

SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE
(Autonomous)
Gobichettipalayam, Erode-638455



Regulation 2023
(Autonomous)

Curriculum and Syllabus
Choice Based Credit System (CBCS)

BE-ELECTRONICS AND COMMUNICATION ENGINEERING



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Curriculum and Syllabus
BE- Electronics and Communication Engineering

1. Program Educational Objective (PEO)

- PEO1: Successful career** - To enable graduates have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.
- PEO2: Foundational concepts** - To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.
- PEO3: Analyze Methodology** - To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

Program Outcomes (POs)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

II. Program Specific Outcomes (PSOs)

- PSO1: Core skills:** Apply knowledge and skills to analyze, Design and develop analog and digital circuits for a electronics applications.
- PSO2: Problem solving skills:** Ability to Design and implement the approaches to solve challenges in the field of communication, signal processing, VLSI and Internet of Things (IoT).
- PSO3: Professional career:** Adapt to emerging Information and communication technologies (ICT) and develop innovative solutions for existing and newer problems

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	Induction Programme															
		Professional English - I	-	-	-	2	-	1	-	-	2	3	-	3	-	-	-
		Matrices and Calculus	3	3	1	1	-	-	-	-	2	-	2	3	-	-	-
		Engineering Physics	3	3	2	1	2	-	-	-	-	-	-	1	-	-	-
		Engineering Chemistry	3	2	2	1	2	2	3	-	-	-	-	1	-	-	-
		Problem Solving and Python Programming	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
		தமிழர் மரபு / Heritage of Tamils	-	-	-	-	-	1	1	1	-	1	-	-	-	-	-
		Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
		Physics and Chemistry Laboratory	3	3	1	1	-	-	-	-	-	-	-	-			
			3	2	1	-	1	3	2	1	-	-	-	1	3	2	1
		English Laboratory	-	-	-	-	-	-	-	1	3	3	-	2	-	-	-
I	II	Professional English - II	-	1	1	-	-	-	1	1	2	3	-	2	-	1	1
		Numerical Methods and statistics	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
		Physics for Electronics Engineering	3	2	1	-	-	-	-	-	-	-	-	-			
		Electrical and Instrumentation Engineering	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2
		Engineering Graphics	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
		Circuit Analysis	3	3	2	2	-	-	-	-	-	1	-	-	3	2	-
		தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	2	-	-	-	-	2	2	2	2	2	-	2	-	-	-
		Engineering Practices Laboratory	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
		Communication Laboratory / Foreign Language	-	-	2	-	-	-	-	1	3	3	-	3	-	-	2
II	III	Probability and Complex functions	3	3	-	-	-	-	-	-	3	-	-	2	-	-	-
		C Programming and Data Structures	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2
		Signals and Systems	3	3	3	3	3	2	-	-	-	-	-	3	2	3	1

		Electronic Devices and Circuits	3	3	3	3	2	2	-	-	-	-	-	1	2	1	1
II	III	Electromagnetic Fields	2	2	2	2	-	-	-	-	-	-	-	-	2	3	1
		Digital Systems Design	3	2.6	2.6	2.3	-	2	-	-	-	-	2	2	3	3	2
		Entrepreneurship and Startup	2	2	2	1.6	1	-	-	-	-	-	-	-	2	2	2
		Electronic Devices and Circuits Laboratory	3	2	1	3	2	1	-	-	-	-	-	1	2	1	1
		C Programming and Data Structures Laboratory	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2
II	IV	Transmission Lines and RF systems	1.6	2.6	2	2.6	2.2	-	-	-	-	-	-	1	2	1	-
		Linear Integrated Circuits	1.4	2.5	3	2.2	-	-	-	-	-	-	1	3	2	1	1
		Analog Communication	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
		Environmental Sciences and Sustainability	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-
		Microprocessors and Microcontrollers	3	1.4	1.6	1.5	1.5	2	-	-	-	-	1	1	1.5	1.5	2
		Digital Signal Processing	3	3	2	2	2	2	-	-	-	-	1	1	2	2	2
		Analog Communication Laboratory	3	3	3	3	3	2.5	-	-	-	1	1	1	-	-	-
		Linear Integrated Circuits Laboratory	2	3	3	3	2	-	-	-	-	-	1	1	3	1.8	2.8
III	V	Digital Communication	3	2	2.5	-	1	-	-	-	-	-	-	2	2.5	2	3
		Control System	3	3	3	2.2	2	-	-	-	-	-	-	-	3	1.8	1.4
		Embedded Systems and IOT Design	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2	1.4
		Digital Communication Laboratory	3	3	3	3	3	2.5	-	-	-	1	1	1	1.5	1	1
III	VI	VLSI and Chip Design	2	2	2	2	1	1.5	-	-	-	-	1	2	3	3	3
		Artificial Intelligence and Machine Learning	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2
		Wireless Communication	2	2	2	1	1	-	-	-	1	1	2	1	2	1	1
		VLSI Laboratory	3	3	3	3	3	2.5	-	-	-	2	1	2	1	1	1.3

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

K. Sathya
Chairman
BoS / ECE

SUMMARY OF CREDITS

S.No	Course Category	Credits per Semester								Total Credits	Credits in %	Credits as per AU Curriculum R-2021	Credits as per AICTE Model Curriculum R-2022
		I	II	III	IV	V	VI	VII	VII I				
1.	HSS	4	3					5		12	7.36	12	15
2.	BS	12	7	4	2					25	15.33	25	23
3.	ES	5	9	3			4			21	12.88	21	17
4.	PC		4	17	20	11.5	7.5			60	36.80	58	61
5.	PE					9	6	3		18	11.05	18	12
6.	OE						3	6		09	5.52	12	12
7.	EEC	1	2	1				4	10	18	11.05	16	20
8.	MC		√		√	√	√						
Total Credits / Semester		22	25	25	22	20.5	20.5	18	10	163	100	162	160

CATEGORIZATION OF COURSES

- Humanities and Social Sciences including Management Courses (HSS)
- Basic Science Courses (BS)
- Engineering Science Courses (ES)
- Professional Core Courses (PC)
- Professional Elective Courses (PE)
- Open Elective Courses (OE)
- Mandatory Courses (MC)
- Employability Enhancement Courses (EEC)
- Other Courses (OC)

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) or 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,

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BE-Electronics and Communication Engineering

SEMESTER I

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Induction Program											
1.	23IPA11	Induction Programme	-	-	-	-		0	-	-	-
Theory											
2.	23ENT11	Professional English - I	HSS	3	0	0	3	3	40	60	100
3.	23MAT11	Matrices and Calculus	BS	3	1	0	4	4	40	60	100
4.	23PHT11	Engineering Physics	BS	3	0	0	3	3	40	60	100
5.	23CYT11	Engineering Chemistry	BS	3	0	0	3	3	40	60	100
6.	23CST11	Problem Solving and Python Programming	ES	3	0	0	3	3	40	60	100
7.	23TAT11	தமிழர் மரபு /Heritage of Tamils	HSS	1	0	0	1	1	40	60	100
Practicals											
8.	23CSL11	Problem Solving and Python Programming Laboratory	ES	0	0	4	4	2	60	40	100
9.	23PCL11	Physics and Chemistry Laboratory	BS	0	0	4	4	2	60	40	100
10.	23ENL11	English Laboratory	EEC	0	0	2	2	1	60	40	100
Total				16	1	10	27	22			

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SEMESTER II

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ENT21	Professional English - II	HSS	2	0	0	2	2	40	60	100
2.	23MAT21	Numerical Methods and Statistics	BS	3	1	0	4	4	40	60	100
3.	23PHT23	Physics for Electronics Engineering	BS	3	0	0	3	3	40	60	100
4.	23EET23	Electrical and Instrumentation Engineering	ES	3	0	0	3	3	40	60	100
5.	23MET21	Engineering Graphics	ES	2	0	4	6	4	40	60	100
6.	23ECI21	Circuit Analysis	PC	3	0	2	5	4	50	50	100
7.	23TAT21	தமிழரும் தொழில்நுட்பமும் /Tamil and Technology	HSS	1	0	0	1	1	40	60	100
Practicals											
8.	23MEL21	Engineering Practices Laboratory	ES	0	0	4	4	2	60	40	100
9.	23ENL21	Communication Laboratory	EEC	0	0	4	4	2	60	40	100
Mandatory Courses											
10.	23MDC21	Mandatory Course - I Yoga for Human Excellence	MC	0	0	1	1	0	100	-	100
Total				17	1	15	33	25			

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SEMESTER III

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MAT33	Probability and Complex functions	BS	3	1	0	4	4	40	60	100
2.	23CST34	C Programming and Data Structures	ES	3	0	0	3	3	40	60	100
3.	23ECT31	Electronic Devices and Circuits	PC	3	0	0	3	3	40	60	100
4.	23ECT32	Signals and Systems	PC	3	1	0	4	4	40	60	100
5.	23ECT33	Electromagnetic Fields	PC	3	0	0	3	3	40	60	100
6.	23ECI31	Digital Systems Design	PC	3	0	2	5	4	50	50	100
7.	23EST31	Entrepreneurship and Startup	EEC	1	0	0	1	1	100	-	100
Practicals											
8.	23ECL31	Electronic Devices and Circuits Laboratory	PC	0	0	3	3	1.5	60	40	100
9.	23CSL34	C Programming and Data Structures Laboratory	PC	0	0	3	3	1.5	60	40	100
Total				19	2	9	29	25			

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SEMESTER IV

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ECT41	Analog Communication	PC	3	0	0	3	3	40	60	100
2.	23ECT42	Linear Integrated Circuits	PC	3	0	0	3	3	40	60	100
3.	23ECT43	Transmission Lines and RF systems	PC	3	0	0	3	3	40	60	100
4.	23CYT41	Environmental Sciences and Sustainability	BS	2	0	0	2	2	40	60	100
5.	23ECI41	Microprocessor and Microcontroller	PC	3	0	2	5	4	50	50	100
6.	23ECI42	Digital Signal Processing	PC	3	0	2	5	4	50	50	100
Practicals											
7.	23ECL41	Analog Communication Laboratory	PC	0	0	3	3	1.5	60	40	100
8.	23ECL42	Linear Integrated Circuits Laboratory	PC	0	0	3	3	1.5	60	40	100
Mandatory Courses											
9.	23MDC41	Mandatory Course - II Soft and Analytical Skills-I	MG	1	0	0	1	0	-	-	-
Total				18	0	10	28	22			

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SEMESTER V

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ECT51	Digital Communication	PC	3	0	0	3	3	40	60	100
2.	23ECT52	Control System	PC	3	0	0	3	3	40	60	100
3.	23ECI51	Embedded Systems and IoT Design	PC	3	0	2	5	4	50	50	100
4.		Professional Elective I*	PE	-	-	-	-	3	40	60	100
5.		Professional Elective II*	PE	-	-	-	-	3	40	60	100
6.		Professional Elective III*	PE	-	-	-	-	3	40	60	100
Practicals											
7.	23ECL51	Digital Communication Laboratory	PC	0	0	3	3	1.5	60	40	100
Mandatory Courses											
8.	23MDC51	Mandatory Course - III Soft and Analytical Skills-II	MC	1	0	0	1	0	-	-	-
9.		Mandatory Course - IV*	MC	3	0	0	3	0	100	0	100
Total								20.5			

* Professional Elective - I to III shall be chosen from the list of Professional electives (Verticals) offered by same Programme.

* Mandatory Course-IV is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-IV)



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SEMESTER VI

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ECT61	VLSI and Chip Design	PC	3	0	0	3	3	40	60	100
2.	23CSI42	Artificial Intelligence and Machine Learning	ES	3	0	2	5	4	50	50	100
3.	23ECT62	Wireless Communication	PC	3	0	0	3	3	40	60	100
4.		Professional Elective IV*	PE	-	-	-	-	3	40	60	100
5.		Professional Elective V*	PE	-	-	-	-	3	40	60	100
6.		Open Elective – I**	OE	-	-	-	-	3	40	60	100
Practicals											
7.	23ECL61	VLSI Laboratory	PC	0	0	3	3	1.5	60	40	100
Mandatory Courses											
8.		Mandatory Course - V*★	MC	3	0	0	3	0	100	-	100
Total				-	-	-	-	20.5			

*Professional Elective - IV to V shall be chosen from the list of Professional electives (Verticals) offered by same Programme

** Open Elective - I shall be chosen from the list of open electives offered by other Programmes

* Mandatory Course-V is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-V)

@The students individually undergo training in reputed firms/research institutes/laboratories for the specified duration (04 Weeks) during summer vacation. After completion of training, a detailed report should be submitted within ten days from the commencement of VII semester.



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SEMESTER VII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23UHV71	Human Values and Ethics	HSS	2	0	0	2	2	40	60	100
2.		Elective – Management [#]	HSS	3	0	0	3	3	40	60	100
3.		Professional Elective VI*	PE	-	-	-	-	3	40	60	100
4.		Open Elective – II**	OE	-	-	-	-	3	40	60	100
5.		Open Elective – III**	OE	-	-	-	-	3	40	60	100
Practicals											
6.	23ECL71	Summer internship [@]	EEC	0	0	0	0	2	100	-	100
7.	23ECL72	Mini Project	EEC	0	0	4	4	2	100	-	100
Total				-	-	-	-	18			

[#]Elective - Management shall be chosen from the Elective Management courses.

^{*}Professional Elective - VI shall be chosen from the list of Professional electives (Verticals) offered by same Programme

^{**} Open Elective - II to III Shall be chosen from the list of open electives offered by other Programmes

[@] The students undergone summer internship during VI semester summer vacation and same will be evaluated in VII semester.



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SEMESTER VIII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Practicals											
1.	23ECL81	Project Work	EEC	0	0	20	20	10	60	40	100
Total				0	0	20	20	10			

TOTAL CREDITS: 163



MANDATORY COURSES IV

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MDC52	Introduction to Women and Gender Studies	MC	3	0	0	3	0	100	-	100
2.	23MDC53	Elements of Literature	MC	3	0	0	3	0	100	-	100
3.	23MDC54	Film Appreciation	MC	3	0	0	3	0	100	-	100
4.	23MDC55	Disaster Risk Reduction and Management	MC	3	0	0	3	0	100	-	100

MANDATORY COURSES V

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MDC61	Well Being with Traditional Practices -Yoga, Ayurveda and Siddha	MC	3	0	0	3	0	100	-	100
2.	23MDC62	History of Science and Technology in India	MC	3	0	0	3	0	100	-	100
3.	23MDC63	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0	100	-	100
4.	23MDC64	State, Nation Building and Politics in India	MC	3	0	0	3	0	100	-	100
5.	23MDC65	Industrial Safety	MC	3	0	0	3	0	100	-	100

ELECTIVE - MANAGEMENT COURSES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MSE71	Principles of Management	HSS	3	0	0	3	3	40	60	100
2.	23MSE72	Total Quality Management	HSS	3	0	0	3	3	40	60	100
3.	23MSE73	Engineering Economics and Financial Accounting	HSS	3	0	0	3	3	40	60	100
4.	23MSE74	Human Resource Management	HSS	3	0	0	3	3	40	60	100
5.	23MSE75	Knowledge Management	HSS	3	0	0	3	3	40	60	100
6.	23MSE76	Industrial Management	HSS	3	0	0	3	3	40	60	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Semiconductor Chip Design and Testing	Vertical II Signal Processing	Vertical III RF Technologies	Vertical IV Biomedical Technologies	Vertical V Underwater Technologies	Vertical VI Sensor Technologies and IoT	Vertical VII Space Technologies	Vertical VIII High Speed Communications
Application specific Integrated circuit	Advanced Digital Signal Processing	RF Transceivers	Wearable Sensor Devices	Underwater Instrumentation System	Advanced Driver Assistance Systems	Radar Technologies	Optical Communication & Networks
VLSI Signal Processing	Image Processing	Signal Integrity	Medical Instrumentation	Underwater Imaging Systems	IoT Based System Design	Avionics Systems	Wireless Broad Band Networks
Low Power IC Design	Speech Processing	Antenna Design and Wave Guide	Medical Imaging Systems	Underwater Communication	Ad hoc and Wireless Sensor Networks	Positioning and Navigation Systems	5G and Beyond Communication Networks
VLSI Testing and Design For Testability	Deep Learning	MICs and RF System Design	Brain Computer Interface and Applications	Underwater Wireless Sensor Networks	Industrial IoT and Industry 4.0	Satellite Communication	Software Defined Networks
Mixed Signal IC Design Testing	DSP Architecture and Programming	EMI/EMC Pre Compliance Testing	Body Area Networks	Underwater Navigation Systems	MEMS Design	Remote Sensing	Massive MIMO Networks
Analog IC Design	Computer Vision	RF ID System Design & Testing	Human Assist Devices	Ocean Acoustics	Vehicular Technology	Rocketry and Space Mechanics	Advanced Wireless Communication Techniques
Fundamentals of Nano Electronics	Wavelets and its applications	RF passive circuits	Artificial Intelligence in Healthcare	Underwater signal processing	Sensors and actuator devices for IoT	Spacecraft sensors and instrumentation	Green radio communication Techniques
Organic semiconductors, polymers and molecular electronics	Optical computing and signal Processing	Advanced radiation systems	Bio Inspired Computing	Underwater acoustic communication	Foundation of robotics	Orbital mechanics	Multicarrier wireless communication

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. 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 2023 (Clause 12).


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PROFESSIONAL ELECTIVE COURSES: VERTICALS**VERTICAL 1: SEMICONDUCTOR CHIP DESIGN AND TESTING**

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE11	Application specific Integrated circuit	PE	3	0	0	3	3	40	60	100
2.	23ECE12	VLSI Signal Processing	PE	3	0	0	3	3	40	60	100
3.	23ECE13	Low Power IC Design	PE	3	0	0	3	3	40	60	100
4.	23ECE14	VLSI Testing and Design For Testability	PE	2	0	2	4	3	50	50	100
5.	23ECE15	Mixed Signal IC Design Testing	PE	2	0	2	4	3	50	50	100
6.	23ECE16	Analog IC Design	PE	2	0	2	4	3	50	50	100
7.	23ECE17	Fundamentals of Nano Electronics	PE	3	0	0	3	3	40	60	100
8.	23ECE18	Organic semiconductors, polymers and molecular electronics	PE	3	0	0	3	3	40	60	100

VERTICAL 2: SIGNAL PROCESSING

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE21	Advanced Digital Signal Processing	PE	2	0	2	4	3	50	50	100
2.	23ECE22	Image Processing	PE	3	0	0	3	3	40	60	100
3.	23ECE23	Speech Processing	PE	2	0	2	4	3	50	50	100
4.	23ECE24	Deep Learning	PE	2	0	2	4	3	50	50	100
5.	23ECE25	DSP Architecture and Programming	PE	2	0	2	4	3	50	50	100
6.	23ECE26	Computer Vision	PE	2	0	2	4	3	50	50	100
7.	23ECE27	Wavelets and its applications	PE	3	0	0	3	3	40	60	100
8.	23ECE28	Optical computing and signal Processing	PE	3	0	0	3	3	40	60	100

VERTICAL 3: RF TECHNOLOGIES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE31	RF Transceivers	PE	2	0	2	4	3	50	50	100
2.	23ECE32	Signal Integrity	PE	2	0	2	4	3	50	50	100
3.	23ECE33	Antenna Design and Wave guide	PE	2	0	2	4	3	50	50	100
4.	23ECE34	MICs and RF System Design	PE	2	0	2	4	3	50	50	100
5.	23ECE35	EMI/EMC Pre Compliance Testing	PE	2	0	2	4	3	50	50	100
6.	23ECE36	RFID System Design and Testing	PE	2	0	2	4	3	50	50	100
7.	23ECE37	RF passive circuits	PE	3	0	0	3	3	40	60	100
8.	23ECE38	Advanced radiation systems	PE	3	0	0	3	3	40	60	100

VERTICAL 4: BIOMEDICAL TECHNOLOGIES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE41	Wearable Sensor Devices	PE	3	0	0	3	3	40	60	100
2.	23ECE42	Medical Instrumentation	PE	3	0	0	3	3	40	60	100
3.	23BME47	Artificial Intelligence in Healthcare	PE	3	0	0	3	3	40	60	100
4.	23BME54	Medical Imaging Systems	PE	3	0	0	3	3	40	60	100
5.	23BME55	Brain Computer Interface and Applications	PE	3	0	0	3	3	40	60	100
6.	23BME58	Bio Inspired Computing	PE	3	0	0	3	3	40	60	100
7.	23BME63	Body Area Networks	PE	3	0	0	3	3	40	60	100
8.	23BME73	Human Assist Devices	PE	3	0	0	3	3	40	60	100

