. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson,2013
4. Raj Kamal "Digital Systems – Principles and Design"Pearson Education India, 2012.
5. JamesW.Bignel,Digital Electronics,Cengage learning,5thEdition,2007.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/117106114
2. https://nptel.ac.in/courses/117106086
3. https://nptel.ac.in/courses/106102181
4. https://archive.nptel.ac.in/courses/108/105/108105132/

PROGRESS THROUGH KNOWLEDGE

EI3353 TRANSDUCERS ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS(8+1 SKILl) 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS (8+1 SKILL) 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS (8+1 SKILL) 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS (8+1 SKILL) 9

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

UNIT V OTHER SENSORS AND TRANSDUCERS (8+1 SKILL) 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors -Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors - Environmental Monitoring sensors (Water Quality & Air pollution).

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Data Sheet of sensors with respect to their Static and Dynamic Characteristics.
2. Selection of Sensors for applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).

4. Design and verification of simple signal conditioning circuit thro simulation.
5. Realization of signal conditioning circuit in hardware.
6. Introduction to other advanced sensors not covered in the above syllabus.

COURSE OUTCOMES:

Students able to

CO1 Understand the working principles of various types of transducers (L2).

CO2 Gain knowledge on the application areas of different sensors (L2).

CO3 Select the right sensor/transducer for a given application (L3).

CO4 Determine the static and dynamic characteristics of transducers using software packages (L4)

CO5 Design simple signal conditioning circuits for the R,L and C type of sensors (L3).

CO6 Summarize the advanced sensor technologies and sensors for specific applications.(L2)

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2019.
2. Patranabis D, “Sensors & Transducers”, 2nd Edition, PHI, New Delhi, 2011.
3. R. K. Jain, “Mechanical and Industrial measurements” Khanna Publishers, 2017

REFERENCES:

1. BelaG.Liptak Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. John Turner and Martyn Hill “Instrumentation for Engineers and Scientists”, Process Measurement and Analysis, 4thEdition, Vol. 1, ISA/CRC Press, 2003.
3. Richard Zurawski “Industrial Communication Technology Handbook”, 2ndedition, CRC Press, 2017.
4. NeubertH.K.P.Instrument Transducers – An Introduction to their Performance and Design Oxford University Press, Cambridge, 2003.

List of Open Source Software/ Learning website:

1. http://nptel.iitm.ac.in/courses.php
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/ mod2.pdf
4. https://instrumentationtools.com/tag/sensors-and-transducers-nptel- pdf
5. https://www.analog.com
6. https://electronics-tutorials.ws/io/io-
7. https://www.cse.wustl.edu/~lu/cse521s/Slides/wirelesshart.pdf

EI3354	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the IC fabrication procedure.
- To learn the characteristics of Op-Amp.
- To design and construct the basic applications of Op–amp.
- To interpret the internal functional blocks and the applications of special ICs.
- To illustrate the operation of application ICs

UNIT I IC FABRICATION (8+1 SKILL) 9

IC classification - fundamentals of monolithic IC technology – basic planar processes - fabrication of typical circuit - Fabrication of diodes, resistance, capacitance and FETs.

UNIT II CHARACTERISTICS AND APPLICATIONS OF OPAMP (8+1 SKILL) 9

Ideal Op-Amp - DC and AC characteristics - Basic applications of Op-Amp – Inverting and Non-inverting Amplifiers, summer, , differentiator and integrator - Op-Amp circuits using Diodes - peak detector, clippers, clampers– comparators – Schmitt trigger- multivibrators - waveform generators – First order and second order Low pass and high pass active filters.

UNIT III SPECIAL ICs(8+1 SKILL) 9

555 Timer - Functional block, characteristics – IC NE/SE 566 Voltage Controlled Oscillator - IC NE/SE 565 Phase Locked Loop - Analog multiplier and Divider IC AD633.

UNIT IV APPLICATION ICs(8+1 SKILL) 9

IC voltage regulators – LM78XX, LM79XX series voltage regulator - LM317, LM723 Variable voltage regulator – µA78S40 switching regulator - LM 380 power amplifier - ICL 8038 function generator IC-LM 324 Quad op amp.