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VERTICAL 5: UNDERWATER TECHNOLOGIES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE51	Underwater Instrumentation System	PE	3	0	0	3	3	40	60	100
2.	23ECE52	Underwater Imaging Systems	PE	2	0	2	4	3	50	50	100
3.	23ECE53	Underwater Communication	PE	2	0	2	4	3	50	50	100
4.	23ECE54	Underwater Wireless Sensor Networks	PE	2	0	2	4	3	50	50	100
5.	23ECE55	Underwater Navigation Systems	PE	3	0	0	3	3	40	60	100
6.	23ECE56	Ocean Acoustics	PE	2	0	2	4	3	50	50	100
7.	23ECE57	Underwater signal processing	PE	3	0	0	3	3	40	60	100
8.	23ECE58	Underwater acoustic communication	PE	3	0	0	3	3	40	60	100

VERTICAL 6: SENSOR TECHNOLOGIES AND IOT

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE61	Advanced Driver Assistance Systems	PE	3	0	0	3	3	40	60	100
2.	23ECE62	IoT Based Systems Design	PE	3	0	0	3	3	40	60	100
3.	23ECE63	Ad hoc and Wireless Sensor Networks	PE	3	0	0	3	3	40	60	100
4.	23ECE64	Industrial IoT and Industry 4.0	PE	2	0	2	4	3	50	50	100
5.	23ECE65	MEMS Design	PE	2	0	2	4	3	50	50	100
6.	23ECE66	Vehicular Technology	PE	3	0	0	3	3	40	60	100
7.	23ECE67	Sensors and actuator devices for IoT	PE	3	0	0	3	3	40	60	100
8.	23ECE68	Foundation of robotics	PE	3	0	0	3	3	40	60	100


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VERTICAL 7: SPACE TECHNOLOGIES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE71	Radar Technologies	PE	3	0	0	3	3	40	60	100
2.	23ECE72	Avionics Systems	PE	3	0	0	3	3	40	60	100
3.	23ECE73	Positioning and Navigation Systems	PE	3	0	0	3	3	40	60	100
4.	23ECE74	Satellite Communication	PE	3	0	0	3	3	40	60	100
5.	23ECE75	Remote Sensing	PE	3	0	0	3	3	40	60	100
6.	23ECE76	Rocketry and Space Mechanics	PE	3	0	0	3	3	40	60	100
7.	23ECE77	Spacecraft sensors and instrumentation	PE	3	0	0	3	3	40	60	100
8.	23ECE78	Orbital mechanics	PE	3	0	0	3	3	40	60	100

VERTICAL 8: HIGH SPEED COMMUNICATIONS

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23ECE81	Optical Communication & Networks	PE	3	0	0	3	3	40	60	100
2.	23ECE82	Wireless Broad Band Networks	PE	3	0	0	3	3	40	60	100
3.	23ECE83	5G and Beyond Communication Networks	PE	2	0	2	4	3	50	50	100
4.	23ECE84	Software Defined Networks	PE	2	0	2	4	3	50	50	100
5.	23ECE85	Massive MIMO Networks	PE	2	0	2	4	3	50	50	100
6.	23ECE86	Advanced Wireless Communication Techniques	PE	3	0	0	3	3	40	60	100
7.	23ECE87	Green radio communication Techniques	PE	3	0	0	3	3	40	60	100
8.	23ECE88	Multicarrier wireless communication	PE	3	0	0	3	3	40	60	100

OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF CIVIL ENGINEERING											
1	23CEO11	Civil and Infrastructure Engineering	OE	3	0	0	3	3	40	60	100
2	23CEO12	Environmental Pollution and waste management	OE	3	0	0	3	3	40	60	100
3	23CEO13	Environmental Impact Assessment	OE	3	0	0	3	3	40	60	100
4	23CEO14	Building Services	OE	3	0	0	3	3	40	60	100
5	23CEO15	Water, Sanitation and Health	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING											
1	23CSO11	Foundation of AR/VR	OE	3	0	0	3	3	40	60	100
2	23CSO12	Web Designing	OE	3	0	0	3	3	40	60	100
3	23CSO13	Block Chain fundamentals	OE	3	0	0	3	3	40	60	100
4	23CSO14	Knowledge Management	OE	3	0	0	3	3	40	60	100
5	23CSO15	Cloud Computing Essentials	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING											
1	23ECO11	Basics of Electronics in Automation	OE	3	0	0	3	3	40	60	100
2	23ECO12	Wireless Optical Communication	OE	3	0	0	3	3	40	60	100
3	23ECO13	Soft Computing techniques	OE	3	0	0	3	3	40	60	100
4	23ECO14	Consumer electronics	OE	3	0	0	3	3	40	60	100
5	23ECO15	Principles of communication Engineering	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING											
1.	23EEO11	Renewable Energy Sources	OE	3	0	0	3	3	40	60	100
2.	23EEO12	Electrical Vehicle	OE	3	0	0	3	3	40	60	100
3.	23EEO13	Energy Auditing and Conservation	OE	3	0	0	3	3	40	60	100
4.	23EEO14	Domestic and Industrial Electrical Installations	OE	3	0	0	3	3	40	60	100
5.	23EEO15	Microcontroller Based System Design	OE	3	0	0	3	3	40	60	100

OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING

1	23MEO11	Industrial Instrumentation	OE	3	0	0	3	3	40	60	100
2	23MEO12	Energy Technology	OE	3	0	0	3	3	40	60	100
3	23MEO13	Reverse Engineering	OE	3	0	0	3	3	40	60	100
4	23MEO14	Fire Safety Engineering	OE	3	0	0	3	3	40	60	100
5	23MEO15	Nano Technology	OE	3	0	0	3	3	40	60	100
6	23MEO16	Entrepreneurship Development	OE	3	0	0	3	3	40	60	100

OFFERED BY DEPARTMENT ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

1	23ADO11	Introduction to Big Data	OE	3	0	0	3	3	40	60	100
2	23ADO12	Principles of Data Science	OE	3	0	0	3	3	40	60	100
3	23ADO13	Data Visualization and its Applications	OE	3	0	0	3	3	40	60	100
4	23ADO14	Data Warehousing and Mining	OE	3	0	0	3	3	40	60	100
5	23ADO15	Principles of Cyber Security	OE	3	0	0	3	3	40	60	100

OFFERED BY DEPARTMENT INFORMATION TECHNOLOGY

1	23ITO11	Basics of Java Programming	OE	3	0	0	3	3	40	60	100
2	23ITO12	Ethical Hacking	OE	3	0	0	3	3	40	60	100
3	23ITO13	E-Commerce and Applications	OE	3	0	0	3	3	40	60	100
4	23ITO14	Basics of Android Application Development	OE	3	0	0	3	3	40	60	100
5	23ITO15	Introduction to Web Design	OE	3	0	0	3	3	40	60	100

OFFERED BY DEPARTMENT OF PHARMACEUTICAL TECHNOLOGY

1	23PTO11	Nutraceuticals	OE	3	0	0	3	3	40	60	100
2	23PTO12	IPR for Pharma Industry	OE	3	0	0	3	3	40	60	100
3	23PTO13	Pharmaceutical Nanotechnology	OE	3	0	0	3	3	40	60	100
4	23PTO14	Basics of Human Anatomy and physiology	OE	3	0	0	3	3	40	60	100

OFFERED BY DEPARTMENT BIOMEDICAL ENGINEERING

1	23BMO11	Biosensors and Instrumentation	OE	3	0	0	3	3	40	60	100
2	23BMO12	Medical Robotics	OE	3	0	0	3	3	40	60	100
3	23BMO13	Biometric systems and their applications	OE	3	0	0	3	3	40	60	100
4	23BMO14	Healthcare Management systems	OE	3	0	0	3	3	40	60	100
5	23BMO15	IoT in Healthcare	OE	3	0	0	3	3	40	60	100

23IPA11

INDUCTION PROGRAMME
(Common to B.E./B.Tech. all Branches)

L	T	P	C
-	-	-	0

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 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.

(i) Physical Activity:

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

(ii) Creative Arts:

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later

(iii) 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, take 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't's, 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.

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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.

(iv) Literary Activity:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules:

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

(vi) 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.

(vii) 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 under privileged.

(viii) 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.

(ix) Department Specific Activities:

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop.

For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games, ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

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

REFERENCES:

1. Guide to Induction program from AICTE

Signature
21/09/2023

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23ENT11

PROFESSIONAL ENGLISH - I
(Common to B.E./B.Tech. all Branches)

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To learn to use basic grammatical structures in suitable contexts.
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
- To help learners use language effectively in professional contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, de initiions, essays and user manuals.

UNIT-I	INTRODUCTION TO EFFECTIVE COMMUNICATION AND FUNDAMENTALS OF COMMUNICATION	10
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Introduction to Effective Communication- Barriers of Communication, Seven C's of Effective Communication, Effective Listening, Effective Speaking, Excellence in Reading, Ways to Develop Language and Communication Skills.

Reading- Reading Brochures (Technical Context), Telephone Messages/ Social Media Messages Relevant to Technical Contexts and Emails.

Writing- Writing Emails / Letters Introducing Oneself.

Grammar- Present Tense (Simple and Progressive); Question Types: Wh/ Yes or No/ and Tags.

Vocabulary- Synonyms; One Word Substitution; Abbreviations & Acronyms (as Used in Technical Contexts)

UNIT-II	NARRATION AND SUMMATION	9
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Reading - Reading Biographies, Travelogues, Newspaper Reports, Excerpts from Literature, and Travel & Technical Blogs.

Writing - Guided writing, Paragraph Writing, Short Report on an Event (Field Trip etc.)

Grammar - Past Tense (Simple); Subject-Verb Agreement; and Prepositions.

Vocabulary - Word Forms (Pre ixes& Suf ixes); Synonyms and Antonyms; Phrasal Verbs.

UNIT-III	DESCRIPTION OF A PROCESS / PRODUCT	9
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Reading - Reading Advertisements, Gadget Reviews; User Manuals.

Writing - Writing De initiions; Instructions; and Product /Process Description.

Grammar - Imperatives; Adjectives; Degrees of Comparison; Present & Past Perfect Tenses.

Vocabulary- Compound Nouns, Homonyms; and Homophones, Discourse Markers (Connectives & Sequence Words)

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UNIT-IV

CLASSIFICATION AND RECOMMENDATIONS

9

Reading - Newspaper Articles; Journal Reports -and Non Verbal Communication (Tables, Pie Charts etc..)

Writing - Note-making / Note-taking (*Study skills to be taught, not tested); Writing Recommendations; Transferring Information from Non Verbal (Chart , Graph etc, to Verbal Mode)

Grammar - Articles; Pronouns - Possessive & Relative Pronouns.

Vocabulary - Collocations; Fixed / Semi Fixed Expressions

UNIT-V

EXPRESSION

8

Reading - Reading Editorials; and Opinion Blogs;

Writing - Essay Writing (Descriptive or Narrative).

Grammar- Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences.

Vocabulary - Cause & Effect Expressions – Content vs. Function Words.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

- CO1:** Use appropriate words in a professional context
- CO2:** Gain understanding of basic grammatical structures and use them in right context
- CO3:** Read and infer the denotative and connotative meanings of technical text
- CO4:** Read and interpret information presented in tables, charts and other graphic forms
- CO5:** Write definitions, descriptions, narrations and essays on various topics

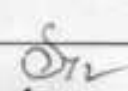
TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication–Principles and Practices", Oxford Univ. Press, New Delhi, 2016.

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- 2 Lakshminarayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt.Ltd. 2012.
- 3 Aysha Viswamohan, "English For Technical Communication (With CD)", Mcgraw HillEducation, ISBN : 0070264244, 2008.
- 4 Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House, 2016.

E. RESOURCES:

- <https://learnenglish.britishcouncil.org/>

CO's-PO's MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	3
CO2	-	-	-	-	-	1	-	-	2	3	-	2
CO3	-	-	-	-	-	1	-	-	3	3	-	3
CO4	-	-	-	2	-	-	-	-	3	3	-	3
CO5	-	-	-	-	-	-	-	-	2	3	-	2
AVR	-	-	-	2	-	1	-	-	2	3	-	3

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

23MAT11

MATRICES AND CALCULUS
(Common to B.E./B.Tech. all Branches)

L T P C
3 1 0 4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications
- To familiarize the students with differential calculus
- To familiarize the student with functions of several variables. This is needed in many branches of engineering
- To make the students understand various techniques of integration
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT-I

MATRICES

9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.

UNIT-II

DIFFERENTIAL CALCULUS

9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules(sum, product, quotient, chain rules) - Implicit differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT-III

FUNCTIONS OF SEVERAL VARIABLES

9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT-IV

INTEGRAL CALCULUS

9+3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Improper integrals - Applications : Hydrostatic force and pressure, moments and centre of mass.

UNIT-V

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 and triple integrals – Applications: Moments and centre of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Use the matrix algebra methods for solving practical problems
- CO2:** Apply differential calculus tools in solving various application problems.
- CO3:** Use differential calculus ideas on several variable functions
- CO4:** Apply different methods of integration in solving practical problems
- CO5:** Apply multiple integral ideas in solving areas, volumes and other practical problems

TEXT BOOKS :

- James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2019. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8]
- Grewal. B. S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018

REFERENCE BOOKS :

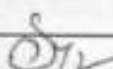
- Thomas. G. B., Hass. J., and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2022
- Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2021
- Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016
- Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016

CO's - PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	2	-	2	3
CO2	3	3	1	1	-	-	-	-	3	-	2	3
CO3	3	3	1	1	-	-	-	-	2	-	2	3
CO4	3	3	1	1	-	-	-	-	2	-	2	3
CO5	3	2	1	1	-	-	-	-	2	-	2	3
AVG	3	3	1	1	-	-	-	-	2	-	2	3

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

SVHEC-R2023


Chairman
BoS / S&H

23PHT11

ENGINEERING PHYSICS
(Common to B.E./B. Tech. all branches)

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics
- Provide knowledge of elastic property, thermal property of materials and its applications
- Impart knowledge of laser and their applications
- Introduce the essential principles of fiber optics and its applications
- Equipping the students to successfully understand the importance of quantum physics

UNIT-I

MECHANICS

10

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia – theorems of M – M.I of a diatomic molecule – torque – rotational dynamics of rigid bodies – rotational energy state of a rigid diatomic molecule – torsional pendulum – double pendulum

UNIT-II

PROPERTIES OF MATTER AND THERMAL PHYSICS

10

Elasticity- Hooke's law – stress – strain diagram – Poisson's ratio – Factors affecting elasticity – bending of beams-Bending moment equation – Depression of a cantilever-Young's modulus by uniform bending – I-shaped girders-Modes of heat transfer – thermal conductivity – Newton's law of cooling – Linear heat law – Lee's disc method – conduction through compound media (series and parallel)

UNIT-III

LASER

9

Lasers: Stimulated absorption – Spontaneous emission – Stimulated emission – Population inversion-Einstein's coefficients derivation and their relations – Pumping methods – Types of lasers – Nd:YAG, CO₂ laser, Semiconductor lasers (homojunction & heterojunction) – Industrial and Medical Applications of lasers

UNIT-IV

FIBER OPTICS

8

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending – Fiber optics communication system (qualitative) – Temperature and displacement sensors – fiber optic endoscope

UNIT-V

QUANTUM PHYSICS

8

Photons and light waves – Electrons and matter waves – Compton effect: theory of scattering – Derivation and experimental verification – The Schrodinger equation (Time dependent and

time independent forms) – particle in a one-dimensional rigid box for eigen value and eigen function – tunneling (qualitative) – scanning tunneling microscope

TOTAL: 45 PERIODS

COURSE OUTCOME:

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

- CO1:** Understand the importance of mechanics.
- CO2:** Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications
- CO3:** Demonstrate a foundational knowledge in lasers
- CO4:** The students will get knowledge on fiber optics
- CO5:** Understand the importance of quantum physics

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics," McGraw Hill Education (Indian Edition), 2017
2. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, "Concepts of Modern Physics," McGraw-Hill (Indian Edition), 2017

REFERENCE BOOKS:

1. K.Thyagarajan and A.Ghatak, "Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2023
2. D.Halliday, R.Resnick and J.Walker, "Principles of Physics," Wiley (Indian Edition), 2021
3. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students," Springer-Verlag, 2012

CO's- PO's MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-
CO3	3	2	2	1	2	-	-	-	-	-	-	1
CO4	3	2	2	1	2	-	-	-	-	-	-	1
CO5	3	3	1	1	2	-	-	-	-	-	-	-
AVG	3	3	2	1	2	-	-	-	-	-	-	1

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

23CYT11

ENGINEERING CHEMISTRY
(Common to B.E./B. Tech. all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques
- To impart knowledge on the basic principles and preparatory methods of nanomaterials
- To introduce the basic concepts and applications of phase rule and composites
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices

UNIT-I

WATER AND ITS TREATMENT

9

Water: Sources and impurities, **Water quality parameters:** turbidity, pH, hardness, alkalinity, TDS, COD and BOD. **Desalination of brackish water:** Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. **Treatment of boiler feed water:** Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)

UNIT-II

NANOCHEMISTRY

9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials:** De inition, properties and uses of – nanoparticle, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, electrochemical deposition. **Applications** of nanomaterials with examples in medicine, agriculture, energy, electronics and catalysis.

UNIT-III

PHASE RULE AND COMPOSITES

9

Phase rule: Introduction, de inition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system – Pattinson's process.

Composites: Introduction: De inition & Need for composites; **Constitution:** Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (iber, particulates, lakes and whiskers). **Properties and applications of:** Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites.

UNIT-IV

FUELS AND COMBUSTION

9

Fuels: Introduction: Classification of fuels; **Coal and coke:** Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Solid biofuels, Compressed biogas, Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Flue gas analysis** - ORSAT Method. **CO₂ emission and carbon footprint.**

UNIT-V

ENERGY SOURCES AND STORAGE DEVICES

9

Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells; **Recent developments in solar cell materials.** **Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H₂-O₂ fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

- CO1:** To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- CO2:** To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- CO3:** To apply the knowledge of phase rule and composites for material selection requirements.
- CO4:** To recommend suitable fuels for engineering processes and applications.
- CO5:** To recognize different forms of energy resources and apply them for suitable applications in energy sectors

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018
2. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018

Shree Venkateshwara Hi-Tech Engineering College (Autonomous)

REFERENCE BOOKS:

1. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanpar Rai & Co (Pvt.) Ltd, New Delhi, 2011
2. O.G. Palanna, "Engineering Chemistry", McGraw Hill Education (India) Private Limited, 2nd Edition, 2017
3. Dr. A.Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Limited, 23rd Edition, 2023

CO's- PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1	3	3	-	-	-	-	-
CO2	3	2	1	1	2	2	-	-	-	-	-	1
CO3	3	3	1	1	1	1	-	-	-	-	-	-
CO4	3	2	1	1	1	1	-	-	-	-	-	-
CO5	3	2	2	1	2	2	2	-	-	-	-	-
AVG	3	2	2	1	1	2	3	-	-	-	-	1

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

23CST11	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common to: B.E. / B.Tech. all Branches)	3	0	0	3

COURSE OBJECTIVES:

- To solve problems using computational thinking methods using pseudo code and flowchart
- To understand the fundamentals of algorithmic problem solving basics and strategies
- To define variables data types and error messages
- To learn to solve problems using Python conditionals loops lists tuples and dictionaries to represent complex data
- To understand the functions modules and do input/output with files in Python

UNIT-I	COMPUTATIONAL THINKING	8
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Introduction - Problem solving and Decomposition - Abstraction - Notations Pseudo code - Flow chart - Programming language

UNIT-II	ALGORITHMIC PROBLEM SOLVING	8
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Algorithm Implementation - Top down design - Simple strategies for developing algorithms - Iteration - Recursion - Fundamental algorithms - Anticipating and Dealing with Errors

UNIT-III	BASICS BUILDING BLOCKS OF PYTHON	9
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Variables - Immutable variables - Data types - Operators - Python Reserved Words - Understanding error messages

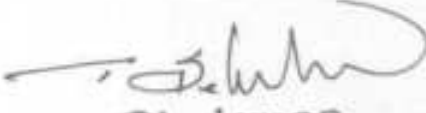
UNIT-IV	CONTROL STATEMENTS AND STRUCTURED TYPES	10
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Control Flow - Indenting - if Statement - while Loop - break and continue - for Loop - String - Lists - Tuples - Sets - Dictionaries

UNIT-V	FUNCTIONS, MODULES AND FILES	10
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Definition - Hiding redundancy - Arguments and return values - Variable Number of Arguments - Scope - Passing Functions to a Function - Mapping Functions in a Dictionary - Lambda function - Recursive Functions - Modules: Standard Modules - OS and SYS modules - User defined Modules - Importing modules - Writing into a File - Reading from a File - File Methods

TOTAL : 45 PERIODS


Chairman
 BOS/CSE&IT

COURSE OUTCOMES:

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

- CO1 :** Develop algorithmic solutions for simple computational problems to develop and execute simple Python programs.
- CO2 :** Write the Algorithms for problem solving basics and strategies to solve complex problems
- CO3 :** Compose simple Python programs using to illustrate variables data types and error messages.
- CO4 :** Represent compound data using Python conditionals loops lists tuples dictionaries for solving problems
- CO5 :** Create functions modules read and write data from/to files in Python programs.