UNIT V SIGNAL CONDITIONING CIRCUITS (8+1 SKILL) 9

V/I and I/V converters.- differential amplifier Instrumentation amplifier -S/H circuit – DAC and ADC characteristics - D/A converter (R- 2R ladder and weighted resistor types) - A/D converter (Flash and Successive approximation types)- Design of signal conditioning circuit for RTD and strain Gauge.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Data Sheet of ICs.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware.
5. Introduction to other advanced logic circuits not covered in the above syllabus.

COURSE OUTCOMES:

CO1 Explain the IC fabrication process and discuss the fabrication of active and passive components. (L2)

CO2 Compute the gain and output voltage of the given Op-Amp circuits. (L3)

CO3 Explain the internal functional blocks and applications of ICs 555, 566, 565, and AD633 . (L2)

CO4 Explain the operation of voltage regulator ICs namely LM78XX, LM79XX, LM317 and LM723. (L2)

CO5 Explain the operation and design of various signal conditioning circuits. (L2)

TEXT BOOKS:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuits", 5th Edition, New Age, 2018.
2. Ramakant A. Gayakward, "Op–Amps and Linear Integrated Circuits", 4th Edition, PHI,2015.
3. David A. Bell, 'Operational Amplifiers and Linear ICs, Oxford higher education, 2013.

REFERENCES:

1. Fiore, 'Opamps& Linear Integrated Circuits Concepts & applications', Cengage, 2018.
2. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill,2016.
3. Jacob Millman, Christos Halkias, Chetan D Parikh, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd edition, 2017.
4. Floyd ,Buchla, 'Fundamentals of Analog Circuits', Pearson, 2013.
5. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition, 2012.

List of Open Source Software/ Learning website:

1. https://www.google.com/url?sa=t&source=web&rct=j&url=https://lecturenotes.in/subject/899/linear-integrated-circuits-and-applications-lica&ved=2ahUKEwjr6e2di-j4AhVETmwGHXi7CjEQFnoECA4QAQ&usg=AOvVaw3rhB8gam3anif-itEmwKX.
2. https://www.google.com/url?sa=t&source=web&rct=j&url=https://archive.nptel.ac.in/content/storage2/courses/downloads_new/108108111/W0A1.pdf&ved=2ahUKEwiJssC3i-j4AhWCS2wGHabOD4AQFnoECDYQAQ&usg=AOvVaw3NDeqOP88V7iqJ09j9vf4K
3. https://nptel.ac.in/courses/108108111

PROGRESS THROUGH KNOWLEDGE

CS3353 C PROGRAMMING AND DATA STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL) 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV NON-LINEAR DATA STRUCTURES (8+1 SKILL) 9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL) 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

COURSE OUTCOMES:

CO1 Develop C programs for any real world/technical application.
CO2 Apply advanced features of C in solving problems.
CO3 Write functions to implement linear and non–linear data structure operations.
CO4 Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
CO5 Appropriately use sort and search algorithms for a given application.
CO6 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 1997.
2. ReemaThareja, “Programming in C”, Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, “The Practice of Programming”, Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, “C How to Program”, Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, “Fundamentals of Data Structures”, Galgotia, 2008.

List of Open Source Software/ Learning website:

https://www.coursera.org/specializations/data-structures-algorithms

https://nptel.ac.in/courses/112107243

https://nptel.ac.in/courses/112105598

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

EI3361	SEMICONDUCTOR DEVICES AND CIRCUITS LABORATORY	L T P C 0 0 3 1.5

COURSE OBJECTIVES:

- To understand the behavior of semiconductor devices experimentally.
- To design the amplifiers and oscillators.
- To analyze the rectifier and filters.

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode.
2. Characteristics of Zener diode and Zener as series voltage regulator.
3. Single Phase half-wave and full wave rectifiers with capacitive filters.
4. Characteristics of JFET.
5. Characteristics of UJT and generation of saw tooth waveform.
6. Characteristics of a BJT under common emitter and common base configurations.
7. Design and testing of Common Emitter amplifier.
8. Design and testing of Common Source amplifier.
9. Differential amplifier using FET.
10. Design and testing of RC phase shift and LC oscillators.
11. Design and testing of Feedback amplifiers (Any one type)
12. Simulation of rectifier circuits using PSIM/SIMULINK

TOTAL: 45 PERIODS

COURSE OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

CO1 Determine the Breakdown voltage, forward and reverse resistance of PN junction diode and Zener diode and calculate the ripple factor of rectifier circuits with filter.

CO2 Calculate the hybrid parameters of BJT under CE and CB configuration

CO3 Obtain the frequency response of CE amplifier and CS amplifier

CO4 Obtain the UJT and JFET parameters from the characteristics and also to calculate the gain of differential amplifier using JFET.

CO5 Design the RC and LC tuned oscillators for a given oscillating frequency.

CO6 Analyze the input and output performance of the given diode based circuit using simulation tools.

PROGRESS THROUGH KNOWLEDGE

CS3362 C PROGRAMMING AND DATA STRUCTURES LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES:

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 Use different constructs of C and develop applications

CO2 Write functions to implement linear and non-linear data structure operations

CO3 Suggest and use the appropriate linear / non-linear data structure operations for a given problem

CO4 Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval

CO5 Implement Sorting and searching algorithms for a given application

SEMESTER IV

EI3451	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the measurement techniques of viscosity,humidity and moisture
- To introduce the measurement of temperature and pressure.
- To introduce the flow measurement techniques.
- To introduce the electrical flow measurement techniques.
- To introduce the level measurement techniques and transmitters.

UNIT I MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 9

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers.

Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

UNIT II TEMPERATURE & PRESSURE MEASUREMENT 9

Definitions and standards –Different types of filled in system thermometers – Bimetallic thermometers – IC sensors – Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation,, Special techniques for measuring high temperature using thermocouple –- Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection, Installation and Calibration, Manometers: Different types, Bourdon tube, Bellows, Diaphragms and Capsules, Pressure gauge selection, installation and calibration using dead weight tester.

UNIT III FLOW MEASUREMENT 9

Orifice plate: different types of orifice plates – Cd variation – pressure tapping– Venturi tube – Flow nozzle – Dall tube – Pitot tube, Installation and applications of head flowmeters, Positive displacement flow meters, Rotameter –theory, characteristics, installation and applications, Mass flow meter, Calibration of flow meters: – Dynamic weighing method.

UNIT IV ELECTRICAL TYPE FLOW METERS 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT V LEVEL MEASUREMENT AND TRANSMITTER 9

Level measurement: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

TOTAL45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Design of signal conditioning circuits for industrial instruments used for measurement of temperature, pressure, flow, level.
2. Calibration of sensor and transmitters along with uncertainty measurement.
3. Configuration of smart transmitters with HART communicator.
4. Selection, installation and commissioning of transducers

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO1 Understand Principles and working of Viscosity, Humidity, Moisture, temperature , pressure, flow and level measuring Instruments.(L2)

CO2 Calibrate temperature, flow , level and Pressure measuring devices .(L3)

CO3 Apply measurement of Viscosity, Humidity, Moisture, temperature , pressure, flow and level in Industrial Applications.(L3)

CO4 Select and install Industrial instruments for various applications (L4)

CO5 Understand various Electrical type Industrial Instruments (L2)

TEXT BOOKS:

1. Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design", 6th McGraw-Hill Education Pvt. Ltd,2011.
2. A.K. Sawhney and PuneetSawhney, "Mechanical Measurements and Instrumentation and Control", DhanpatRai& Co. (P) Limited, 2015.

REFERENCES:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press,2005.
2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, McGraw-Hill Education,2017.
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited,1990.
4. Singh,S.K., "Industrial Instrumentation and Control", Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi,2009.
5. https://swayam.gov.in/ Principles of Industrial Engineering

List of Open Source Software/ Learning website:

1. http://instrumentationtoolbox.com
2. Our instrumentation.com.
3. Home Instrumentation Tools.