TEXT BOOKS:

1. R. G. Dromey "How to Solve it by Computer", Pearson Education., 2015
2. Charles Dierbach "Introduction to Computer Science using Python: A Computational Problem- Solving Focus", Wiley India., 2015

REFERENCE BOOKS:

1. John V. Guttag "Introduction to Computation and Programming using Python", The MIT press. 2021 (3rd Edition).
2. Paul Gries, Jennifer Campbell, Jason Montojo "Practical Programming: An Introduction to Computer Science using Python 3", Pragmatic Programmers., 2013 , Second edition
3. Robert Sedgewick, Kevin Wayne, Robert Dondero "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India., 2016
4. Karl Beecher "Computational Thinking - A beginner's guide to problem solving and Programming", BCS Learning &Development., 2017

E-RESOURCES:

1. <http://www.flowgorithm.org/>
2. <https://www.python.org/>
3. <https://nptel.ac.in/courses/106104074>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	2	3	3	3	2	-	-	-	-	-	2	-	3	3	3
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	2	2	3	3
AVG	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3

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

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23TAT11

HERITAGE OF TAMILS
(Common to B.E./B. Tech. all branches)

L T P C
1 0 0 1

COURSE OBJECTIVES:

- To understand the Sangam and modern literature of Tamil
- To learn the heritage of Tamil culture
- To recognize the various art forms of Tamils
- To explain the Thinaï concept of Tamils
- To realize the contribution of Tamils to Indian national movement and Indian culture

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, Yath 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 CONCEPTS 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

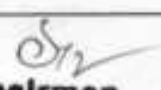
**CONTRIBUTION OF TAMILS TO INDIAN
NATIONAL MOVEMENT AND INDIAN CULTURE**

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

SVHEC-R0023


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COURSE OUTCOMES:

At the end of the course the student will be able to

- CO1:** Gain knowledge about various literatures of Tamil
- CO2:** Learn the uniqueness of Tamil cultural heritage
- CO3:** Find various art forms of Tamil Nadu
- CO4:** Understand the Thinaï concepts in Tamil
- CO5:** Distinguish the contribution of Tamils to Indian national movement and Indian culture

E- RESOURCES:

1. <https://www.tamilvu.org/>

CO's -PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

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

23TAT11

தமிழர் மரபு

L T P C
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(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- தமிழின் இலக்கியங்கள் மற்றும் நவீன இலக்கியங்களைப் புரிந்துகொள்ளுதல்
- தமிழ் கலாச்சார பாரம்பரியத்தைக் கற்றுக்கொள்ளுதல்
- தமிழர்களின் பல்வேறு கலைவடிவங்களைக் கண்டறிதல்
- தமிழர்களின் திணைக்கோட்பாடுகளை விளக்குதல்
- இந்திய சுதந்திர போராட்ட இயக்கங்களுக்கும் இந்திய கலாச்சாரத்திற்குமான தமிழர்களின் பங்களிப்பை உணர்தல்

அலகு - I

மொழி மற்றும் இலக்கியம்

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் ஆறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த மதங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு - II

மரபு - பாரை ஒவியங்கள் முதல் நவீன ஒவியங்கள் வரை - சிற்பக் கலை

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், 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

நாட்டப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள்

3

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

அலகு - IV

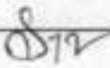
தமிழர்களின் திணைக் கோட்பாடுகள்

3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவு, கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

SVHEC-R2023

சென்னை
11/02/2023


Chairman
BoS / S&M

அலகு - V

இந்திய தேசிய இயக்கம் மற்றும்

3

இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

- CO1: தமிழின் பல்வேறு இலக்கியங்களைப் பற்றிய அறிவைப் பெறுவார்கள்
- CO2: தமிழ் கலாச்சார பாரம்பரியத்தின் தனித்தன்மையைக் கற்றுக்கொள்வார்கள்
- CO3: தமிழகத்தின் பல்வேறு கலைவடிவங்களைக் கண்டறிவார்கள்
- CO4: தமிழர்களின் திணைக்கோட்பாடுகளை அறிந்துகொள்வார்கள்
- CO5: தமிழ் சுதந்திரப்போராட்ட வீரர்கள் மற்றும் தமிழ் கலாச்சாரத்தை இந்தியாவின் மற்ற பகுதியுடன் ஒப்பிடும் திறனைப் பெறுவார்கள்

மின் -ஆதாரங்கள்:

1. <https://www.tamilvu.org/>

CO's -PO's விவரணையாக்கம்:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

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

SVHEC-R2023

நவம்பர் 15
2023


Chairman
BoS / S&H

**PROBLEM SOLVING AND PYTHON PROGRAMMING
LABORATORY**

L T P C

23CSL11

0 0 4 2

(Common to: B.E. / B.Tech. all Branches)

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python

LIST OF EXPERIMENTS

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

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. Implementing 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. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL : 60 PERIODS


Chairman
BOS/CSE&IT

COURSE OUTCOMES:

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

- CO1 :** Develop algorithmic solutions to simple computational problems
- CO2 :** Develop and execute simple Python programs.
- CO3 :** Implement programs in Python using conditionals and loops for solving problems.
- CO4 :** Deploy functions to decompose a Python program.
- CO5 :** Process compound data using Python data structures and Utilize Python packages in developing software applications.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

E-RESOURCES:

1. <http://www.flowgorithm.org/>
2. <https://www.python.org/>
3. <https://nptel.ac.in/courses/106104074>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	-	2	-	3	3	
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	-	2	3	3
AVG	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3

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

23PCL11

PHYSICS AND CHEMISTRY LABORATORY
(Common to B.E./B. Tech. all branches)

L	T	P	C
0	0	4	2

PHYSICS LABORATORY
(Any Seven Experiments)

COURSE OBJECTIVES:

- Determination of the physical parameters such as young's modulus by Uniform bending method, Non-Uniform bending method, Simple harmonic oscillations of cantilever and rigidity modulus of wire
- To impart knowledge in the determination of the thermal conductivity of a bad conductor by Lee's Disc method and band gap of a semiconductor
- Determination of the wavelength of the laser using grating, numerical aperture and acceptance angle in an optical fiber and width of the groove in a compact disc by using laser
- Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
- Knowledge on the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus

LIST OF EXPERIMENTS

1. Determination of Young's modulus by Uniform bending method
2. Determination of Young's modulus by non-uniform bending method
3. Simple harmonic oscillations of cantilever
4. Determination of rigidity modulus of wire and moment of inertia of regular objects - Torsion pendulum
5. Determination of thermal conductivity of a bad conductor - Lee's Disc method
6. Determination of band gap of a semiconductor
7. Determination of the wavelength of the laser using grating
8. a) Determination of numerical aperture and acceptance angle in an optical fiber
b) Determination of width of the groove in a compact disc by using laser
9. Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
10. Determination of the frequency of alternating current using electrically vibrating tuning fork - Melde's apparatus

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- | | |
|-------------|--|
| CO1: | Experiment and determine the physical characteristics of given solid materials using Young's modulus-Uniform bending method, non-uniform bending method, cantilever method and Torsion Pendulum. |
| CO2: | Experiment and determine the thermal conductivity of a bad conductor using Lee's Disc method and band gap energy of a given semiconducting material using Zener diode. |
| CO3: | Experiment and determine the optical property of light sources, acceptance angle of optical fiber and width of the groove in a compact disc using Laser. |
| CO4: | Experiment and determine the velocity of ultrasonic waves using ultrasonic interferometer. |
| CO5: | Experiment and determine the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus |

TEXT BOOKS:

1. Dr. P. Mani, Engineering Physics Practicals, Dhanam Publications (2022)

CO's - PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	-	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-
AVG	3	3	1	1	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY
(Any Seven Experiments)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity.
- To acquire the knowledge in total hardness and dissolved oxygen and its impacts in industries through experiments
- To understand the impacts of chlorine in water sample through volumetric analysis.
- To induce the students to familiarize with electroanalytical techniques in the determination of impurities in aqueous solutions.
- To determine the amount of metal ions through spectroscopic techniques.

LIST OF EXPERIMENTS

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in a water sample
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
9. Estimation of iron content of the given solution using potentiometer.
10. Estimation of sodium /potassium present in water using a flame photometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- CO1:** Analyse the quality of water samples with respect to their acidity and alkalinity of water samples
- CO2:** Examine the water quality parameters like total hardness and DO with volumetric analysis.
- CO3:** Learn the permissible limit of chlorine in the given water sample
- CO4:** Analyse the impurities in solution by electro analytical techniques quantitatively
- CO5:** Determine the amount of metal ions through spectroscopic techniques.

CO's - PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	3	3	1	-	-	-	1
CO2	3	2	2	-	-	3	3	1	-	-	-	1
CO3	3	2	1	-	-	3	3	1	-	-	-	1
CO4	3	2	2	-	1	2	1	-	-	-	-	-
CO5	3	2	1	-	1	2	1	-	-	-	-	-
Avg.	3	2	1	-	1	3	2	1	-	-	-	1

TEXT BOOKS:

1. "Vogel's Textbook of Quantitative Chemical Analysis", (8th Edition, 2014)
2. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis", (2009)

23ENL11

ENGLISH LABORATORY
(Common to B.E./B.Tech. all Branches)

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To help learners use language effectively in academic /work contexts.
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities those are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT-I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening- Listening for General Information-Specific Details- Conversation: Introduction to Classmates - Audio / Video (Formal & Informal); Telephone Conversation; Listening to Voicemail & Messages; Listening and Filling a Form.

Speaking- Making Telephone Calls- Self Introduction; Introducing a Friend; - Politeness Strategies- Making Polite Requests, Making Polite Offers, Replying to Polite Requests and Offers- Understanding Basic Instructions (Filling out a Bank Application for Example).

UNIT-II NARRATION AND SUMMATION 6

Listening - Listening to Podcasts, Anecdotes / Stories / Event Narration; Documentaries and Interviews with Celebrities.

Speaking - Narrating Personal Experiences / Events-Talking about Current and Temporary Situations & Permanent and Regular Situations - Describing Experiences and Feelings- Engaging in Small Talk- Describing Requirements and Abilities.

UNIT-III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to Product and Process Descriptions; A Classroom Lecture; and Advertisements about Products.

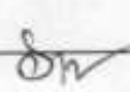
Speaking - Picture Description- Describing Locations in Workplaces- Giving Instruction to Use the Product- Explaining Uses and Purposes- Presenting a Product- Describing Shapes and Sizes and Weights- Talking about Quantities (Large & Small)- Talking about Precautions.

UNIT-IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening - Listening to Technology, Entertainment and Design (TED) Talks; Listening to Lectures - and Educational Videos.

Speaking - Small Talk; Discussing and Making Plans-Talking about Tasks-Talking about Progress- Talking about Positions and Directions of Movement- Talking about Travel Preparations- Talking about Transportation.

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UNIT-V

EXPRESSION

6

Listening - Listening to Debates/ Discussions; Different Viewpoints on an Issue; and Panel Discussions.

Speaking - Making Predictions- Talking about a Given Topic-Giving Opinions- Understanding a Website- Describing Processes.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

- CO1:** To listen to and understand general and complex academic information
- CO2:** To listen to and understand different points of view in a discussion
- CO3:** To speak fluently and accurately in formal and informal communicative contexts
- CO4:** To describe products and processes and explain their uses clearly as well as accurately
- CO5:** To express their opinions effectively in both formal and informal discussions

E. RESOURCES:

- <https://www.ted.com/about/programs-initiatives/ted-talks-education>
- <https://learnenglish.britishcouncil.org/>

CO's & PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	-	2	3	-	2
CO5	-	-	-	-	-	-	-	1	3	3	-	2
AVR	-	-	-	-	-	-	-	1	3	3	-	2

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

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23ENT21

PROFESSIONAL ENGLISH - II
(Common to B.E./B.Tech. all Branches)

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills.
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT-I

MAKING COMPARISONS

6

Reading - Reading Advertisements, User Manuals, Brochures Emails.

Writing - Professional Emails, Email Etiquette - Compare and Contrast Essay.

Grammar - Mixed Tenses, Prepositional Phrase.

UNIT-II

EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING

6

Reading - Reading Longer Technical Texts- Cause and Effect Essays, and Letters / Emails of Complaint.

Writing - Writing Responses to Complaints.

Grammar - Active Passive Voice Transformations, In infinitive and Gerunds.

UNIT-III

PROBLEM SOLVING

6

Reading - Case Studies, Excerpts from Literary Texts, News Reports etc.

Writing - Letter to the Editor, Checklists, Problem Solution Essay / Argumentative Essay.

Grammar - Error Correction; If Conditional Sentences.

UNIT-IV

CLASSIFICATION AND RECOMMENDATIONS

6

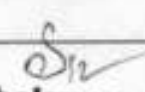
Reading - Newspaper Articles.

Writing - Recommendations, Transcoding, Accident Report, Survey Report

Grammar - Reported Speech, Modals.

Vocabulary - Conjunctions- Use of Prepositions.

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UNIT-V

EXPRESSION

6

Reading - Company Profiles, Statement of Purpose, (SOP), An Excerpt of Interview with Professionals.

Writing - Job / Internship Application – Cover Letter & Resume.

Grammar - Numerical Adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

- CO1:** Compare and contrast products and ideas in technical texts.
- CO2:** Identify and report cause and effects in events, industrial processes through technical texts
- CO3:** Analyse problems in order to arrive at feasible solutions and communicate them in the written format
- CO4:** Present their ideas and opinions in a planned and logical manner
- CO5:** Draft effective resumes in the context of job search.

TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Raman, Meenakshi, Sharma & Sangeeta, "Professional English", Oxford University Press, New Delhi, 2019.
2. Dr. V. Chellammal, "Learning to Communicate", Allied Publishers, New Delhi, 2003
3. V.N. Arora and Laxmi Chandra, "Improve Your Writing", Oxford University Press, New Delhi, 2001.

E. RESOURCES:

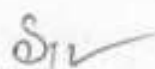
- <https://learnenglish.britishcouncil.org/>

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CO'S-PO'S MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	-	1	-	-	-	-	-	1	2	3	-	2
C02	-	-	-	-	-	-	1	-	3	3	-	3
C03	-	1	1	-	-	-	-	-	3	3	-	3
C04	-	-	-	-	-	-	-	-	2	3	-	2
C05	-	-	-	-	-	-	-	-	2	3	-	2
AVG	-	1	1	-	-	-	1	1	2	3	-	2

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


Chairman
BoS / S&H

23MAT21

**NUMERICAL METHODS AND STATISTICS
(Common to B.E./B.Tech. all Branches)**

**L T P C
3 1 0 4**

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control

UNIT-I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method- Solution of linear system of equations - Gauss elimination method - Pivoting-Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

**UNIT-II INTERPOLATION, NUMERICAL DIFFERENTIATION AND 9+3
NUMERICAL INTEGRATION**

Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules

**UNIT-III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL 9+3
EQUATIONS**

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

UNIT-IV TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) - Tests for single variance and equality of variances - Chi square test for goodness of fit - Independence of attributes

UNIT-V DESIGN OF EXPERIMENTS 9+3

One way and two way classifications - Completely randomized design - Randomized block design - Latin square design - 2^2 factorial design.

TOTAL : 60 PERIODS

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COURSE OUTCOMES:

At the end of the Course the students will be able to

- CO1 :** Apply the numerical techniques of interpolation in various intervals and differentiation and integration for engineering problems
- CO2 :** Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations
- CO3 :** Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications
- CO4 :** Apply the concept of testing of hypothesis for small and large samples in real life problems
- CO5 :** Apply the basic concepts of classifications of design of experiments in the field of agriculture

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2023
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2019

REFERENCE BOOKS:

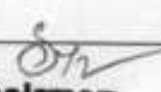
1. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016
3. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014
- 5 Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, India, 2022

CO's – PO's MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	-	-	-	2	-	2	3
CO2	3	3	1	1	1	-	-	-	2	-	2	2
CO3	3	3	1	1	1	-	-	-	2	-	2	3
CO4	3	3	1	1	1	-	-	-	2	-	2	3
CO5	3	2	1	1	1	-	-	-	2	-	3	3
AVG	3	3	1	1	1	-	-	-	2	-	2	3

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

SVHEC- R2023


Chairman
BoS / S&H

23PHT23

PHYSICS FOR ELECTRONICS ENGINEERING
(for B.E. / B.TECH - ECE, EEE and PT)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the electrical properties of materials
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To understand the theory and applications of dielectric materials
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To provide the students a sound platform towards learning about new engineering materials and their applications

UNIT-I

ELECTRICAL PROPERTIES OF MATERIALS

9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Fermi-Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids.

UNIT-II

SEMICONDUCTING MATERIALS

9

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors - variation of Fermi level with temperature and impurity concentration - Hall effect and devices - Ohmic contacts - Schottky diode.

UNIT-III

DIELECTRIC MATERIALS

9

Dielectrics - Dielectric constant - Polarization - Displacement vector - Electric susceptibility - Types of polarization mechanisms: Electronic, ionic, orientational and space-charge - Frequency and temperature dependence - Internal field - Clausius-Mosotti relation - Dielectric loss - Dielectric breakdown - Ferroelectric materials.

UNIT-IV

OPTICAL PROPERTIES OF MATERIALS

9

Classification of optical materials - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain - Optoelectronic devices: light detectors and solar cells - light emitting diode - laser diode - OLED

UNIT-V

NEW ENGINEERING MATERIALS

9

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses: Properties, preparation and applications – Shape memory alloys: Characteristics and applications – Carbon nanotubes: Properties and applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- C01:** Gain knowledge on the electrical properties of materials and their applications
- C02:** Understand clearly of semiconductor physics and functioning of semiconductor devices
- C03:** Get knowledge on theories and applications of dielectric materials
- C04:** Understand the optical properties of materials and working principles of various optical devices
- C05:** The students will understand the basics of ceramics, composites and nanomaterials


TEXT BOOKS:

1. S.O. Kasap, "Principles of Electronic Materials and Devices", McGraw Hill Education (Indian Edition), 2020.
2. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2020.

REFERENCE BOOKS:

1. Laszlo Solymar, Walsh, Donald, Syms and R.A. Richard, "Electrical Properties of Materials", Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", McGraw-Hill Education (Indian Edition), 2019.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley India Edition, 2022

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Shree Venkateshwara Hi-Tech Engineering College (Autonomous)

CO's -PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	1	-	-	-	-	-	-	-	-	-
C02	3	2	1	-	-	-	-	-	-	-	-	-
C03	3	2	1	-	-	-	-	-	-	-	-	-
C04	3	2	1	-	-	-	-	-	-	-	-	-
C05	3	1	1	-	-	-	-	-	-	-	-	-
AVG	3	2	1	-	-	-	-	-	-	-	-	-

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

23EET23	ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
	(B.E - ECE branch)	3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge in types, construction and working of DC machines, AC rotating machines and transformers.
- To educate the functional elements and working of measuring instruments.
- To understand the concepts storage and display devices.

UNIT-I	DC MACHINES	10
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Introduction and Constructional features, Motor and generator mode, EMF and Torque equation, Circuit model, Methods of excitation- Characteristics, Starting and speed control, Stepper motors – Applications.

UNIT-II	AC ROTATING MACHINES	10
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Alternator: Working principle, Equation of induced EMF, Voltage regulation, Principle of operation of three-phase induction motors, Construction, Types, Equivalent circuit, Speed control, Single phase induction motors, Construction, Types, Starting methods.

UNIT-III	TRANSFORMER	9
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Single phase Transformer, Phasor diagram, Equivalent circuit, Testing, Efficiency and Voltage regulation, Three phase transformers, Applications, Auto transformers, Advantages.


UNIT-IV	MEASUREMENTS AND INSTRUMENTATION	8
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Functional elements of an instrument, Standards and calibration, Operating principle, Types, Moving coil and Moving iron meters, Measurement of three phase power, Energy meter, Instrument transformers, CT and PT.

UNIT-V	STORAGE AND DISPLAY DEVICES	8
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Magnetic disk and tape, Recorders, Digital plotters and printers, CRT display, Digital CRO, LED, LCD & Dot matrix display, DSO Block diagram.

TOTAL: 45 PERIODS


Chairman
BoS / EEE

COURSE OUTCOMES:

At the end of this course the students will able to :

- CO1** Analyze the output characterizes of DC machines.
- CO2** Understand the construction and working principle of AC machines.
- CO3** Explain the working principle of transformer.
- CO4** Explain the types and operating principles of measuring instruments.
- CO5** Understand the concepts of storage and display devices.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Kothari DP and IJ Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019
2. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2018.
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2017

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	1	-	-	3	2	1
CO2	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	3
AVG	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2

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

23MET21

ENGINEERING GRAPHICS
(Common to: B.E./B.Tech. all Branches)

L	T	P	C
2	0	4	4

Course Objectives:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing projection of points, lines and plane surface.
- Drawing projection of solids and freehand sketching.
- Drawing of sectioned solids and development of surfaces
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT-I PLANE CURVES**5+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics — 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 above curves.

UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACE**6+12**

Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND FREEHAND SKETCHING**6+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Orthographic projection- Freehand sketching of multiple views from pictorial views of objects.

UNIT-IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**7+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

UNIT-V ISOMETRIC AND PERSPECTIVE PROJECTIONS**6+12**

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL : 90 PERIODS

COURSE OUTCOMES:

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

- CO1:** Construct the conic curves, involutes and cycloid
- CO2:** Solve practical problems involving projection of lines, Planes.
- CO3:** Draw Projection of solids and can draw freehand sketch.
- CO4:** Draw projection of sectioned solids and development of surfaces
- CO5:** Draw the isometric and perspective projections.

TEXT BOOKS:

1. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

REFERENCE BOOKS:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/112/102/112102304/>
2. https://onlinecourses.nptel.ac.in/noc20_me79/preview
3. <https://www.youtube.com/watch?v=ANEvQyt3PnU>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Avg	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

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

23ECI21

CIRCUIT ANALYSIS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To learn the basic concepts and behavior of DC circuits.
- To apply the network theorems concepts in DC circuits.
- To understand the sinusoidal steady state analysis of electric circuits.
- To analyze the transient and steady state response of RL, RC, RLC circuits.
- To analyze the concept of Resonance and coupling circuits.

UNIT-I**DC CIRCUIT ANALYSIS****9**

Basic components of electric circuits, Charge, Current, Voltage and Power, Voltage and Current sources, Ohms law, Kirchhoff's laws, Series and Parallel connected Independent sources, Resistors in series and parallel, Voltage division and Current division rule, Mesh current and Node voltage methods of analysis in DC circuits.

UNIT-II**NETWORK REDUCTION AND THEOREMS****9**

Network Reduction: Source transformation, Star delta conversion. Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem to DC circuits.

UNIT-III**SINUSOIDAL STEADY STATE ANALYSIS****9**

Sinusoidal Steady state analysis, Characteristics of Sinusoids, Mesh current and node voltage methods of analysis AC circuit. AC Circuit Power Analysis: Instantaneous Power, Average Power, Apparent power and Power factor, Complex power.

UNIT-IV**TRANSIENT RESPONSE ANALYSIS****9**

Laplace transforms and inverse laplace transforms, Standard test signals, Transient response of RL, RC and RLC circuits using laplace transform for source free, Step input and Sinusoidal input.

UNIT-V**RESONANCE AND COUPLED CIRCUITS****9**

Series and parallel resonance, Frequency response, Quality factor and Bandwidth, Self and mutual inductance, Coefficient of coupling, Dot rule, Analysis of coupled circuits, Single tuned circuits.

THEORY :45 PERIODS**PRACTICAL EXERCISES:**

1. Verifications of KVL and KCL laws.
2. Verifications of Thevenin & Norton theorem.
3. Verification of Superposition Theorem.
4. Verification of maximum power transfer Theorem

5. Determination of Resonance Frequency of Series & Parallel RLC Circuits.
6. Transient analysis of RL and RC circuits.

PRACTICAL: 30 PERIODS
TOTAL (45+30): 75 PERIODS

COURSE OUTCOMES:

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

- CO1:** Explain circuit's behavior using circuit laws and analyze the mesh analysis and nodal analysis.
- CO2:** Apply the network theorems to determine the behavior of the given DC circuits.
- CO3:** Analyze the sinusoidal steady state analysis of electric circuits.
- CO4:** Analyze steady state response and transient response for any RC, RL and RLC circuits.
- CO5:** Analyze the frequency response of series and parallel resonance circuits and coupled circuits.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9th edition, New Delhi, 2020.
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, 7th Edition, 2022.

REFERENCE BOOKS:

1. Nilsson Riedel, "Electric Circuits ", Pearson Education India, 12th Edition, 2022.
2. D. Chattopadhyay, P. C. Rakshit, "Fundamentals of Electric Circuit Theory", S. Chand, 7th Revised Edition, 2021.
3. Abhijit Chakrabarti, "Circuit Theory - Analysis and Synthesis", Dhanpat Rai & Co, 12th Edition, 2021.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	1	-	-	2	1	-
CO2	3	3	2	2	-	-	-	-	-	1	-	-	2	1	-
CO3	3	3	3	3	-	-	-	-	-	1	-	-	3	2	-
CO4	3	3	3	3	-	-	-	-	-	1	-	-	3	2	-
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	2	-
AVG	3	3	2	2	-	-	-	-	-	1	-	-	3	2	-

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

Shree Venkateshwara Hi-Tech Engineering College (Autonomous)

23TAT21

TAMILS AND TECHNOLOGY
(Common to B.E./B. Tech. all branches)

L T P C
1 0 0 1

COURSE OBJECTIVES:

- To understand about weaving and ceramic technology of Tamils
- To compare the design and constructive technology of Cheras, Cholas, Pallavas and Nayakkars
- To gain knowledge in various manufacturing technology of Tamils
- To analyse the agriculture and fishery knowledge of Tamils
- To learn about scientific Tamil and its usage in online platforms

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 beads - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT-IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3


Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoombu 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

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COURSE OUTCOMES:

At the end of the course the student will be able to

- CO1:** Relate the weaving ceramic technology of Tamils
- CO2:** Understand the knowledge of Tamils in design and construction technology
- CO3:** Recognize the manufacturing technology knowledge of Tamils
- CO4:** Criticize the agriculture and isherly knowledge of Tamils
- CO5:** Apply scienti ic Tamil in Various online platforms

E- RESOURCES:

1. <https://www.tamilvu.org/>
2. <https://sorkuvai.com/>

CO's -PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	1	-	-	-	-	1	1	1	1	1	-	1
C02	2	-	-	-	-	2	2	2	2	2	-	2
C03	2	-	-	-	-	2	2	2	2	2	-	2
C04	1	-	-	-	-	1	1	1	1	1	-	1
C05	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

23TAT21

தமிழரும் தொழில்நுட்பமும்

L T P C
1 0 0 1

(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- நெசவு மற்றும் பாணைத்தொழில்நுட்பத்தைப் புரிந்து கொள்ளுதல்
- சேர, சோழ, பல்லவ மற்றும் நாயக்கர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தை ஒப்பிடுதல்
- தமிழர்களின் பல்வேறு உற்பத்தி தொழில்நுட்பத்தைப் பற்றிய அறிவைப் பெறுதல்
- தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைப் பெற்றுக்கொள்ளுதல்
- அறிவியல் தமிழையும் அதன் இணையப்பயன்பாட்டையும் கற்றல்

அலகு - I

நெசவு மற்றும் கட்டிடத் தொழில்நுட்பம்

3

சங்க காலத்தில் நெசவுத்தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்சங்க காலத்தில் நெசவுத்தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்

அலகு - II

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்

3

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

அலகு - III

உற்பத்தித் தொழில்நுட்பம்

3

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

அலகு - IV

வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்

3

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

அலகு - V

அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்

3

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

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

- C01: நெசவு மற்றும் பாளைத்தொழில்நுட்பத்தை பற்றிப் புரிந்துகொள்வார்கள்
- C02: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தில் தமிழர்களின் அறிவைப் பெறுவார்கள்
- C03: தமிழர்களின் உற்பத்தி தொழில்நுட்பத்தை கண்டறிவார்கள்
- C04: தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைக் குறித்து விவாதிப்பார்கள்.
- C05: பல்வேறு இணையப் பயன்பாடுகளில் அறிவியல் தமிழைப் பயன்படுத்திப்பார்ப்பார்கள்

மின் -ஆதாரங்கள்:

1. <https://www.tamilvu.org/>
2. <https://sorkuvai.com/>

CO's -PO's விவரணையாக்கம்:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	1	-	-	-	-	1	1	1	1	1	-	1
C02	2	-	-	-	-	2	2	2	2	2	-	2
C03	2	-	-	-	-	2	2	2	2	2	-	2
C04	1	-	-	-	-	1	1	1	1	1	-	1
C05	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

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23MEL21

ENGINEERING PRACTICES LABORATORY
(Common to: B.E./B.Tech. all Branches)

L	T	P	C
0	0	4	2

Course Objectives:

- Acquire skills in operating hand tools and instruments. Provide hands on training on common household plumbing work and wood work
- Provide hands on training on welding processes.
- Provide hands on training on various simple machining processes. Making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire network.
- Soldering and testing simple electronic circuits. Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

I) CIVIL ENGINEERING PRACTICES

(12)

PLUMBING WORK:

Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components - External thread cutting

WOOD WORK:

Hands-on-exercise: Sawing, Planing and Making joints

II) MECHANICAL ENGINEERING PRACTICES

(18)

WELDING WORK:

Fabrication of Models with MS Plate using Arc Welding

BASIC MACHINING WORK:

- a) Simple Turning
- b) Drilling and Tapping Practice

SHEET METAL WORK:

Model making – Trays and funnels

ASSEMBLING AND DISMANTLING WORK:

Assembling a centrifugal pump

GROUP B (ELECTRICAL & ELECTRONICS)

III) 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

IV) ELECTRONIC ENGINEERING PRACTICES

(15)

SOLDERING WORK:

Soldering simple electronic circuits and checking continuity

ELECTRONIC ASSEMBLY AND TESTING WORK:

Assembling and testing electronic components on a small PCB

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone
- Assembly and dismantle of LED TV
- Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Make a wooden model using carpentry Process.
- CO2:** Make various shapes using welding processes.
- CO3:** Make various shapes using manufacturing processes like machining and sheet metal work.
- CO4:** Wires various electrical joints in common household electrical wire network.
- CO5:** Solder and test simple electronic circuits. Assemble and test simple electronic components on PCB.

REFERENCE:

- Manual prepared by the faculty of Civil, Mechanical, Electrical and Electronics and Communication Engineering Department, SVHEC.

E-RESOURCES:

- <https://www.youtube.com/watch?v=GPnQjCrb83Y>
- <https://www.youtube.com/watch?v=njwdsMI3PcY>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO2	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO3	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO4	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO5	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
Avg	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1

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

23ENL21

COMMUNICATION LABORATORY
(Common to B.E./B.Tech. all Branches)

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT-I	MAKING COMPARISONS	12
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Speaking - Role Play Exercises Based on Workplace Contexts- Talking about Competition- Discussing Progress toward Goals- Talking about Experiences- Talking about Events in Life-Discussing Past Events.

Writing - Writing Emails (Formal & Semi-Formal)

UNIT-II	EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING	12
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Speaking - Discussing News Stories – Talking about Frequency- Talking about Travel Problems-Discussing Travel Procedures- Talking about Travel Problems- Making Arrangements-Describing Arrangements- Arrangements Discussing Plans and Decisions-Discussing Purposes and Reasons- Understanding Common Technology Terms.

Writing -Writing Different Types of Emails.

UNIT-III	PROBLEM SOLVING	12
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Speaking - Discussing Predictions- Describing the Climate- Discussing Forecasts and Scenarios- Talking about Purchasing- Discussing Advantages and Disadvantages- Making Comparisons- Discussing Likes and Dislikes- Discussing Feelings about Experiences- Discussing Imaginary Scenarios.

Writing - Short Essays and Reports- Formal/Semi-Formal letters.

UNIT-IV	CLASSIFICATION AND RECOMMENDATIONS	12
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Speaking - Discussing the Natural Environment- Describing Systems- Describing Position and Movement Explaining Rules (Example- Discussing Rental Arrangements)- Understanding Technical Instructions.

Writing - Writing Instructions -Writing a Short Article.

UNIT-V

EXPRESSION

12

Reading - Describing Things Relatively-Describing Clothing-Discussing Safety Issues (Making Recommendations) Talking about Electrical Devices-Describing Controlling Actions.

Writing - Job Application (Cover Letter + Curriculum Vitae) - Writing Recommendations.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

- CO1:** Speak effectively in group discussions held in a formal/semi formal contexts
- CO2:** Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- CO3:** Create emails, letters and effective job applications with resume.
- CO4:** Write critical reports to convey data and information with clarity and precision
- CO5:** Deliver suitable instructions and recommendations for safe execution of tasks

E-RESOURCES:

- <https://www.englishclub.com/speaking/>
- <https://learnenglish.britishcouncil.org/>

CO's-PO's MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	2	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	3
CO5	-	-	1	-	-	-	-	1	3	3	-	2
AVG	-	-	2	-	-	-	-	1	3	3	-	3

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

Shree Venkateshwara Hi-Tech Engineering College (Autonomous)

23MDC21	YOGA FOR HUMAN EXCELLENCE (Common to B.E./B.Tech. all Branches)	L	T	P	C
		0	0	1	0
UNIT-I	SIMPLIFIED PHYSICAL EXERCISES				3
Physical exercises: Hand exercises – Leg exercises. Breathing exercises: Eye exercises – Kapalabathi, Makarasana. Body massages: Acupressure – Relaxation.					
UNIT-II	KAYA KALPA				3
Kaya Kalpa Exercise – Aswini Mudra – Moola Bandha – Ojas Breath (Kayakalpa Exercise should be learnt directly from the World Community Service Centre.)					
UNIT-III	MEDITATION				3
Agha. Santhi : Clearance. Thuriya. Thuriyatheetham meditation					
UNIT-IV	HUMAN RESOURCES DEVELOPMENT				3
Eradication of worries – Benefits of Blessings – Greatness of Friendship – Neutralization of anger - Individual peace and world peace					
UNIT-V	YOGASANAS				3
Surya Namaskar, Padmasana, Vajrasana, Sukasana, Chakrasana (side posture), Viruchasana, Bhujangasana, Yoga mudra, Ustrasana, Maha Mudra, Vakkarasana.					
TOTAL : 15 PERIODS					

TEXT BOOKS:

1. Yoga Practices – I: VISION, Vethathiri Publications.
2. Yogasana – Vethathiri Publications

REFERENCE BOOKS:

1. Simplified Physical Exercises – Vethathiri Publications.
2. Sound health through yoga – Dr. K. Chandrasekaran.


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COURSE OUTCOME:

At the end of the Course the students will able to

- CO1:** Understand the fundamental knowledge of the concepts of probability and one dimensional random variable which can describe real life phenomenon
CO2: Understand the basic concepts of two dimensional random variables and apply in engineering problems and knowledge of standard distributions
CO3: Apply the concept of random processes in engineering disciplines
CO4: To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property
 To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals
CO5:

TEXT BOOKS:

1. Johnson. R.A., Miller. I and Freund. J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCE BOOKS:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis. A. and Unnikrishnapillai . S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross . S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan . R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

CO'S - PO'S MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	2	-	-	1
CO2	3	3	3	-	-	-	-	-	2	-	-	1
CO3	3	3	2	-	-	-	-	-	2	-	-	1
CO4	3	3	2	-	-	-	-	-	2	-	-	1
CO5	3	3	3	-	-	-	-	-	2	-	-	1
AVG	3	3	3	-	-	-	-	-	2	-	-	1

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

23CST34

C PROGRAMMING AND DATA STRUCTURES**L T P C**

(for B.E., ECE, EEE)

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**

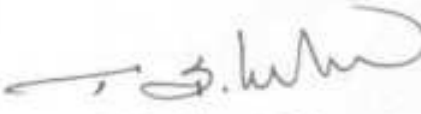
Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly-Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

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


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COURSE OUTCOMES:

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

- 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.

REFERENCE BOOKS:

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.

E-RESOURCES:

1. <https://www.coursera.org/specializations/data-structures-algorithms>
2. <https://nptel.ac.in/courses/112107243>
3. <https://nptel.ac.in/courses/112105598>

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	-	-	1	2	1	3	2	1	3
CO2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
CO3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
CO4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
CO5	1	2	1	2	2	1	-	-	1	2	1	3	2	2	3
AVG	2	2	1	2	2	1	-	-	1	1	1	2	2	2	2

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

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23ECT31

ELECTRONIC DEVICES AND CIRCUITS
(For-B.E - ECE and BME)

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT-I SEMICONDUCTOR DEVICES DEVICES

9

PN junction diode, Zener diode, BJT, MOSFET, UJT -structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers - Half Wave and Full Wave Rectifier, Zener as regulator.

UNIT-II AMPLIFIERS

9

Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model - Analysis of CE, CB, CC amplifiers- Gain and frequency response -MOSFET small signal model- Analysis of CS, CG and Source follower - Gain and frequency response- High frequency analysis.

UNIT-III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

9

Cascode amplifier, Differential amplifier - Common mode and Difference mode analysis - MOSFET input stages - tuned amplifiers - Gain and frequency response - Neutralization methods.

UNIT-IV FEEDBACK AMPLIFIERS AND OSCILLATORS

9

Advantages of negative feedback - Voltage / Current, Series , Shunt feedback Amplifiers - positive feedback-Condition for oscillations, phase shift - Wien bridge, Hartley, Colpitts and Crystal oscillators .

UNIT-V POWER AMPLIFIERS

9

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect-Class AB Power amplifier using MOSFET

TOTAL: 45 PERIODS

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

- C01:** Explain the structure and working operation of basic electronic devices
- C02:** Design and analyze amplifiers.
- C03:** Analyze frequency response of BJT and MOSFET amplifiers
- C04:** Design and analyze feedback amplifiers and oscillator principles.
- C05:** Design and analyze power amplifiers and supply circuits

TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7th Edition, 2014.

REFERENCE BOOKS:

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
CO2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
CO3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
CO4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
CO5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
AVG	3	3	3	3	2	2	-	-	-	-	-	1	2	1	1

1 -low,2-medium,3-high,'-'-nocorrelation

23ECT32

SIGNALS AND SYSTEMS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the basic properties of signal & systems.
- To know the methods of characterization of LTI systems in time domain.
- To analyze continuous time signals and system in the Fourier and Laplace domain.
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT-I CLASSIFICATION OF SIGNALS AND SYSTEMS

6+6

Standard signals- Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Operations on signals, Classification of systems- CT systems and DT systems, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable

UNIT-II ANALYSIS OF CONTINUOUS TIME SIGNALS

6+6

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT-III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

6+6

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel

UNIT-IV ANALYSIS OF DISCRETE TIME SIGNALS

6+6

Baseband signal Sampling-Fourier Transform of discrete time signals (DTFT)- Properties of DTFT - Z Transform & Properties

UNIT-V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

6+6

Impulse response-Difference equations-Convolution sum- Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 30+30 PERIODS

COURSE OUTCOMES:


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

- CO1:** Determine if a given system is linear/causal/stable.
- CO2:** Determine the frequency components present in a deterministic signal
- CO3:** Characterize continuous LTI systems in the time domain and frequency domain
- CO4:** Characterize discrete LTI systems in the time domain and frequency domain.
- CO5:** Compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)

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2. Barry Van Veen Simon Haykin, "Signals and Systems", 2nd Edition, Wiley, 2021.

REFERENCE BOOKS:

1. B. P. Lathi, "Principles of Linear Systems and Signals", 3rd Edition, Oxford, 2019
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2020.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	-	3	-	3	2	-	-	-	-	-	3	-	-	1
C02	3	-	3	-	-	2	-	-	-	-	-	3	-	3	-
C03	3	3	-	-	3	2	-	-	-	-	-	3	2	-	-
C04	3	3	-	-	3	2	-	-	-	-	-	3	-	3	1
C05	3	3	-	3	3	2	-	-	-	-	-	3	-	3	1
AVG	3	3	3	3	3	2	-	-	-	-	-	3	2	3	1

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

23ECT33

ELECTROMAGNETIC FIELDS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behaviour of the propagation of EM waves
- To study the significance of Time varying fields

UNIT-I INTRODUCTION

9

Sources and effects of electromagnetic fields, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Helmholtz's theorem, Verify theorems for different path, surface and volume, Electric field, Coulomb's law, Gauss's law and applications.

UNIT-II ELECTROSTATICS

9

Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT-III MAGNETOSTATICS

9

Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques.

UNIT-IV ELECTRODYNAMIC FIELDS

9

Magnetic Circuits - Faraday's law - Transformer and motional EMF - Displacement current - Maxwell's equations (differential and integral form) - Relation between field theory and circuit theory - Applications.

UNIT-V ELECTROMAGNETIC WAVES

9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Relate the fundamentals of vector, coordinate system to electromagnetic concepts.
- CO2:** Analyze the characteristics of Electrostatic field.
- CO3:** Interpret the concepts of Electric field in material space and solve the boundary conditions.
- CO4:** Explain different methods of emf generation and Maxwell's equations.
- CO5:** Explain the concept of electromagnetic waves and characterizing parameters.