PROGRESS THROUGH KNOWLEDGE

IC3451 AUTOMATIC CONTROL SYSTEMS L T P C

3 1 0 4

COURSE OBJECTIVES:

- To introduce the control system components and transfer function model with their graphical representation.
- To understand the analysis of system in time domain along with steady state error.
- To introduce frequency response analysis of systems.
- To accord basic knowledge in design of compensators.
- To introduce the state space models.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION (11+1 SKILL) 12

Control System: Terminology and Basic Structure- Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchro.

UNIT II TIME RESPONSE ANALYSIS (11+1 SKILL) 12

Transient response-steady state response-Measure of performance of the standard first order and second order system-Time domain specifications -Effect on an additional zero and an additional pole-Steady state error - Type number-PID control-Effect of PD, PI, PID control systems.

UNIT III FREQUENCY RESPONSE ANDSYSTEM ANALYSIS (11+1 SKILL) 12

Closed loop frequency Response-Performance specification in frequency domain - Bode Plot – Polar Plot- Design of compensators using Bode plots - Cascade lead compensation - Cascade lag compensation- Cascade lag-lead compensation.

UNIT IV CONCEPTSOFSTABILITYANALYSIS (11+1 SKILL) 12

Concept of Stability-Bounded – Input Bounded – Output Bounded-Routh Hurwitz stability Criterion-Relative Stability-Root locus concept-Guidelines for sketching root locus - Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHOD(11+1SKILL) 12

State variable Representation-Conversion of state variable models to transfer Functions-Conversion of transfer functions to state variable Models-Solution of state Equations-Concepts of Controllability and Observability -Equivalence between transfer function and state variable representations.

TOTAL60 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Explore various controllers presently used in industries.
2. Develop control structures for industrial processes.
3. Implement the controllers for various transfer functions of industrial systems.
4. Using software tools for practical exposures to the controllers used in industries by undergoing training.
5. Realisation of various stability criterion techniques for economical operation of process.

COURSE OUTCOMES:

CO1 To represent and develop systems in different forms using the knowledge gained (L5).

CO2 To analyses the system in time and frequency domain (L4).

CO3 To discuss the effect of PID controller in closed loop systems (L2).

CO4 To construct compensator for the linear systems in frequency domain.(L5)

CO5 To analyses the stability of physical systems(L4).

CO6 To acquire and analyses knowledge in State variable model for MIMO systems(L4)

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers,2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014

REFERENCES:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C. Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M. Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/112107240
2. https://onlinecourses.nptel.ac.in/noc20_me25/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee90/preview
4. https://www.classcentral.com/course/swayam-automatic-control-9850

PROGRESS THROUGH KNOWLEDGE

IC3401	MODERN ELECTRONIC INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the meters used to measure current and voltage.
- To provide detailed study of digital interfaces and signal conditioning.
- To study electronic instruments for measurement of certain important mechanical parameters.
- To understand the basic principles in MEMS and wireless devices.
- To gain knowledge on case studies on design of typical measurement systems.

UNIT I BASIC ELECTRICAL MEASUREMENTS 9

DC Voltage Measurements – Types and Electronic voltmeter - DC Current Measurements – AC Voltage - AC current Measurements – Measurement of frequency, time and phase.

UNIT II DIGITAL INTERFACES AND SIGNAL CONDITIONING 9

ADC Types: SAR, Dual-Slope, Flash, Sigma-Delta – DAC Types: R-2R, Sigma-Delta – IEEE-488 - Digital filters – DFT & FFT applications in signal conditioning - PC based Measurement.

UNIT III MECHANICAL MEASUREMENTS 9

Linear Measurement: Displacement, Velocity, Acceleration – Angular Measurement: Displacement, Velocity, Acceleration – Measurement of force and torque.

UNIT IV MECHANICAL MICROSENSORS AND WIRELESS INSTRUMENTATION 9

MEMS: Accelerometer, Pressure sensor, Gyros, Cantilever based MEMS sensor. Wireless Instrumentation.

UNIT V DESIGN OF MEASUREMENT SYSTEMS 9

Glucose Measurement system – Ranging system and Velocimeter – Detection of hidden objects – wireless patient Monitoring systems – Applications of MEMS sensors.