TEXT BOOKS:

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015
3. Rohit Khurana, "Electromagnetic Field Theory", 6th edition, Vikash Publishers, 2018

REFERENCE BOOKS:

1. Edward C. Jordan & Keith G. Balmain, "Electromagnetic waves and Radiating Systems", Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
2. W.H. Hayt and J.A. Buck, "Engineering electromagnetic", 7th ed., McGraw-Hill (India), 2006
3. B.M. Notaros, "Electromagnetics", Pearson: New Jersey, 2011
- 4.R.L.Yadhava, "Electromagnetic fields and waves", 2nd edition, Khanna Publishers, 2019

E-RESOURCES:

https://onlinecourses.swayam2.ac.in/aic21_ge25/preview

CO's - PO's & PSO's MAPPING

CO/ PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	1
CO2	2	2	3	3	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	-
CO4	2	2	3	2	-	-	-	-	-	-	-	-	-	3	1
CO5	2	2	2	2	-	-	-	-	-	-	-	-	-	3	1
AVG	2	2	2	2	-	-	-	-	-	-	-	-	2	3	1

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

23ECI31

DIGITAL SYSTEMS DESIGN

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To present the fundamentals of digital circuits and simplification methods
- To practice the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To learn integrated circuit families.
- To introduce semiconductor memories and related technology

UNIT-I BASIC CONCEPTS

9

Review of number systems-Review of Boolean algebra- theorems, , canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates ,Tabulation methods

UNIT-II COMBINATIONAL LOGIC CIRCUITS

9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder - Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Parity Generator/Checker, Seven Segment display decoder.

UNIT-III SYNCHRONOUS SEQUENTIAL CIRCUITS

9

Latches, Flip flops,Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, lock-out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT-IV ASYNCHRONOUS SEQUENTIAL CIRCUITS

9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT-V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES

9

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL,ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:TOTAL :30 PERIODS

1. Design of adders and subtractors& code converters.
2. Design of Multiplexers &Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators
5. Design and implementation of counters using flip-flops

6. Design and implementation of shift registers

TOTAL HOURS: 45+30=75

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

- C01** Use Boolean algebra and simplification procedures relevant to digital logic.
- C02** Design various combinational digital circuits using logic gates.
- C03** Analyse and design synchronous sequential circuits.
- C04** Analyse and design asynchronous sequential circuits.
- C05** Build logic gates and use programmable devices.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 6th Edition, 2020.(Unit - I -V).

REFERENCE BOOKS:

1. Charles H. Roth, Jr, Larry L. Kinney, et al 'Fundamentals of Logic Design', Jaico Books, 5th Edition, 2019
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 2002.
- 3.loyd T L, "Digital Fundamentals", 11th Edition, Pearson Education, New Delhi, 2015.
4. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4th Edition, 2007.

E-RESOURCES:

- 1.<https://archive.nptel.ac.in/content/storage2/courses/106108099//Digital%20Systems.pdf>
- 2.<https://archive.nptel.ac.in/courses/108/105/108105132/>
- 3.<https://nptel.ac.in/courses/117106086>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	2	2	-	2	-	-	-	-	3	3	3	3	2
C02	-	-	-	-	-	-	-	-	-	-	2	1	2	3	2
C03	-	3	3	2	-	2	-	-	-	-	2	2	3	3	2
C04	-	-	-	-	-	-	-	-	-	-	3	2	2	3	1
C05	-	3	3	3	-	-	-	-	-	-	2	2	3	3	2
AVG	3	2.6	2.6	2.3	-	2	-	-	-	-	2	2	3	3	2

1 -low,2-medium,3-high,'-'-nocorrelation

23EST31	ENTREPRENEURSHIP AND STARTUP	L	T	P	C
	(Common to: B.E / B.Tech. all Branches)	1	0	0	1

Course Objectives:

The main learning objective of this course is to prepare the students :

- To develop a knowledge on basic concepts of entrepreneurship.
- To know about business opportunities and project evaluation criteria.
- To explore the concept of startups, government schemes and other financial institutions support

UNIT-I ENTREPRENEURSHIP CONCEPTS 5

Entrepreneurship-Meaning-Origin-Functions-Factors Affecting Entrepreneurial Growth- - Role of Entrepreneurship in Economic Development- Skills required for an Entrepreneur - Barriers to Entrepreneurship - Stages in Entrepreneurial Process.

UNIT-II PROJECT FORMULATION AND IDENTIFICATION 5

Identification of business opportunities -Project formulation- Project Classification and Identification - Project Objectives - Technical Analysis, Financial Analysis – Environmental Appraisal of Project - EDP Phases - Project Report Preparation.

UNIT-III START UP OPPORTUNITIES AND FINANCE 5

The New Industrial Revolution- Business Start-up - Rise of the startup Economy- Government Initiatives - Government schemes and incentives - Institutional service to entrepreneur - Sources of Finance.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

- CO1:** Enhanced the knowledge of entrepreneurship qualities and skills to startup a business.
- CO2:** Understand the project classification and prepare a feasibility report.
- CO3:** Provide vision for the own Start-up and its importance for economic development.

TEXT BOOKS:

1. Gupta C.B and Srinivasan N.P- Entrepreneurial development-Sultan Chand and Sons- Latest edition.
2. Khanka S.S.-Entrepreneurial Development-S.Chand& Co, RamNagar, New Delhi, Latest edition.

REFERENCE BOOKS:

1. Vasant Desai-Project Management and Entrepreneurship-Himalaya Publishing House,2023
2. P.Narayana Reddy – Entrepreneurship Text and Cases- cengage learning.2022
3. Prasanna Chandra- Projects planning, analysis, selection, implementation and review Tata McGraw-Hill Publishing Co, Latest edition.
4. Donald F.Kuratko- Entrepreneurship theory, process & practice-9th Edition-Cengage Learning,2022.

E-RESOURCES:

1. http://nptel.ac.in/courses/122106032/Pdf/7_2.pdf, "Business Plan", Dr.T. J.Kamalanabhan, Indian Institute of Technology Madras.
2. <http://www.nptel.ac.in/syllabus/110104049/>, "Entrepreneurial Finance", Dr. B.V. Phani, IIT Kanpur.
3. http://nptel.ac.in/noc20_mg35/ Entrepreneurship and Start up

CO, PO & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	2	2
CO2	2	3	1	3	-	-	-	-	-	-	-	-	2	1	2
CO3	1	-	3	2	2	-	-	-	-	-	-	-	1	3	2
Avg	2	2	2	1.6	1	-	-	-	-	-	-	-	2	2	2

1-low, 2-medium, 3- high, '-'-no correction

23ECL31

ELECTRONIC DEVICES AND CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

(For-B.E - ECE and BME)

COURSE OBJECTIVES:

1. To learn the characteristics of PN Junction diode and Zener diode.
2. To understand the operation of rectifiers and filters.
3. Familiarize the operation and characteristics of transistor like BJT and FET.
4. To assist the students in obtaining a better understanding of the operation of electronic circuits and devices
5. To study the characteristics of amplifier.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode and Zener diode.
2. Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
4. Common Emitter input-output Characteristics.
5. MOSFET Drain Characteristic and Transfer Characteristics.
6. Frequency response of CE and CS amplifiers.
7. Frequency response of CB and CC amplifiers.
8. Frequency response of Cascode Amplifier
9. CMRR measurement of Differential Amplifier
10. Class A Transformer Coupled Power Amplifier.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- C01:** Characteristics of PN Junction Diode and Zener diode.
- C02:** Experiment and test half wave and full wave rectifier circuit using PN junction diode and obtain the ripple factor, rectifier efficiency and experiment and test voltage regulation characteristics.
- C03:** Design and Testing of BJT and MOSFET amplifiers
- C04:** Analyze the characteristics of FET based differential amplifier experimentally.
- C05:** Operation of power amplifiers.

REFERENCE BOOKS:

1. Manual prepared by the faculty of ECE Department, SVHEC

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	1	3	2	1	-	-	-	-	-	1	2	1	1
C02	3	2	1	3	2	1	-	-	-	-	-	1	2	1	1
C03	3	2	1	1	1	1	-	-	-	-	-	1	2	1	1
C04	3	2	1	-	3	1	-	-	-	-	-	1	2	1	1
C05	3	2	1	-	2	1	-	-	-	-	-	1	2	1	1
AVG	3	2	1	3	2	1	-	-	-	-	-	1	2	1	1

1 -low,2-medium,3-high,'-'-nocorrelation

23CSL34	C PROGRAMMING AND DATA STRUCTURES LABORATORY (for B.E. – ECE, EEE)	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

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

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

CO's - PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
C02	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
C03	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
C04	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
C05	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
AVG	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

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

23ECT41

ANALOG COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce Analog Modulation Schemes
- To study of various Angle modulation techniques
- To understand the concepts of random process, stationary and autocorrelation functions.
- To acquire knowledge to analyze the noise performance of analog modulation techniques
- To understand the pulse modulation techniques

UNIT-I INTRODUCTION

9

Need and Importance of Communication, Elements of a Communication System, Types of Communication systems - Electromagnetic Spectrum used in communication, concept of bandwidth and power, Receiver characteristics, Need for modulation, Generation and detection of AM wave-spectra-DSBSC, Hilbert Transform, Pre-envelope & complex envelope - SSB and VSB -comparison -Super heterodyne Receiver.

UNIT-II ANGLE MODULATION

9

Phase and frequency modulation, Narrow Band and Wide band FM - Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation -Direct and Indirect methods, FM Demodulation - FM to AM conversion, FM Discriminator - PLL as FM Demodulator

UNIT-III RANDOM PROCESS

9

Random variables, Central limit Theorem, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process Through a LTI filter

UNIT-IV NOISE CHARACTERIZATION

9

Noise sources and types - Noise figure and noise temperature - Noise in cascaded systems. Narrow band noise - PSD of in-phase and quadrature noise -Noise performance in AM systems - Noise performance in FM systems - Pre-emphasis and de-emphasis - Capture effect, threshold effect.

UNIT-V PULSE MODULATION SYSTEMS

9

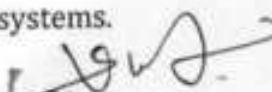
Sampling theorem, Types of Sampling. Pulse modulation schemes - PAM, PPM and PWM generation and detection-Pulse code modulation. Conversion of PWM to PPM. Multiplexing Techniques - FDM and TDM - problems related to FDM and TDM.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

- CO1:** Understand the various Analog Communication systems.
- CO2:** Design angle modulated communication systems.
- CO3:** Apply the concepts of Random Process to design communication systems.

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CO4: Analyze the noise performance of AM and FM Systems.

CO5: Comprehend and compare the different pulse modulation techniques

TEXT BOOKS:

1. Simon Haykins, "Communication Systems", Wiley, 5th Edition, 2009. (Unit I - V).
2. Marcelo S. Alencar, Valdemar C. da Rocha Jr, "Communication Systems", Second Edition, Springer, 2020.
3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.
4. George Kennedy, Davis, "Electronic Communication Systems", Tata McGraw Hill Education, 4th edition, 1999.

REFERENCE BOOKS:

1. Sanjay Sharma, "Analog Communication Systems", S.K. Katariya & Sons, 2nd Edition, 2007.
2. Taub and Schilling, Principles of communication systems, TMH, New Delhi, 4th Edition, 2017.
3. Michael Moher Simon Haykin, An Introduction to Analog & Digital Communications, 2nd Edition, 2012.
4. Simon Haykin, Communication Systems, John Wiley & sons, NY, 5th Edition, 2016.

E-RESOURCES:

1. <http://nptel.iitm.ac.in/courses/117106086>, "Digital Circuits and Systems-video", Prof.S.Srinivasan, IITM.
2. <http://www.satishkashyap.com/2012/02/digital-electronic-circuits-by-shouri.html>, "Digital Electronics", Dr.ShouriChatterjee, IIT- Delhi.
3. <http://nptel.ac.in/courses/117103063/26>, "Ideal op-amp and its applications" Dr. Chitralekha Mahanta Department of Electrical and Communication Engineering Indian Institute of Technology, Guwahati.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO3	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-	-
CO5	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
AVG	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-

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

23ECT42

LINEAR INTEGRATED CIRCUITS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

UNIT-I BASICS OF OPERATIONAL AMPLIFIERS

9

Basic information about op-amps - Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, Open and closed loop configurations

UNIT-II APPLICATIONS OF OPERATIONAL AMPLIFIERS

9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT-III ANALOG MULTIPLIER AND PLL

9

Analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.

UNIT-IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

9

Analog and Digital Data Conversions, D/A converter - specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters - specifications - Flash type - Successive Approximation type - Single Slope type - Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma - Delta converters.

UNIT-V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs

9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop - Out (LDO) Regulators - Switched capacitor filter, Frequency to Voltage and Voltage to Frequency converters.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Design linear and nonlinear applications of OP – AMPS.
- CO2:** Design applications using analog multiplier and PLL.
- CO3:** Design ADC and DAC using OP – AMPS.
- CO4:** Generate waveforms using OP – AMP Circuits.
- CO5:** Analyze special function ICs.

TEXT BOOKS:

- 1.D.RoyChoudhry, Shail B Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2021, Sixth Edition. (Unit I – V).
- 2.Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill, 2016 (Unit I – V).

REFERENCE BOOKS:

- 1.Ramakant A. Gayakwad, "OP-AMPS and Linear Integrated Circuits", 4th Edition, Pearson Education, 2021.
- 2.RobertF. Coughlin and Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits , 6th Edition, Pearson Education 2015.
- 3.S.Salivahanan& V.S. KanchanaBhaskaran, "Linear Integrated Circuits and Applications", TMH,2nd Edition, First Edition 2018.

E-RESOURCES:

- 1.<http://nptel.iitm.ac.in/courses/117106086>, "Digital Circuits and Systems-video",Prof.S.Srinivasan, IITM.

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	1	-	2	1	1
CO2	2	3	3	2	-	-	-	-	-	-	-	-	2	1	1
CO3	1	-	-	2	-	-	-	-	-	-	-	-	2	1	1
CO4	1	-	-	2	-	-	-	-	-	-	-	-	2	1	1
CO5	1	2	3	3	-	-	-	-	-	-	-	3	2	1	1
AVG	1.4	2.5	3	2.2	-	-	-	-	-	-	1	3	2	1	1

1 -low,2-medium,3-high,'-'-nocorrelation

23ECT43

TRANSMISSION LINES AND RF SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics
- To understand high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using Smith Chart.
- To introduce passive filters and basic knowledge of active RF components
- To learn the concepts of a RF system transceiver design.

UNIT-I TRANSMISSION LINE THEORY

9

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT-II HIGH FREQUENCY TRANSMISSION LINES

9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT-III IMPEDANCE MATCHING IN HIGH FREQUENCY LINE

9

Impedance matching: Quarter wave transformer, One Eighth wave line, Half wave line - Impedance matching by stubs- Single stub and double stub matching - Smith chart - Application of Smith chart, Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT-IV WAVEGUIDES

9

Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE and TM waves, Transverse Electromagnetic waves, TM and TE waves in Rectangular waveguides, TM and TE waves in Circular waveguides.

UNIT-V RF SYSTEM DESIGN CONCEPTS

9

Active RF components: RF field effect transistors, High electron mobility transistors, Fundamentals of MMIC, Basic concepts of RF design: Filters, couplers, power dividers, Amplifier power relations, Low noise amplifiers, Power amplifiers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Explain the characteristics of transmission lines and its losses.
- CO2:** Calculate the standing wave ratio and input impedance in high frequency Transmission lines..
- CO3:** Analyze impedance matching by stubs using Smith Charts.
- CO4:** Comprehend the characteristics of TE and TM waves.
- CO5:** Design a RF transceiver system for wireless communication

TEXT BOOKS:

1. John D Ryder, "Networks lines and fields", Prentice Hall of India, New Delhi, 2005. (Unit I-IV)
2. Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002 (Unit - V)
3. Annapurna Das, Sisir K. Das, "Microwave Engineering", McGraw Hill Education (India) private limited, Third edition, 2000. (Unit - V)

REFERENCE BOOKS:

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design" - Theory and Applications", Pearson Education Asia, First Edition, 2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits"- Analysis and Design, John Wiley & Sons, 2004.
3. Richard Chi-Hsi Li - , "RF Circuit Design" - A John Wiley & Sons, Inc, Publications
4. W.Alan Davis, Krishna Agarwal, "Radio Frequency Circuit Design", John willy & Sons, 2001

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	-	-	-	-	-	-	1	2	1	-
CO2	1	3	2	3	-	-	-	-	-	-	-	1	2	1	-
CO3	2	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO4	1	-	-	-	3	-	-	-	-	-	-	1	2	1	-
CO5	1	-	-	-	2	-	-	-	-	-	-	1	2	1	-
AVG	1.6	2.6	2	2.6	2.2	-	-	-	-	-	-	1	2	1	-

1 -low, 2-medium, 3-high, '-'-nocorrelation

23CYT41	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L T P C
	(Common to B.E./B.Tech. all Branches)	
		2 0 0 2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and sustainable practices
- To imbibe awareness on population issues and manmade activities

UNIT-I	ENVIRONMENT AND BIODIVERSITY	6
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Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity – values of biodiversity, India as a mega-diversity nation – threats to biodiversity – conservation of biodiversity.

Activity: Documentation of ecosystems/Biodiversity within Campus.

UNIT-II	ENVIRONMENTAL POLLUTION	6
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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 (OHSMS). Environmental protection, Environmental protection acts.

Activity: Documentation of pollution issues in Erode district.

UNIT-III	RENEWABLE SOURCES OF ENERGY	6
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Energy management and conservation - New Energy Sources: Need and different types of new energy sources. Concept, origin and applications of - Hydrogen energy, Ocean energy, Tidal energy and geothermal energy conversion.

Activity: Documentation of available renewable resources in Erode district.

UNIT-IV	SUSTAINABILITY AND MANAGEMENT	6
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Development, GDP, Sustainability- concept, needs and challenges - Sustainable Development Goals - Concept of Carbon Credit, Carbon Footprint. Circular economy, ISO 14000 Series, Material Life Cycle Assessment, Environmental Impact Assessment. Green Engineering.

Activity: Documentation of sustainable goals of Tamilnadu. **Case Study:** E-Waste Management

UNIT-V	HUMAN POPULATION AND DISASTER MANAGEMENT	6
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Population growth, Population explosion— Family Welfare Program – Environment and human health. Human rights – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health – Disaster management: Floods, earthquake, cyclone and landslides.

Activity: Documentation of women development schemes in Tamilnadu.

TOTAL HOURS 30

COURSE OUTCOMES:

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

- CO1 :** To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- CO2 :** To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- CO3 :** To identify and apply the understanding of renewable and non-renewable resources
- CO4 :** To recognize the different goals of sustainable development and sustainability practices and apply them for future development.
- CO5 :** To aware the population issues and to handle the disaster issues

TEXT BOOKS:

1. Dr. A.Ravikrishnan "Environmental Sciences and Sustainability", 2nd Edition, Sri Krishna Hitech Publishing Company Pvt. Ltd, 2022.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2010.
3. Gilbert M.Masters & Wendell P Ela, 'Introduction to Environmental Engineering and Science', 3rd edition, Prentice – Hall of India Pvt. Ltd, New Delhi, 2008.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2009.
2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2022.
3. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2023.

ONLINE SOURCES:

- Unit 1:** <https://www.youtube.com/watch?v=Ar04qG1P8Es> (IIT ROORKEE NPTEL) & <https://www.youtube.com/watch?v=SHxAOoxhKTA> (IIT KANPUR NPTEL)
- Unit 2:** <https://www.youtube.com/watch?v=17Z34WU257U> (IIT ROORKEE NPTEL)
- Unit 3:** <https://www.youtube.com/watch?v=1kUE0BZtTRc> (NATIONAL GEOGRAPHIC)
- Unit 4:** <https://www.youtube.com/watch?v=Crd3CFq5B4s> (IITM NPTEL)
- Unit 5:** <https://www.youtube.com/watch?v=sMqtwbKc8EA> (FINANCIAL TIMES)

CO's & PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	1	-	-	-	2	3	-	-	-	-	2
C02	3	2	-	-	-	3	3	-	-	-	-	2
C03	3	-	1	-	-	2	2	-	-	-	-	2
C04	3	2	1	1	-	2	2	-	-	-	-	2
C05	3	2	1	-	-	2	2	-	-	-	-	1

23ECI41

MICROPROCESSOR AND MICROCONTROLLER

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To understand the Architecture of 8086 microprocessor
- To learn the design aspects of I/O and Memory Interfacing circuits
- To interface microprocessors with supporting chips
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system

UNIT-I THE 8086 MICROPROCESSOR

9

Introduction to 8086 - Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Modular Programming - Linking and Relocation - Stacks - Procedures - Macros - Interrupts and interrupt service routines - Byte and String Manipulation.

UNIT-II 8086 SYSTEM BUS STRUCTURE

9

8086 signals - Basic configurations - System bus timing - System design using 8086 - I/O programming - Introduction to Multiprogramming - System Bus Structure - Multiprocessor configurations - Coprocessor, Closely coupled and loosely Coupled configurations - Introduction to advanced processors.