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Able to select instruments based on description of process and performance requirements.
2. Able to design and analyze signal conditioning circuits for conditioning, conversion and transmission of analog measurement signals.
3. Able to conduct measurements using appropriate instruments along with error analysis.
4. Perform calibration of given instrument using appropriated calibrations.

COURSE OUTCOMES:

CO1 To understand the principle behind measurement of Electrical/ mechanical quantities..(L1)

CO2 To interpret the specifications of different ADCs/DACs/ Digital interfaces. (L2)

CO3 To gain knowledge on different types of MEMS Sensors and their merits/ demerits. (L2)

CO4 To learn the basics of wireless instrumentation. (L1)

CO5 To analyze and design measurement system for simple applications.(L3)

CO6 To develop simple measurement solutions for the measuring given physical quantity.(L4)

TEXT BOOKS:

1. Introduction to instrumentation and measurements, Third Edition, Robert B.Northrop, CRC Press, Taylors & Francis Group, New York, 2014.
2. Ernest O. Doeblin, “measurement systems applications and design”, McGraw Hill International editions, 1990

REFERENCES:

1. S.K.Singh, ‘Industrial Instrumentation and control’, Tata McGraw Hill, 2nd edn., 2002.
2. J.B.Gupta, ‘A Course in Electronic and Electrical Measurements and Instrumentation’,S.K.Kataria& Sons, Delhi,2003.
3. Martin U. Reissland, ‘Electrical Measurement – Fundamental Concepts and Applications’, New Age International (P) Ltd., 2001.
4. J.J. Carr, “Elements of Electronic Instrumentation and Measurement”, Pearson Education India, New Delhi,2011
5. W.Golding & F.C.Widdis, ‘Electrical Measurements Measuring Instruments’, A.H.Wheeler& Co,2001
6. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi,2010

Online course

1. https://nptel.ac.in/courses/108105153/
2. https://www.dsslearning.com/ac-dc-theory-electrical-measurement/E50060/
3. https://pdhonline.com/courses/e244/e244_new.htm
4. https://swayam.gov.in/nd1_noc19_ee44/
5. https://www.udemy.com/course/complete-course-in-electrical-measurement-instrumentation/
6. https://www.youtube.com/watch?v=xLjk5DrScEU

PROGRESS THROUGH KNOWLEDGE

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

L	T	P	C
2	0	0	2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols - Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

IC3402	EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To get familiarized with the embedded hardware architecture.
- To understand the basics of RTOS and the attributes of various communication protocols.
- To build knowledge on Embedded C programming and realize the concept of peripheral interfacing.
- To get introduced with the concept of IoT and architecture of IoT systems.
- To acquire knowledge over IoT implementation tools and thecore elements of IIoT.

UNIT I EMBEDDED HARDWARE ARCHITECTURE 9

CISC Architecture:- Introduction to MCS51 Family - 8051 Microcontroller - Architecture - Timers - Interrupts - Serial Data Communication - RISC Architecture:- overview of PIC 16F87x family - PIC16F877A - Architecture - Timers - Interrupts - Serial ports - Introduction to ARM - LPC4088 Architecture.

UNIT II REAL TIME OPERATING SYSTEM & COMMUNICATION INTERFACES 9

Types of RTOS - Functions of RTOS - Task, Process and Threads, Interrupt handling, Multiprocessing & Multitasking and Task scheduling - Serial communication interfaces - RS232, RS485, I^2C SPI and USB.

UNIT III EMBEDDED PROGRAMMING AND PERIPHERAL INTERFACING 9

Embedded C Programming for Embedded Applications - Input and output devices Interface, ADC Interface - DAC Interface - PWM Generation - sensor Interface.

UNIT IV INTRODUCTION TO INTERNET OF THINGS 9

IoT Definition and Characteristics - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies - Levels of IoT Deployment - IoT Device Management- Domain specific IoTs.

UNIT V IoT IMPLEMENTATION TOOLS AND IIoT 9

IoT gateways - IoT analytics platforms - IoTapplication development using Raspberry Pi - Introduction to IIoT - IIoT Middleware Platforms - Industrial Internet Security.