UNIT-III I/O INTERFACING

9

Memory Interfacing and I/O interfacing - Parallel communication interface - Serial communication interface - D/A and A/D Interface - Timer - Keyboard /display controller - Interrupt controller - DMA controller - Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT-IV MICROCONTROLLER

9

Architecture of 8051 - Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT-V INTERFACING MICROCONTROLLER

9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming - LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

TOTAL : 30 PERIODS

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations.
2. Move a data block without overlap.
3. Code conversion, decimal arithmetic and Matrix operations.
4. Password checking, Print RAM size and system date

Peripherals and Interfacing Experiments

5. Traffic light controller
6. Stepper motor control
7. Key board and Display
8. Serial interface and Parallel interface

8051 Experiments using kits and MASM

9. Basic arithmetic and Logical operations
10. Square and Cube program, Find 2's complement of a number
11. Unpacked BCD to ASCII

TOTAL HOURS: 45+30=75

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

- CO1** Understand and execute programs based on 8086 microprocessor.
- CO2** Demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor.
- CO3** Design and interface I/O circuits.
- CO4** Describe an 8 bit microcontroller architecture- 8051
- CO5** Design and implement 8051 microcontroller based systems.

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, – Microcomputer Systems: The 8086 / 8088 Family – Architecture , Programming and Design]], Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, –The 8051 Microcontroller and Embedded Systems: Using Assembly and C]], Second Edition, Pearson education, 2011.

REFERENCE BOOKS:

1. Douglas V.Hall, –Microprocessors and Interfacing, Programming and Hardware || , TMH , 2012
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012.

E-RESOURCES:

- 1.<https://nptel.ac.in/courses>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	1	2	-	-	-	-	1	1	1	1	2
CO4	3	1	-	-	-	-	-	-	-	-	1	1	2	2	2
CO5	3	2	2	2	2	-	-	-	-	-	-	-	-	-	-
AVG	3	1.4	1.6	1.5	1.5	2	-	-	-	-	1	1	1.5	1.5	2

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

23ECI42

DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To learn discrete Fourier transforms, properties of DFT and its application to linear filtering.
- To learn discrete Fourier transform, properties of DFT and its application to linear filtering
- To understand the effects of finite precision representation on digital filters.
- To understand the fundamental concepts of multi rate signal processing and its applications
- To introduce the concepts of adaptive filters and its application to communication engineering

UNIT-I DISCRETE FOURIER TRANSFORM

9

Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT).

UNIT-II INFINITE IMPULSE RESPONSE FILTERS

9

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) -Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations

UNIT-III FINITE IMPULSE RESPONSE FILTERS

9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations .

UNIT-IV FINITE WORD LENGTH EFFECTS

9

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT-V DSP APPLICATIONS

9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor - Adaptive Filters: Introduction, Applications of Multirate signal processing- DSP Architecture-Fixed and Floating point architecture principles.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES :

30 PERIODS

USING MATLAB / EQUIVALENT SOFTWARE

1. Generation of standard signals
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF)
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF)

USING DSP PROCESSOR BASED IMPLEMENTATION

7. Study of architecture of Digital Signal Processor
8. Perform MAC operation using various addressing modes
9. Generation of various signals
10. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
11. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
12. Implement an Up-sampling and Down-sampling operation in DSP Processor

TOTAL HOURS:45+30 =75

COURSE OUTCOMES:

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

- C01:** Apply DFT for the analysis of digital signals and systems.
- C02:** Design IIR and FIR filters.
- C03:** Characterize the effects of finite precision representation on digital filters
- C04:** Design Multirate filters.
- C05:** Apply adaptive filters appropriately in communication systems.

TEXT BOOKS:

1. John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, –Discrete-Time Signal Processing||, 8th Indian Reprint, Pearson, 2004.

REFERENCE BOOKS:

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2020
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2017.
3. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2016.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>
SVHEC-R2023


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BoS / ECE

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	3	3	2	2	-	-	-	-	1	1	3	3	2
C02	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
C03	3	3	3	3	2	2	-	-	-	-	1	1	1	2	2
C04	3	3	2	2	3	1	-	-	-	-	1	1	2	2	3
C05	3	2	2	2	3	2	-	-	-	-	1	1	2	2	1
AVG	3	3	2	2	2	2	-	-	-	-	1	1	2	2	2

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

23ECL41

ANALOG COMMUNICATION LABORATORY

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To study the AM & FM Modulation and Demodulation.
- To learn the filters for improving the performance of frequency modulation.
- To understand the Pulse Modulation.
- To Verify the Sampling Theorem.
- To Simulate Analog Modulation Schemes.

LIST OF EXPERIMENTS

1. Amplitude modulation and demodulation.
2. Frequency modulation and demodulation.
3. Balanced modulator and Synchronous detector.
4. SSB modulation and Demodulation.
5. Pre-emphasis and de-emphasis.
6. Phase Locked Loop.
7. Characteristics of Mixer.
8. PAM modulation and demodulation.
9. PWM and PPM modulation and demodulation.
10. Sampling theorem verification.

USING MATLAB communication toolbox and simulink

1. Amplitude modulation and demodulation.
2. Frequency modulation and demodulation.
3. Balanced modulator and Synchronous detector.
4. PAM modulation and demodulation.
5. PWM and PPM modulation and demodulation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze the practical aspects of various analog modulation schemes.
CO2:	Evaluate the various measures that improve receiver performance.
CO3:	Analyze the improvement of the noise performance of Communication system
CO4:	Ability to study issues from communication links and channels, and their equalization techniques.
CO5:	Apply the programming aspects of MATLAB in simulating various analog modulation techniques.

REFERENCE BOOKS:

1. Manual prepared by the faculty of ECE Department, SVHEC
SVHEC-R2023


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E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	3	3	3	3	2	-	-	-	1	1	1	-	-	-
CO3	3	3	3	3	3	2	-	-	-	1	1	1	-	-	-
CO4	3	3	3	3	3	3	-	-	-	1	1	1	-	-	-
CO5	3	3	3	3	3	2	-	-	-	1	1	1	-	-	-
AVG	3	3	3	3	3	2.5	-	-	-	1	1	1	-	-	-

1 -low,2-medium,3-high,'-'-nocorrelation

23ECL42

LINEAR INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

LIST OF EXPERIMENTS

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. RC Integrator and Differentiator circuits using Op-Amp
5. Clippers and Clampers
6. Instrumentation amplifier
7. Active low-pass, High pass & Band pass filters
8. PLL Characteristics and its use as frequency multiplier, clock synchronization
9. R-2R ladder type D-A converter using Op-Amp

SIMULATION USING SPICE

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Astable, Monostable, Bistable Multivibrator
4. Schmitt Trigger circuit with Predictable hysteresis
5. Analysis of power amplifier using IC555

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David.A.Bell, "Electronic Devices and Circuits", Prentice Hall of India, 2004.
2. D.RoyChoudhry, Shail B Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2021, Sixth Edition.

E-RESOURCES:

1. <http://nptel.iitm.ac.in/courses/117106086>, "Digital Circuits and Systems-video", Prof.S.Srinivasan, IITM.
2. <http://www.satishkashyap.com/2012/02/digital-electronic-circuits-by-shouri.html>, "Digital Electronics", Dr.ShouriChatterjee, IIT- Delhi.

COURSE OUTCOMES:

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

- C01:** Analyze various types of feedback amplifiers
- C02:** Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators.
- C03:** Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators, filters using SPICE Tool.
- C04:** Design amplifiers, oscillators, D-A converters using operational amplifiers.
- C05:** Designs filters using op-amp and perform an experiment on frequency response.

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	3	3	3	-	-	-	-	-	-	1	1	3	1	2
C02	2	3	3	3	-	-	-	-	-	-	1	1	3	2	3
C03	2	3	3	3	-	-	-	-	-	-	1	1	3	2	3
C04	2	3	3	3	2	-	-	-	-	-	1	1	3	2	3
C05	2	3	3	3	-	-	-	-	-	-	1	1	3	2	3
Avg	2	3	3	3	2	-	-	-	-	-	1	1	3	1.8	2.8

1 -low,2-medium,3-high,'-'-nocorrelation

23MDC41

SOFT AND ANALYTICAL SKILLS - I

L	T	P	C
1	0	0	0

COURSE OBJECTIVES:

- ☐ To make the students aware of critical thinking.
- ☐ To understand the significance of emotional intelligence in self-growth.
- ☐ Basic Knowledge about the Arithmetic Ability.
- ☐ To solve the problems in Business Computations.
- ☐ Understand the basics of Data Interpretation

UNIT-I

CRITICAL THINKING

3

Active Listening -Observation -Curiosity -Introspection -Analytical Thinking -Open-mindedness - Creative Thinking.

UNIT-II

EMOTIONAL INTELLIGENCE

3

Transactional analysis - Empathy - Sympathy - Conflict management.

UNIT-III

ARITHMETIC ABILITY

3

Vedic Maths - Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

UNIT-IV

BUSINESS COMPUTATIONS

3

Time & Distance, Partnership, simple & compound interest.

UNIT-V

DATA INTERPRETATION

3

Line Graphs - Venn diagrams - Mixed Graphs.

TOTAL : 15PERIODS


Chairman
BoS / S&H

COURSE OUTCOMES:

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

- CO1 :** Analyse and evaluate arguments and identify most common fallacies.
- CO2 :** Discover personal competence and techniques of building emotional intelligence.
- CO3 :** Enhance the Aptitude Round Clearing ability in interview process.
- CO4 :** Infer the concepts of Business Computations.
- CO5 :** Interrupt the data.

TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India.

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Communication Skills for Engineers and Scientists , Sharma, Sangeeta & Binod Mishra., PHI India. (2 nd edition).


**Chairman
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23MDC51

SOFT AND ANALYTICAL SKILLS - II

L	T	P	C
1	0	0	0

COURSE OBJECTIVES:

- ☐ To enhance the collaboration and cooperation between individuals towards a common goal.
- ☐ To provide a critical perspective on the socialization of men and women.
- ☐ Basic Knowledge about the Verbal Reasoning.
- ☐ To solve the problems in Quantitative Aptitude.
- ☐ Understand the basics of Data Interpretation

UNIT-I

TEAM SKILLS

3

Trust and collaboration - Team building - Shouldering responsibilities

UNIT-II

GENDER SENSITIZATION

3

Media and the Social Context - Social Networks - Gender Sensitization

UNIT-III

VERBAL REASONING

3

Verbal Reasoning: Syllogism, Blood relationship

UNIT-IV

QUANTITATIVE APTITUDE

3

Ratio and proportion, Problems on ages, Partnership.

UNIT-V

DATA INTERPRETATION

3


Tabulation - Profit & loss, Percentage.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

- CO1: Share and exchange knowledge and ideas, clarify doubts, and arrive at a collective decision or understanding.
- CO2: Meet the needs of an increasingly ethnically and gender-diverse workplace.
- CO3: Enhance the Aptitude Round Clearing ability in interview process
- CO4: Solve problems pertaining to quantitative ability.
- CO5: Interpret the data.


 Chairman
 BoS / S&H

23ECT51

DIGITAL COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Understand the basics of digital modulation and detection techniques
- To Investigate different modulation schemes and analyze the probability of error
- To Identify the concepts of information theory and source coding
- To Interpret various baseband transmission schemes, pass band transmissions schemes.
- To study the generation of various error control code methods used in communications.

UNIT-I INTRODUCTION TO DIGITAL COMMUNICATION SYSTEMS 9

Elements of digital communication system, advantages and disadvantages- pulse code modulation (PCM) - sampling, quantization and coding, quantization error, companding in PCM systems-differential Pulse Code Modulation-Delta modulation & Adaptive delta modulation-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ - Bipolar NRZ - Manchester

UNIT-II DIGITAL MODULATION TECHNIQUES 9

Introduction, ASK modulator, coherent and non-coherent ASK detector-FSK modulator, spectrum of FSK, Generation, detection, PSD & BER of Coherent BPSK,BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers

UNIT-III INFORMATION THEORY 9

Measure of information - Entropy - Source coding theorem - Discrete memoryless channels-BEC, BSC - Mutual information - Channel capacity - Shannon Hartley law- Source Coding Techniques - Shannon-Fano coding, Huffman Coding.

UNIT-IV BASEBAND TRANSMISSION 9

Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ - Bipolar NRZ - Manchester- ISI - Nyquist criterion for distortion less transmission - Pulse shaping - Correlative coding - Eye pattern - Equalization-Matched filter Receiver and Correlative Receiver.

UNIT-V ERROR CONTROL CODING 9

Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes-Viterbi Decoder

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- C01:** Interpret the concepts of digital communication system.
- C02:** Analyze the mechanism of digital modulation schemes and data transmission
- C03:** Illustrate the operation of information theory and error coding techniques in digital systems
- C04:** Ability to develop baseband transmission schemes, pass band transmissions schemes
- C05:** Able to understand the designing of various codes like linear block codes, cyclic codes, convolution codes

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TEXT BOOKS:

1. Bernard Sklar and Fredric J. Harris, Digital Communications: Fundamentals and Applications, 2020, 3rd Edition, Pearson , UK.
2. Marcelo S. Alencar , Valdemar C. da Rocha Jr, "Communication Systems", Second Edition, Springer,2020.
3. R. Bose, Information Theory, Coding and Cryptography, McGraw-Hill Education, 3rd Edition,2016

REFERENCE BOOKS:

1. Sanjay Sharma, "Analog Communication Systems", S.K.Katariya & amp; Sons,2nd Edition, 2007.
2. Taub and Schilling, Principles of communication systems, TMH, New Delhi, 4th Edition, 2017.
3. Michael Moher Simon Haykin, An Introduction to Analog & amp; Digital Communications, 2nd Edition,2012.
4. Simon Haykin, Communication Systems, John Wiley & amp; sons, NY, 5th Edition, 2016.

E-RESOURCES:

1. <http://nptel.iitm.ac.in/courses/117106086>, "Digital Circuits and Systems-video", Prof.S.Srinivasan, IITM.
2. <http://www.satishkashyap.com/2012/02/digital-electronic-circuits-by-shouri.html>, "Digital Electronics", Dr.ShouriChatterjee, IIT- Delhi.

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO2	3	2	3	-	1	-	-	-	-	-	-	2	2	-	-
CO3	3	2	2	-	1	-	-	-	-	-	-	2	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO5	3	2	-	-	1	-	-	-	-	-	-	2	3	2	-
AVG	3	2	2.5	-	1	-	-	-	-	-	-	2	2.5	2	3

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

23ECT52

CONTROL SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response of the systems.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To know the various methods for analyzing stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT-I SYSTEMS COMPONENTS AND THEIR REPRESENTATION

9

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

UNIT-II TIME RESPONSE ANALYSIS

9

Transient response-steady state response-Measures of performance of the standard first order and second order system -steady error constant and system- type number-PID control- Analytical design for PD, PI,PID control systems

UNIT-III FREQUENCY RESPONSE AND SYSTEM ANALYSIS

9

Bode plots, Polar plots ; Frequency domain specifications: Gain Margin and phase Margin; Nyquist plot: Nyquist stability criterion.

UNIT-IV CONCEPTS OF STABILITY ANALYSIS

9

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus

UNIT-V DESIGN OF FEED BACK CONTROL SYSTEM

9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques –PID controller - Nichols technique - PID control in State Feedback form.

TOTAL: 45 HOURS

COURSE OUTCOMES

The students will be able to:

- C01** Represent simple systems in transfer function and state variable forms.
- C02** Analyze simple systems in time domain
- C03** Analyze simple systems in frequency domain.
- C04** Infer the stability of systems in time and frequency domain.
- C05** Interpret characteristics of the system and find out solution for simple control problems.

TEXT BOOKS:

1. J. Nagrath and M. Gopal, Control System Engineering, 2018, 6th Edition, New Age International Publishers
2. Norman S. Nise, Control System Engineering, 2019, 8th Edition, John Wiley & Son

REFERENCES:

1. I.J. Nagrath and M. Gopal, Control Systems Engineering, 2018, 6th Edition, New Age International Pvt. Ltd., New Delhi, India.
2. K. Ogata, Modern Control Engineering, 2016, 5th Edition, Pearson.
3. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
4. Norman S. Nise, Control Systems Engineering, 2019, 8th Edition, John Wiley & Sons, New Jersey, USA

Online Sources

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	2	-	-	-	-	-	-	-	3	2	2
Avg	3	3	3	2.2	2	-	-	-	-	-	-	-	3	1.8	1.4

6. Interfacing keyboard and Stepper Motor.

Experiments using IOT

7. Interface LED Array
8. Interface With Zigbee
9. Home Automation

PRACTICAL: 30 PERIODS
TOTAL (45+30) =75 PERIODS

COURSE OUTCOMES:

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

- CO1:** Discuss and design embedded systems.
- CO2:** Identify the significance hardware/software co-design for embedded system.
- CO3:** Analyze the concepts of real time operating systems.
- CO4:** Learn the architecture and protocols of IoT.
- CO5:** Design an IoT based system for any application.

TEXT BOOKS:

1. Mohammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2014, Pearson, India.
2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.
3. Sudip Misra , Anandarup Mukherjee, and Arijit Roy Introduction to IoT , First Edition, Cambridge University Press 2022.

REFERENCE BOOKS:

1. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
2. Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.
3. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-on Approach, Universities Press, 2017.

E-RESOURCES:

1. <https://www.sanfoundry.com/microcontroller-mcqs-introduction/>
2. NPTEL video: <https://nptel.ac.in/courses/106/105/106105159/>, –Introduction to Embedded Systems], Dr.AnubamBasu, Computer Science Engineering, IIT Kharagpur.
3. NPTEL video: <https://nptel.ac.in/courses/108/102/108102169/> , –Introduction to Embedded

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
AVG	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2	1.4

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

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R.S.W.
 Chairman
 BoS / ECE

23ECI51

EMBEDDED SYSTEMS AND IoT DESIGN

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To learn the basics of an embedded system.
- To understand the hardware/software co-design for embedded systems.
- To understand the Real -Time processing in an Embedded System.
- To learn the architecture and design flow of IoT.
- To Build an IoT based system.

UNIT-I INTRODUCTION TO EMBEDDED CONCEPTS

9

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software.

UNIT-II HARDWARE/SOFTWARE CO-DESIGN FOR EMBEDDED SYSTEMS

9

Microcontrollers for embedded systems, 32-bit RISC Architectures for embedded Design, ARM architectural details, The ARM programmer's model, ARM development tools, ARM microcontroller programming in C, Peripheral Interfacing with ARM, Basic Wire and Wireless Protocols like, UART, I2C, SPI, PLCC, Bluetooth, WiFi, Zig-Bee.

UNIT-III PROCESSES AND OPERATING SYSTEMS

9

Structure of a real - time system - Task Assignment and Scheduling - Multiple Tasks and Multiple Processes - Multirate Systems - Pre emptive real - time Operating systems - Priority based scheduling - Interprocess Communication Mechanisms - Distributed Embedded Systems - MPSoCs and Shared Memory Multiprocessors - Design Example - Audio Player, Engine Control Unit and Video Accelerator.

UNIT-IV IOT ARCHITECTURE AND PROTOCOLS

9

Internet - of - Things - Physical Design, Logical Design - IoT Enabling Technologies - Domain Specific IoTs - IoT and M2M - YANG - IoT Platform Design - Methodology - IoT Reference Model - Domain Model - Communication Model - IoT Reference Architecture - IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

UNIT-V IOT SYSTEM DESIGN

9

Basic building blocks of an IoT device, Raspberry Pi - Board , Linux on Raspberry Pi, Interfaces, Programming with Python, Case Studies: Home Automation, Smart Cities, Environment and Agriculture.

THEORY: 45 PERIODS

PRACTICAL EXERCISES :

Experiments using 8051

1. Programming Arithmetic and Logical Operations in 8051.
2. Programming using Serial Ports in 8051.
3. Design of a Digital Clock using Timers/Counters in 8051.

Experiments using ARM

4. Interfacing ADC and DAC
5. Blinking of LEDs and LCD

SVHEC-R2023

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BoS / ECE

23ECL51

DIGITAL COMMUNICATION LABORATORY

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To study Modulation and Demodulation techniques.
- To learn the basic concepts of Multiple Access techniques.
- To study about the Digital Modulation techniques.
- To understand the concept of Error control techniques.
- To Simulate Communication link Schemes.

LIST OF EXPERIMENTS

1. Pulse Code Modulation and Demodulation..
2. Differential Pulse Code Modulation and Demodulation.
3. Delta Modulation.
4. Time Division Multiplexing.
5. Amplitude Shift Keying.
6. Frequency Shift Keying.
7. Phase Shift Keying.
8. Differential Phase Shift Keying.
9. Quadrature Phase Shift Keying.

USING MATLAB communication toolbox and simulink

1. Simulation of error control coding schemes.
2. Simulation of Communication link.
3. Simulation of ASK,FSK and PSK.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- C01:** Understand basic theories of Digital communication system in practical.
- C02:** Design and implement differential modulation and demodulation techniques.
- C03:** Analyze the Multiple Access Techniques.
- C04:** Analyze digital modulation techniques by using MATLAB tools
- C05:** Apply the programming aspects of MATLAB in simulating various digital modulation techniques.