TOTAL: 45+30 = 75 PERIODS

1. Implementation of specific tasks using Embedded C/Python programming
2. Interfacing input devices with 8051/PIC16F877A/LPC4088.
3. Interfacing ADC & DAC with 8051 microcontroller.
4. PWM generation using PIC16F877A/LPC4088.
5. Interfacing input and output devices with Raspberry Pi using Python.
6. IoT enabled field sensing using Raspberry Pi.

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Embedded systems architecture.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
3. Design and verification of embedded systems and rtos applications in any of the software.
4. Realization of embedded and rtos in hardware.
5. Able to gather and process data from IOT devices, and perform data analysis and prediction.

COURSE OUTCOMES:

The students will be able to

CO1 Understand the concept of embedded system and its architectural features

CO2 Develop embedded software using Embedded C and Python.

CO3 Integrate/Interface real world field devices with microcontrollers.

CO4 Utilize the power of RTOS for embedded applications.

CO5 Acquire real world signals and perform remote process monitoring utilizing the concept of IoT.

CO6 Design and implement IoT enabled embedded control strategy for a given application.

TEXT BOOKS:

1. Rajkamal, ‘Embedded system-Architecture, Programming, Design’, TataMcgraw Hill, 2011.
2. Peckol, “Embedded System Design”, John Wiley,2010.
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun(editor)
4. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

REFERENCES:

1. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
2. Han-Way Huang, ”Embedded system Design using C8051”, Cengage Learning,2009.
3. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.
4. Shibu.k.v, “Introduction to Embedded Systems”, TataMcgraw Hill, 2009
5. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , Industrial Internet of Things: Cybermanufacturing Systems, Springer, 2017

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108105057
2. https://nptel.ac.in/courses/128108016
3. https://nptel.ac.in/courses/106105193
4. https://nptel.ac.in/courses/106105172

5. https://www.iare.ac.in/sites/default/files/lecture_notes/ESD%20NOTES-A70440.pdf
6. https://www.udemy.com/course/embedded-device-interfacing.
7. https://nptel.ac.in/courses/108108123

IC3452 ELECTRICAL MACHINES AND DRIVES L T P C
2 0 2 3

COURSE OBJECTIVES:

To impart basic knowledge on different AC& DC Machines.

- To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
- To impart knowledge on testing and controlling of different machines.
- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics.
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I DC MACHINES 6

Construction of D.C. Machines – DC Generator: Principle of operation – Characteristics- DC Motor: Principle of operation -Types-Torque equation-Characteristics.

UNIT II TRANSFORMERS 6

Transformer - Principle - Theory of ideal transformer - EMF equation - Construction details of shell and core type transformers - Tests on transformers.

UNIT III THREE PHASE INDUCTION MOTOR 6

Three phase Induction motor:- Construction and principle of operation - torque and toque-slip characteristics-Efficiency- Application-starting methods – speed control of induction motor.

UNIT IV POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 6

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC.

UNIT V DRIVES AND CONTROL 6

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives– Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only)

TOTAL : 30 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Differentiate the switching characteristics of the semiconductor devices.
2. Design the SCR circuit with the help of two BJT and explain the switching characteristics for the same.
3. Elaborate the speed control of Induction motor and starting methods for the same.
4. Practically compare the characteristics of 3 φ induction motor and DC machines.

5. Discuss the no load and load test on transformers [Group seminar].

LIST OF EXPERIMENTS FOR MACHINES LAB

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Speed control of D.C. shunt motor.
5. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
6. Load test on single phase induction motor.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 Ability to understand the terms associated with electrical machines
CO2 Ability to understand basic concepts and working principle of electrical machines
CO3 Ability to understand the performance characteristics of machines
CO4 Ability to identify suitable machines for carrying out interdisciplinary projects.
CO5 Ability to understand the motor operating principle and characteristics of motor
CO6 Ability to understand the motor operating principle and characteristics of transformer

TEXT BOOKS:

1. Fitzgerald A.E., Kingsley C., Umans, S. and Umans S.D., "Electric Machinery", McGraw-Hill,Singapore, 2003. 6th Edition.
2. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand and Co., New Delhi, 2007
3. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York, 1995.