REFERENCE BOOKS:

1. Manual prepared by the faculty of ECE Department, SVHEC

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	3	3	3	3	-	-	-	1	1	1	1	1	1
C02	3	3	3	3	3	2	-	-	-	1	1	1	2	1	1
C03	3	3	3	3	3	2	-	-	-	1	1	1	2	1	1
C04	3	3	3	3	3	3	-	-	-	1	1	1	-	1	-
C05	3	3	3	3	3	2	-	-	-	1	1	1	1	-	1
AVG	3	3	3	3	3	2.5	-	-	-	1	1	1	1.5	1	1

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

23MDC51

SOFT AND ANALYTICAL SKILLS - II

L	T	P	C
1	0	0	0

COURSE OBJECTIVES:

- ☐ To enhance the collaboration and cooperation between individuals towards a common goal.
- ☐ To provide a critical perspective on the socialization of men and women.
- ☐ Basic Knowledge about the Verbal Reasoning.
- ☐ To solve the problems in Quantitative Aptitude.
- ☐ Understand the basics of Data Interpretation

UNIT-I**TEAM SKILLS****3**

Trust and collaboration - Team building - Shouldering responsibilities

UNIT-II**GENDER SENSITIZATION****3**

Media and the Social Context - Social Networks - Gender Sensitization

UNIT-III**VERBAL REASONING****3**

Verbal Reasoning: Syllogism, Blood relationship

UNIT-IV**QUANTITATIVE APTITUDE****3**


Ratio and proportion, Problems on ages, Partnership.

UNIT-V**DATA INTERPRETATION****3**

Tabulation - Profit & loss, Percentage.

TOTAL : 15 PERIODS**COURSE OUTCOMES:****At the end of the course the students will be able to**

- CO1:** Share and exchange knowledge and ideas, clarify doubts, and arrive at a collective decision or understanding.
- CO2:** Meet the needs of an increasingly ethnically and gender-diverse workplace.
- CO3:** Enhance the Aptitude Round Clearing ability in interview process
- CO4:** Solve problems pertaining to quantitative ability.
- CO5:** Interpret the data.


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TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Cornerstone: Developing Soft Skills, Sherfield, Pearson India


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SUB. CODE	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
23MDC52	(Common to: B.E / B.Tech. all Branches)	3	0	0	0

Course Objectives:

The main learning objective of this course is to prepare the students :

- To explore the concepts of sex and gender, understanding how they influence social constructs.
- To educate the key feminist theories and perspectives.
- To provide an overview of global and national women's movements with a focus on historical contexts and impacts.
- To understand how language shapes the ideas about gender, and how it can either reinforce or question traditional gender roles.
- To know how language influence the understanding of gender and how can it support or challenge traditional gender roles. is this correct.

UNIT-I	CONCEPTS	9
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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	9
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Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT-III	WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL	9
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Rise of Feminism in Europe and America. Women's Movement in India.

UNIT-IV	GENDER AND LANGUAGE	9
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Linguistic Forms and Gender. Gender and narratives.

UNIT-V	GENDER AND REPRESENTATION	9
---------------	----------------------------------	----------

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

Total Hours 45

COURSE OUTCOMES:

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

- CO1:** Differentiate between sex and gender, identifying the roles of socialization, patriarchy, and power structures in shaping gender norms and relations.
- CO2:** Critically evaluate feminist theories and apply them to analyze gender dynamics in various societal contexts.
- CO3:** Assess the historical and contemporary significance of women's movements globally and in India, recognizing their contributions to gender equality.
- CO4:** Understand and analyze the intersection of language, narratives, and gender, identifying how linguistic constructs influence societal perceptions of gender.
- CO5:** Examine the representation of gender in mainstream and alternative media, identifying stereotypes and advocating for more inclusive narratives.


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TEXT BOOKS:

1. Melissa J. Gillis and Srinivasan - Introduction to Women's and Gender Studies: An Interdisciplinary Approach 2nd edition.
2. Chris Beasley, Feminist Theory Today: An Introduction to Second-Wave Feminism, SAGE Publications.

REFERENCE BOOKS:

1. Dr.Girish Pachauri, Dr.Premalata Maisnam, Dr.Vandana Goswami.- 2023
2. Shagufta Siddiqui, Women and Gender Study: A Critical Exploration - 2024

E-RESOURCES:

- <https://plato.stanford.edu/entries/feminism-philosophy>
- <https://www.unwomen.org/en/digital-library>

CO, PO & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	1	1	1	-	-	-	-	-	-	3	3	2
CO2	2	3	3	-	-	2	-	-	-	-	-	-	2	-	-
CO3	1	-	2	2	2	1	-	-	-	-	-	-	1	3	2
CO4	-	2	3	2	1	-	-	-	-	-	-	-	1	2	1
CO5	2	2	1	3	1	1	-	-	-	-	-	-	1	1	-
Avg	1.6	2	1.8	1.6	1	1	-	-	-	-	-	-	1.6	1.8	1

1-low, 2-medium, 3- high, '-'-no correction

23MDC53

ELEMENTS OF LITERATURE

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

UNIT-I	INTRODUCTION TO ELEMENTS OF LITERATURE	9
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- a) Nature of Literature: Meaning, Characteristics, literature as an art form.
- b) Functions of Literature: The aesthetic, moral, and cultural functions of literature.
- c) Types of Literature: Introduction to the three main genres: Prose, Poetry, and Drama.

UNIT-II	RELEVANCE OF LITERATURE	9
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- a) Enhances Reading, thinking, discussing and writing skills.
- b) Develops finer sensibility for better human relationship.
- c) Increases understanding of the problem of humanity without bias.

UNIT-III	ELEMENTS OF FICTION	9
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- a) Fiction, fact and literary truth.
- b) Fictional modes and patterns.
- c) Plot character and perspective.

UNIT-IV	ELEMENTS OF POETRY	9
----------------	---------------------------	----------

- a) Emotions and imaginations.
- b) Figurative language.
- c) Figures of Speech: Simile, metaphor, conceit, symbol, pun, personification irony and trend.

UNIT-V	ELEMENTS OF DRAMA	9
---------------	--------------------------	----------

- a) Drama as representational art.
- b) Drama as narration, mediation and persuasion.
- c) Features of tragedy, comedy and satire.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

TEXT BOOKS:

- 1) An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
- 2) The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2014.
- 3) The Elements of Drama, J.L. Styan, Literary Licensing, 2011.
- 4) An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
- 5) The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press, 1991.

REFERENCE BOOKS:

- 1) To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

	FILM APPRECIATION	L	T	P	C
23MDC54	(BE/B.Tech- Common to all Branches)	3	0	0	0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved overall century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film 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

- C-1: Realist theory; Auteurists
- C-2: Psychoanalytic, Ideological, Feminists
- C-3: How to read films?
- C-4: Film 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.


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23MDC55

DISASTER RISK REDUCTION AND MANAGEMENT

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response
- To develop disaster response skills by adopting relevant tools and technology
- To Enhance awareness of institutional processes for Disaster response in the country
- To Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

UNIT-I**HAZRADS, VULNERABILITY AND DISASTER RISKS****9**


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 and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - Inter relations between Disasters and Sustainable development Goals

UNIT-II**DISASTER RISK REDUCTION (DRR)****9**

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****9**

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)


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UNIT-IV**TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT****9**

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****9**

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: 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 -


TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

- CO1 :** To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
- CO2 :** To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
- CO3 :** To develop disaster response skills by adopting relevant tools and technology
- CO4 :** Enhance awareness of institutional processes for Disaster response in the country and
- CO5 :** Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]


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REFERENCE BOOKS:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press


E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/124/107/124107010/>
2. <https://nptel.ac.in/courses/124107010>

CO's - PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
CO2	3	3	3	3	-	-	2	1	-	-	2	-	2		1
CO3	3	3	3	3	-	-	2	2	-	-	-	-	2		1
CO4	3	3	2	3	-	-	2	1	-	-	2	-	2		1
CO5	3	3	2	3	-	-	2	2	-	-	2	-	3		1

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


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23ECE11

APPLICATION SPECIFIC INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the architecture of different types of FPGA
- To familiarize the different types of programming technologies and logic devices
- To study the design flow of different types of ASIC.
- To analyze the synthesis, Simulation and testing of systems.
- To understand the design issues of SOC.

UNIT-I FIELD PROGRAMMABLE GATE ARRAY

9

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 - Spartan II and Virtex II FPGAs -Apex and Cyclone FPGAs

UNIT-II OVERVIEW OF ASIC AND PLD

9

Types of ASICs - Design flow - CAD tools used in ASIC Design - Programming Technologies: Antifuse - static RAM - EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs - PLA -PAL. Gate Arrays - CPLDs and FPGAs.

UNIT-III ASIC PHYSICAL DESIGN

9

System partition -partitioning - partitioning methods - interconnect delay models and measurement of delay - floorplanning - placement - Routing : global routing - detailed routing - special routing - circuit extraction - DRC.

UNIT-IV LOGIC SYNTHESIS, SIMULATION AND TESTING

9

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test -fault simulation - automatic test pattern generation.

UNIT-V SOC DESIGN

9

Design Methodologies - Processes and Flows - Embedded software development for SOC - Techniques for SOC Testing - Configurable SOC -Hardware / Software codesign Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Complete overview to FPGA.
- CO2:** Understand the fundamental concept of ASIC and PLD.
- CO3:** Explain the concept of ASIC physical design.
- CO4:** Learn the concept of Logic Synthesis &VHDL Programming.
- CO5:** Explain the basics of SOC Design.

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TEXT BOOKS:

1. John V. Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications 2021.
2. M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 2017
3. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000.

REFERENCE BOOKS:

1. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 2014.
2. S. Brown, R. Francis, J. Rose, Z. Vranesic, Field Programmable Gate Array, Kluwer Pubin, 2012.
3. N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003

E-RESOURCES:

NPTEL-Online Courses and Video lectures:

<https://archive.nptel.ac.in/courses/106/103/106103116/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	-	-	-	2	2	3	2	3
CO2	2	3	3	3	2	1	1	-	-	-	2	2	3	3	2
CO3	3	2	2	3	2	3	3	-	-	-	3	2	2	2	2
CO4	3	3	2	3	2	3	3	-	-	-	2	2	1	2	1
CO5	3	2	3	3	3	3	2	-	-	-	2	2	1	2	1
AVG	2.8	2.6	2.6	3	2.2	2.4	2	-	-	-	2	2	2	2	2

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

23ECE12

VLSI SIGNAL PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Understand Pipelining, and parallel processing.
- To Study various Algorithms for Strength Reduction Techniques.
- To Understand VLSI design for digital filters
- To Optimize VLSI architectures for basic DSP algorithms.
- To know Numerical Strength Reduction techniques.

UNIT-I PIPELINING AND PARALLEL PROCESSING

9

Introduction To DSP Systems: Introduction; representation of DSP algorithms: Block Diagram, signal flow graph, data flow graph, dependence graph-Introduction, Pipelining of FIR Digital Filters, Parallel Processing. Pipelining and Parallel Processing for Low Power. Retiming: Introduction, Definition and Properties, Solving System of Inequalities, Retiming Techniques.

UNIT-II RETIMING, ALGORITHMIC STRENGTH REDUCTION

9

Loop bound, iteration bound, Longest path matrix algorithm, Retiming - definitions and properties, Unfolding - an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application.

UNIT-III FAST CONVOLUTION, PIPELINING OF IIR FILTERS

9

Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel Recursive filters - Look-Ahead pipelining in first-order IIR filters.

UNIT-IV BIT LEVEL ARITHMETIC ARCHITECTURES

9

Bit-level arithmetic architectures - parallel multipliers with sign extension, parallel carry-ripple and Carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule.

UNIT-V NUMERICAL STRENGTH REDUCTION

9

Numerical strength reduction - sub-expression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase Clocking, two-phase clocking, wave pipelining.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Interpret a various Pipelining, and parallel processing.
- CO2:** Identify the Algorithms for Strength Reduction Techniques.
- CO3:** Discuss VLSI design for digital filters
- CO4:** Optimize VLSI architectures for basic DSP algorithms..
- CO5:** Demonstrate the Numerical Strength Reduction techniques.

TEXT BOOKS:

1. R. Keshab K. Parhi, " VLSI Digital Signal Processing Systems, Design and implementation ", Wiley, Interscience, 2019.

REFERENCE BOOKS:

1. Mohammed Ismail, Terri, Fiez, "Analog VLSI Signal and Information Processing", Second edition McGraw Hill, 2017.
2. Kung, S.Y., H.J. White house T.Kailath, "VLSI and Modern signal processing", Prentice Hall, 2016.
3. Jose E. France, YannisTsividis, "Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing", Prentice Hall, 2016.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee44/preview

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	1	1	2	2	2	1	1
CO2	3	2	2	1	1	-	-	-	1	1	2	2	2	1	1
CO3	3	2	2	1	1	-	-	-	-	1	2	2	2	1	1
CO4	3	2	2	1	1	-	-	-	-	1	2	1	2	1	-
CO5	3	2	2	1	1	-	-	-	-	1	2	1	1	1	-
AVG	3	2	2	1	1	-	-	-	1	1	2	1	2	1	1

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

23ECE13

LOW POWER IC DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamentals of low power low voltage VLSI design.
- To understand the impact of power on system performances.
- To understand the different design approaches.
- To develop the low power low voltage adders.
- To develop the low power low voltage memories

UNIT-I FUNDAMENTALS OF LOW POWER CIRCUITS

9

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-II LOW-POWER DESIGN APPROACHES

9

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT-III LOW-VOLTAGE LOW-POWER ADDERS

9

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques – Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

UNIT-IV LOW-VOLTAGE LOW-POWER MULTIPLIERS

9

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT-V LOW-VOLTAGE LOW-POWER MEMORIES

9

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refres Circuit, Future Trend and Development of DRAM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the fundamentals of Low power circuit design.
- CO2:** Attain the knowledge of architectural approaches.

C03: Analyze and design Low-Voltage Low-Power combinational circuits.

C04: Design and develop Low Power, Low Voltage Multiplier Circuits

C05: Learn the design of Low-Voltage Low-Power Memories

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, "Low Voltage Low Power VLSI Subsystems", Tata Mc-Graw Hill, 2009.

REFERENCE BOOKS:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012.
2. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998
3. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures:
<https://archive.nptel.ac.in/content/storage2/courses/106103116/handout/mod1.pdf>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	2	3	2	-	-	-	-	-	-	2	2	2	2
C02	3	2	1	2	3	-	-	-	-	-	-	1	2	2	1
C03	3	3	3	2	2	-	-	-	-	-	-	1	2	2	2
C04	2	3	3	3	3	-	-	-	-	-	-	1	2	3	3
C05	3	3	3	2	2	-	-	-	-	-	-	2	2	2	3
AVG	2.8	2.8	2.4	2.4	2.4	-	-	-	-	-	-	1.8	2	2	2

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

23ECE14

VLSI TESTING AND DESIGN FOR TESTABILITY

L	T	P	C
2	0	2	4

COURSE OBJECTIVES:

- To introduce logic and fault simulation and testability measures.
- To study the design for testability.
- To know about interfacing and testing of memory
- To introduce power management techniques in testing
- To study testability in analog circuits.

UNIT-I TEST REQUIREMENTS AND METRICS

6

Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR.

UNIT-II SCAN DESIGN AND BIST

6

Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation. Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.

UNIT-III MEMORY TEST AND TEST INTERFACES

6

Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test.

UNIT-IV DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST

6

Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods.

UNIT-V ANALOG TEST

6

Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.

THEORY : 30 PERIODS

PRACTICAL EXERCISES :

USING XILINX / EQUIVALENT SOFTWARE

1. Implement a simple circuit with boundary scan cells.
2. Simulate the scan chain to generate test patterns for the flip-flops.
3. Simulate the memory array (SRAM/DRAM) and inject faults like stuck-at, transition, and coupling faults.
4. Study how these self-test mechanisms improve yield and reduce testing costs.
5. Evaluate the impact of DFT techniques on fault coverage and circuit performance.
6. Designing of CMOS inverter/ logic gate and testing of delay estimation.

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** To Understand logic and fault simulation requirements and testability measures.
- CO2:** To Understand the Design for Testability.
- CO3:** To Develop interfacing and memory testing.
- CO4:** To Perform testing with power management techniques.
- CO5:** To Carry-out fault Detection in analog circuits.

TEXT BOOKS:

1. Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Vishwani Agrawal and Michael Bushnell, Springer, 2012.
2. Parag K.Lala, "An Introduction to Logic Circuit Testing", Morgan & Claypool Publishers, 2009.

REFERENCE BOOKS:

1. Laung-Terng Wang, Cheng-Wen Wu Xiaoqing Wen, "VLSI Test Principles and Architectures: Design for Testability", Kluwer Academic Publishers, 2006
2. N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003
3. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/117/105/117105137/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2	2
CO2	3	2	1	2	3	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	2
CO4	2	3	3	3	3	-	-	-	-	-	-	1	2	3	3
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	2	3
AVG	2.8	2.8	2.4	2.4	2.4	-	-	-	-	-	-	1.8	2	2	2

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

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23ECE15

MIXED SIGNAL IC DESIGN TESTING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To know about mixed-signal devices and the need for testing these devices.
- To study the various techniques for testing.
- To learn about ADC and DAC based testing.
- To understand the Clock and Serial Data Communications Channels
- To study the general purpose measuring devices.

UNIT- I MIXED – SIGNAL TESTING

6

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits - Post- Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature.

UNIT- II YIELD, MEASUREMENT ACCURACY, AND TEST TIME

6

Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time - Guardbands - Effects of Measurement Variability on Test Yield

UNIT- III DAC TESTING

6

Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications.

UNIT- IV ADC TESTING

6

ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer Curves.

UNIT-V CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREMENT

6

Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests.

THEORY: 30 PERIODS

PRACTICAL EXERCISES :

USING XILINX / EQUIVALENT SOFTWARE

1. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
2. R-2R Ladder Type and Flash Type ADC.
3. DC power supply using LM317 and LM723.

4. Design of asynchronous counter
5. Design of synchronous counter
6. Implementation and Testing of RS Latch and Flip-flops

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Learn the fundamentals of mixed signal circuits.
- CO2:** Define the various measurement terminologies.
- CO3:** Acquire knowledge of Analog to Digital Converters.
- CO4:** Learn testing of Analog to Digital Converters.
- CO5:** Comprehend the attributes of a clock signal.

TEXT BOOKS:

1. Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012.
2. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002.

REFERENCE BOOKS:

1. An Introduction to Mixed-Signal IC Test and Measurement (The Oxford Series in Electrical and Computer Engineering) October 2011.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures:
<https://archive.nptel.ac.in/content/storage2/courses/106103116/handout/mod1.pdf>, "Mixed Signal IC Design", Prof.Anirrudhan.
2. https://onlinecourses.nptel.ac.in/noc22_ee37/preview

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	1	2	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1	2
AVG	3	3	2.8	2.2	1.8	1.8	-	-	-	-	-	2.2	3	2	2

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

23ECE16

ANALOG IC DESIGN

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To study the basics of MOS Circuits.
- To analyse the noise characteristics of amplifiers.
- To study the performance parameters of amplifiers.
- To comprehend the compensation techniques
- To understand the detection and testing of faults.

UNIT-I SINGLE STAGE AMPLIFIERS 6

Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT-II HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS 6

Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT-III FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS 6

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT-IV STABILITY, FREQUENCY COMPENSATION 6

Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT-V LOGIC CIRCUIT TESTING 6

Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Design a CMOS inverter and analyze its characteristics.
2. Design a Common source amplifier and analyze its performance.
3. Design a Common drain amplifier and analyze its performance.
4. Design a Common gate amplifier and analyze its performance.
5. Design a differential amplifier with resistive load using transistors.
6. Design three stage and five stage ring oscillator circuit and compare its frequencies.

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Design amplifiers to meet user specifications.
- CO2:** Analyse the frequency and noise performance of amplifiers.
- CO3:** Design and analyse feedback amplifiers and one stage op amps .
- CO4:** Analyse stability of op amp.
- CO5:** Testing experience of logic circuits.

TEXT BOOKS:

- Behzad Razavi, "Design Of Analog Cmos Integrated Circuits", Tata Mcgraw Hill, 2001.(Unit -I,II,III,IV)
- Parag K.Lala, "An Introduction to Logic Circuit Testing", Morgan & Claypool Publishers,2009.(Unit V).

REFERENCE BOOKS:

- Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006.
- Grebene, "Bipolar And Mos Analog Integrated Circuit Design", John Wiley & Sons,Inc.,2003
- Phillip E.Allen, Douglas R .Holberg, "Cmos Analog Circuit Design", Oxford University Press, 2nd Edition, 2002.
- Jacob Baker "CMOS: Circuit Design, Layout, and Simulation, Wiley IEEE Press, 3rd Edition, 2010.