PROGRESS THROUGH KNOWLEDGE

REFERENCES:

1. Del Toro, V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 1995.
2. Cotton, H., "Advanced Electrical Technology", Sir Isaac Pitman and Sons Ltd., London, 1999.
3. Lecture series on "Electrical Machines I" and "Electrical Machines II" by Dr.KrishnaVasudevan, IIT Madras.
4. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108106072

2. https://nptel.ac.in/courses/108105131
3. https://lecturenotes.in/notes/69764-note-for-electrical-drives-and-controls-edc-by-bhuvaneswari-c
4. https://electrical-engineering-portal.com/download-center/books-and-guides/automation-control/electrical-machines-and-drives

EI3461	DIGITAL AND LINEAR INTEGRATED CIRCUITS LABORATORY	L T P C 0 0 3 1.5

OBJECTIVES:

- To design, test and characterize circuit behavior with digital and analog ICs.
- To design and test various combinational and sequential circuits.
- To introduce the functions of counter, shift register.
- To interpret and realize the basic applications of Op–amp and timer.
- To explain the behavior of special ICs.

LIST OF EXPERIMENTS:

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Implementation of Binary to Gray code converter and vice-versa.
3. Implementation of Encoders, Decoders using logic gates and MSI devices
4. Implementation of multiplexer and de multiplexer using logic gates and MSI devices.
5. Implementation of Shift Registers: SISO, SIPO, PISO, PIPOusing MSI devices.
6. Implementation of Counters: synchronous and Asynchronous types (Each one).
7. Design and testing of inverting , non-inverting amplifier and Adder
8. Design and testing of comparator and Schmitt trigger.
9. Design and testing of Integrator and Differentiator.
10. Design and testing of Astable and Monostable operation using 555 timer.
11. Verification of Variability Voltage Regulator using IC LM317/LM723.
12. Simulation of combinational circuits using VHDL codes
13. Simulation of any one of the Op amp application circuit using PSPICE/SIMULINK

TOTAL: 45 PERIODS

OUTCOMES:

Studentswill be able to:

CO1: Design and implement the given Boolean function using logic gates.
CO2: Design and verify the truth table of combinational logic circuits (code converters, encoders, decoders, multiplexer and demultiplexer).
CO3: Design and implement the Counters and Shift registers.
CO4: Design and testing of Op-Amp circuits and to simulatethe op-amp application circuit using simulation tools.
CO5: Design and testing of as table and monostablecircuits using Timer IC NE/SE 555.
CO6: Design and testing of variable voltage regulator using IC LM317/LM723.

EI3462	SENSORS AND SIGNAL CONDITIONING CIRCUITS LABORATORY	L T P C 0 0 3 1.5

COURSE OBJECTIVES:

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students study on the design of signal conditioning circuit for different transducers.

LIST OF EXPERIMENTS

1. Determination of Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermo-well.
2. Determination of Static and Dynamic characteristics of RTD and Thermistor.
3. Determination of Characteristics of linear displacement transducers (LVDT and Hall Effect sensor).
4. Determination of Characteristics of angular displacement transducers (Synchros and Capacitive transducer).
5. Determination of Characteristic study of load cell and pressure cell.
6. Sensitivity analysis of strain gauge bridges (quarter, half and full).
7. a. Determination of Static characteristic of flapper-nozzle system
   b. Loading effect on resistive potentiometer.
8. Determination of Characteristic of seismic type accelerometer.
9. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.
10. Design of signal conditioning circuits for resistive & capacitive sensors
11. Design of signal conditioning circuits for inductive sensors
12. Design of cold junction compensation for Thermocouples and lead wire compensation schemes for RTD

TOTAL 45 PERIODS

COURSE OUTCOMES:

CO1 Ability to perform error analysis and uncertainty analysis.

CO2 Ability to evaluate the static and dynamic characteristics of measuring instruments.

CO3 Ability to design and construct measurement systems using different types of resistance, capacitance and inductance transducers.

CO4 Ability to apply special transducers for measurement applications.

CO5 Ability to interface and analyze different signal conditioning units.

CO6 Ability to present the results in oral form as well as in written form as a report and graph.

PROGRESS THROUGH KNOWLEDGE