E-RESOURCES:

- NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO2	3	2	3	-	1	-	-	-	-	-	-	2	2	-	-
CO3	3	2	2	-	1	-	-	-	-	-	-	2	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO5	3	2	-	-	1	-	-	-	-	-	-	2	3	2	-
AVG	3	2	-	-	1	-	-	-	-	-	-	2	2.5	2	3

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

23ECE17

FUNDAMENTALS OF NANO ELECTRONICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the the fundamental underpinnings of Nano electronics.
- To familiarize the electron properties of traditional low dimensional structures
- To study the comprehend the mechanism behind single electronic transistors.
- To analyze the key performance of Nano electronic devices.
- To understand the the basics of spin based devices.

UNIT-I BASICS OF NANO ELECTRONICS

9

Scaling to Nano-Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics-General postulates of quantum mechanics-Spin and angular momentum-Wave packets and uncertainty

UNIT-II ELECTRONS CONFINEMENT IN LOW DIMENSIONAL STRUCTURES

9

Statistics of the electrons in solids and nanostructures, Density of states in nanostructures, Time independent Schrodinger wave equation- Electron confinement-Quantum dots, electron confinement Quantum wires, electron confinement Quantum wells.

UNIT-III COULOMB BLOCKADE AND SINGLE ELECTRON TRANSISTOR

9

Coulomb blockade-Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions- Single electron transistors, Semiconductor nanowire SETs, Molecular SETs and molecular electronics.

UNIT-IV NANO ELECTRONIC DEVICES

9

Field-effect transistors, Quantum Cellular automata, Tunneling effect- Tunneling element - Tunneling diode Resonant Tunneling Devices- Light emitting diodes and lasers.

UNIT-V SPIN BASED DEVICES

9

Ferro magnetic devices, Giant magneto resistance devices, Magnetic tunnel junction devices, Spin transfer torque devices

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Complete overview of the fundamental underpinnings of nano electronics.
- CO2: Understand the analyze the electron properties of traditional low dimensional structures
- CO3: Explain the comprehend the mechanism behind single electronic transistors.
- CO4: Analyze the key performance of Nano electronic devices.
- CO5: Explain the explore the basics of spin based devices.

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TEXT BOOKS:

1. Robert Puers, Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
2. Hanson, "Fundamentals of Nanoelectronics", Pearson education, 2013.

REFERENCE BOOKS:

1. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices", Springer-Verlag, 2014.
2. Mircea Dragoman, Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: <https://nptel.ac.in/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	2	1	-	-	-	2	2	3	2	3
CO2	2	1	2	2	2	1	1	-	-	-	2	2	3	3	2
CO3	3	1	2	2	2	3	3	-	-	-	3	2	2	2	2
CO4	3	1	2	2	2	3	3	-	-	-	2	2	1	2	1
CO5	3	1	2	2	3	3	2	-	-	-	2	2	1	2	1
AVG	2.8	1	2	2	2.2	2.4	2	-	-	-	2	2	2	2	2

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

23ECE18	ORGANIC SEMICONDUCTORS, POLYMERS AND MOLECULAR ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamental electronic and optical properties of organic electronic materials
- To understand the organic materials to develop electronic and optoelectronic devices for various applications.
- To understand the device physics and working principles of, PVD
- To analyze the key performance of OLED.
- To understand the basic fabrication process for developing organic devices.

UNIT-I ORGANIC SEMICONDUCTORS 9

Organic semiconducting (small) molecules; orbitals and conjugation; Excitations: excitons and polarons; Exciton spin: singlets and triplets; Synopsis electronic and optical processes; Optical properties: a few examples EG (Energy Gap) vs. molecular weight Electron-phonon coupling: vibrational structure and thermochromism.

UNIT-II ORGANIC LIGHT EMITTING DEVICES 9

OLED principle - HOMO and LUMO levels - Organic p-n junction-Factors affecting OLED performance - Energy level diagram-radiative and non-radiative recombination decay of excitons. White light emitting device (WOLED).

UNIT-III POLYMER-BASED PHOTOVOLTAIC DIODES (PVD) 9

Fundamental process; Exciton absorption; Exciton dissociation; Charge collection; Characterization of PVDs; Relevant performance parameters; Examples of polymer-based PVDs; Polymer-polymer heterojunctions; Enhanced dissociation at type II heterojunctions.

UNIT-IV ORGANIC FIELD EFFECT TRANSISTORS (OFET) 9

Polymer-based field-effect transistors, FETs Structure Fundamental processes; Channel formation; Charge transport Characterization; Relevant performance parameters; Examples of successful strategies.

UNIT-V FABRICATION OF OFET AND MOLECULAR ELECTRONICS 9

Fabrication process of OFETs -operation and characteristics - organic thin film transistors (OTFTs), Molecular Electronics: Overview - organic vs inorganic devices-Rectifiers- Molecular wires-Molecular switches-Data storage -molecular engineering of doped polymers for optoelectronics

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Analyze the fundamental electronic and optical properties of organic electronic materials
- CO2:** Understand the organic materials to develop electronic and optoelectronic devices for various applications.
- CO3:** Illustrate the device physics and working principles of, PVD.
- CO4:** Analyze the working principle of OFET.
- CO5:** Explain the fabrication process for developing organic devices.

TEXT BOOKS:

1. G. Cumberti and G. Fagas, Introducing molecular electronics, Springer, 2015.
2. S.C. Levshevski, Nano and molecular electronics hand book, CRC press, 2017.
3. Wolfgang Brütting, Physics of Organic Semiconductors, Wiley - VCH, 2016.

REFERENCE BOOKS:

1. Drobny, Jiri George, Polymers for Electricity and Electronics: Materials, Properties and Applications

E-RESOURCES:

1. <https://nptel.ac.in/courses/117108047/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	2	1	-	-	-	2	2	3	2	3
CO2	2	1	2	2	2	1	1	-	-	-	2	2	3	3	2
CO3	3	1	2	2	2	3	3	-	-	-	3	2	2	2	2
CO4	3	1	2	2	2	3	3	-	-	-	2	2	1	2	1
CO5	3	1	2	2	3	3	2	-	-	-	2	2	1	2	1
AVG	2.8	1	2	2	2.2	2.4	2	-	-	-	2	2	2	2	2

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

23ECE21	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To provide rigorous foundations in Multirate signal processing
- To understand different parametric techniques for power spectral estimation
- To understand different non-parametric techniques for power spectral estimation.
- To learn the concept of linear prediction and filtering.
- To Apply the Adaptive filter algorithms for signal processing applications

UNIT-I MULTIRATE SIGNAL PROCESSING 6

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion.

UNIT-II PARAMETRIC POWER SPECTRUM ESTIMATION 6

Parametric Methods for Power Spectrum Estimation: Relationship between Auto Correlation and Model Parameters – Model based approach: AR-MA - ARMA Signal modelling, The Yule Walker method for the AR model parameters

UNIT-III NON-PARAMETRIC POWER SPECTRUM ESTIMATION 6

Periodogram, Modified Periodogram, Bartlett method - Welch method - Blackman Tukey method- Performance comparisons - Minimum variance spectrum estimation, Maximum entropy method, Frequency estimation method.

UNIT-IV LINEAR ESTIMATION AND PREDICTION 6

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter: FIR Wiener Filter, IIR Wiener Filter-Recursive estimators Forward and backward linear prediction-Prediction error-Levinson recursion algorithm for solving Toeplitz system of Equations.

UNIT-V ADAPTIVE FILTERS AND APPLICATIONS 6

FIR Adaptive filters - Adaptive filters based on steepest descent method -LMS Adaptive algorithm-Adaptive channel equalization-Adaptive echo canceller-Adaptive noise cancellation-Adaptive recursive filters – Recursive least squares – Recursive Kalman estimator and predictor.

THEORY : 30 PERIODS

PRACTICAL EXERCISES :

1. Interpolation & decimation of a given sequence
2. Estimate the PSD of a noisy signal using periodogram and modified periodogram
3. Estimation of PSD using different methods (Bartlett, Welch, Blackman-Tukey).
4. Estimation of power spectrum using parametric methods (YuleWalker)
5. Design and Implementation of Wiener Filter

6. Design and Implementation of FIR Linear Predictor
7. Design of adaptive filters using LMS algorithm

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Comprehend Multirate signal processing and demonstrate its applications.
- CO2:** Estimate power spectrum using parametric techniques.
- CO3:** Estimate power spectrum using non-parametric techniques
- CO4:** Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
- CO5:** Illustrate the various adaptive filter algorithms and their applications.

TEXT BOOKS:

1. Digital Signal Processing Principles, Algorithms, and Applications by John G. Proakis, Prentice-Hall International Inc., 4th Edition, 2012.
2. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2016.

REFERENCE BOOKS:

1. D.G.Manolakis, V. K. Ingle, and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw-Hill, 2016.
2. M.H.Hays, "Statistical Digital Signal Processing and Modeling", John-Wiley, 2010.

E-RESOURCES:

1. <https://dss-kiel.de/index.php/teaching/lectures/lecture-advanced-digital-signal-processing>
2. https://onlinecourses.nptel.ac.in/noc24_ee76/preview
3. <http://nptel.ac.in/courses/117102060/41>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	1	3	3	1
CO2	3	3	3	2	2	2	-	-	-	-	-	1	3	3	1
CO3	3	3	3	2	2	2	-	-	-	-	-	1	3	3	1
CO4	3	3	3	2	2	2	-	-	-	-	-	1	3	2	1
CO5	3	3	2	2	2	2	-	-	-	-	-	1	3	2	1
AVG	3	3	3	2	2	2	-	-	-	-	-	1	3	2	1

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

23ECE22

IMAGE PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression methods.

UNIT-I BASICS OF IMAGE PROCESSING AND IMAGE TRANSFORM 9

Introduction - steps in image processing - Image acquisition - representation - sampling and quantization - relationship between pixels - color models - basics of color image processing. Introduction to Fourier transform: 1D, 2D DFT and its inverse transform - Walsh - Hadamard - Haar transform, DCT.

UNIT-II IMAGE ENHANCEMENT 9

Image enhancement in spatial domain - some basic gray level transformations - histogram processing - enhancement using arithmetic, logic operations - basics of spatial and frequency filtering: smoothing and sharpening filters.

UNIT-III IMAGE RESTORATION AND SEGMENTATION 9

Image restoration: Model of degradation and restoration process - noise models - restoration in the presence of noise - Image segmentation: Thresholding and region based segmentation.

UNIT-IV IMAGE REPRESENTATION AND DESCRIPTION 9

Representation and Description: Chain codes-Boundary descriptors -Regional Descriptors - Texture -Morphology - dilation and erosion - opening and closing.

UNIT-V IMAGE COMPRESSION 9

Need for image compression, Redundancy in images, Classification of redundancy in images, Classification of image compression schemes, Run length coding, Shannon-Fano coding, Huffman coding, Arithmetic coding, JPEG standard, MPEG , Wavelet-based image compression.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- CO2:** Operate on images using the techniques of smoothing, sharpening and enhancement.
- CO3:** Understand the restoration concepts and basics of segmentation.

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CO4: Outline the concepts of image Representation and Description.

CO5: Comprehend image compression concepts and its standards.

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 4 Edition, Pearson Education Limited, 2018.
2. Anil K.Jain, "Fundamentals of Digital Image Processing", 2015, 1st edition, Pearson India, India.

REFERENCE BOOKS:

1. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2016.
2. Mark Nixon & Alberto Aguado, "Feature Extraction, and Image Processing", 2016, 3rd edition, Elsevier's Science & Technology Publications, Woborn MA, Great Britain
3. Scott E Umbaugh, "Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIP tools", 2011, 2nd edition, CRC press, Boca Raton, FL, USA.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee116/preview
2. <https://nptel.ac.in/courses/117105079>
3. <https://archive.nptel.ac.in/courses/117/105/117105135/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	-	-	-	3	3	1	1
CO2	3	2	2	1	1	-	-	-	-	-	-	2	3	1	1
CO3	3	2	2	1	1	-	-	-	-	-	-	2	2	1	1
CO4	3	2	2	1	1	-	-	-	-	-	-	2	2	1	1
CO5	3	2	2	1	1	-	-	-	-	-	-	2	2	1	1
AVG	3	2	2	1	1	-	-	-	-	-	-	2	2	1	1

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

23ECE23

SPEECH PROCESSING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To introduce the fundamentals of speech processing.
- To Study and understand Various Speech analysis Techniques.
- To understand the speech modeling methods.
- To learn to build speech enhancement and recognition.
- To know the concepts of speech synthesis.

UNIT-I BASIC CONCEPTS

6

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Method.

UNIT-II SPEECH ANALYSIS

6

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT-III SPEECH MODELING

6

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, and Implementation issues.

UNIT-IV SPEECH ENHANCEMENT AND RECOGNITION

6

Classes of Speech Enhancement Algorithms, MMSE Spectral Subtraction Algorithm, Wiener Filters in the Time and frequency Domain, Wiener Filters for Noise Reduction, Subspace Algorithms. Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

UNIT-V SPEECH SYNTHESIS

6

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

THEORY : 30 PERIODS

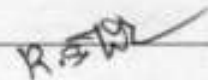
PRACTICAL EXERCISES:

1. Write a MATLAB Program to classify voiced and unvoiced segment of speech using various time-domain measures
2. Write a MATLAB Program to calculate the MFCC for a speech signal
3. Implement Markov Processes Speech modelling in MATLAB
4. Write a MATLAB Program to implement Wiener Filters for Noise Reduction
5. Design a speech emotion recognition system using DCT and WPT in MATLAB

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Understand the fundamentals of speech.
- CO2:** Extract various speech features for speech related applications.
- CO3:** Choose an appropriate speech modeling for a given Process.
- CO4:** Demonstrate the speech enhancement and recognition system.
- CO5:** Build a text-to-speech synthesis system for various applications

TEXT BOOKS:

1. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
2. Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013

REFERENCE BOOKS:

1. L.R. Rabiner and S. W. Schafer, Digital Processing of Speech Signals , Pearson Education, 2008.
2. Ben Gold & Nelson Morgan, Speech & Audio Signal Processing , 1st Edition, Wiley, 2011.
3. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012.

E-RESOURCES:

1. <https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-ec13/>
2. <https://nptel.ac.in/courses/117105145>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	-	-	2	3	3	1
CO2	3	2	1	2	1	-	-	-	-	-	-	2	2	3	1
CO3	1	2	1	1	1	-	-	-	-	-	-	2	2	2	1
CO4	1	-	1	1	-	-	-	-	-	-	-	2	2	2	-
CO5	1	-	1	1	-	-	-	-	-	-	-	1	1	2	-
AVG	1.8	2	1	1	2	-	-	-	-	-	-	1.8	2	2.4	1

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

23ECE24

DEEP LEARNING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To introduce the idea of artificial neural networks and their architecture
- To understand how to build the neural network.
- To understand the principles of deep learning and its capabilities.
- To know how to implement efficient CNN or RNN.
- To become familiar with Autoencoder models and Adversarial Networks

UNIT-I MODERN PRACTICAL DEEP NETWORKS 6

Fundamentals of Neural Networks – Model of Biological and Artificial Neuron – Neural Network Architectures – Activation Functions- McCulloch Pitts neuron Model- Perceptron Learning Algorithms - XOR Problem-K Means Clustering – Decision Trees.

UNIT-II LINEAR MODELS 6

Multilayer Perceptron- Gradient Descent- Forward and Backward Back propagation-RBF Fully Connected layers- PCA- GLCM - LBP – Particle Swarm Optimization- Cuckoo Search optimization- Grey wolf optimization -Support Vector Machine.

UNIT-III IMPROVING DEEP LEARNING 6

Introduction to deep learning - Shallow Neural Networks – Radial Basis Function Neural Network -Planar data classification with a hidden layer -Layers in Neural Network Convolution and its types-Pooling layers and its types- Building your Deep Neural Network: step by step-Deep Neural Network – Hyper parameter tuning, Batch Normalization.

UNIT-IV DEEP CONVOLUTIONAL MODELS 6

1D, 2D, 3D Convolutional Neural Network, Basic structure of Convolutional Network – Overfitting-Activation ReLU - Case studies: LeNet, Alex net, VGGNet, GoogLeNet –RNN- Design of New architectures.

UNIT-V AUTOENCODERS AND ADVERSARIAL NETWORKS 6

Autoencoder models - Introduction to Generative Adversarial Networks - Generator, Discriminator, Adversarial Networks - Application of autoencoder for dimensionality reduction and adversarial model for image generation.

THEORY : 30 PERIODS

PRACTICAL EXERCISES :

1. Implement logistic regression classification with (a) gradient descent and (b) stochastic gradient descent method. Plot cost function over iteration.
2. Experiment with logistic regression by adding momentum term, and adaptive subgradient method
3. Write the code to learn weights of a perceptron for Boolean functions (NOT, OR, AND,NOR, and NAND).
4. Implement a feed-forward neural network for solving (a) regression and (b) 2-class classification problem. Also experiment with hyper-parameter tuning.

5. Create a 2D and 3D CNN for image classification. Experiment with different depth of network, striding and pooling values.
6. Implement (a) RNN for image classification, (b) GRU network and (c) Implement LSTM networks

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Know the basic concepts in Neural Networks and applications.
- CO2:** Analyze various parameters to improve the performance of deep learning models.
- CO3:** Learn the fundamentals of deep learning, and the main research activities in this field.
- CO4:** Implement CNN and RNN algorithms and solve real world problem.
- CO5:** Apply various adversarial network models for image generation.

TEXT BOOKS:

1. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, Deep Learning Using Python, Wiley, 2019.
2. Heaton, Jeff, Ian goodfellow, yoshua bengio, and aaron Courville, "Deep learning", 2018.

REFERENCE BOOKS:

1. Pattanayak, Santanu, Pattanayak, and Suresh John, "Pro deep learning with tensor flow", New York, NY, USA, Apress, 2017
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009
4. Satis Kumar, Neural networks: A Classroom Approach, Tata McGraw-Hill Education, 2000.

E-RESOURCES:

1. <http://www.deeplearning.net>
2. <http://neuralnetworksanddeeplearning.com/>
3. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
4. <https://archive.nptel.ac.in/courses/106/106/106106184/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	-	-	-	-	-	-	3	3	2	1
CO2	2	2	3	3	2	-	-	-	-	-	-	3	3	2	1
CO3	2	2	3	3	2	-	-	-	-	-	-	3	3	2	1
CO4	2	2	2	3	2	-	-	-	-	-	-	3	3	2	1
CO5	2	2	2	2	2	-	-	-	-	-	-	3	2	2	1
AVG	2	2	3	3	2	-	-	-	-	-	-	3	3	2	1

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

23ECE25

DSP ARCHITECTURE AND PROGRAMMING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To Study the architecture of programmable DSP processors
- To learn about the addressing modes, instruction set of DSP processor
- To understand the basic DSP algorithms in TMS320C67XX processor.
- To learn the implementation of various standard DSP algorithms in DSP Processors.
- To Use the Programmable DSP Processors to build real-time DSP systems

UNIT-I ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS 6

Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing.

UNIT-II TMS320C5X PROGRAMMABLE DSP PROCESSOR 6

Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit.

UNIT-III TMS320C6X PROGRAMMABLE DSP PROCESSOR 6

Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools.

UNIT-IV IMPLEMENTATION OF DSP ALGORITHMS 6

DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.

UNIT-V APPLICATIONS OF DSP PROCESSORS 6

Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition.

THEORY : 30 PERIODS

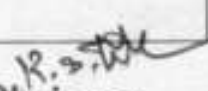
PRACTICAL EXERCISES :

1. Real-Time Sine Wave Generation
2. Programming examples using C, Assembly and linear assembly
3. Implementation of moving average filter
4. FIR implementation with a Pseudorandom noise sequence as input to a filter
5. Fixed point implementation of IIR filter
6. FFT of Real-Time input signal

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Understand the architectural features of DSP Processors..
- CO2:** Comprehend the organization of TMS320C54xx DSP processors.
- CO3:** Build solutions using TMS320C6x DSP Processor.
- CO4:** Implement DSP Algorithms
- CO5:** Study the applications of DSP Processors.

TEXT BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
2. RulphChassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008

REFERENCE BOOKS:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Sen M. Kuo, Woon-Seng S. Gan, "Digital Signal Processor - Architectures, Implementation and Applications", Pearson Prentice Hall, 2005

E-RESOURCES:

1. TMS320C5416/6713 DSK user manual at <https://www.ti.com>
2. <https://nptel.ac.in/courses/108106149>
3. <https://archive.nptel.ac.in/courses/108/108/108108185/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	1	-	2	3	3	1
CO2	3	3	2	2	2	-	-	-	-	1	-	2	3	3	1
CO3	3	3	2	2	2	-	-	-	-	1	-	2	2	2	-
CO4	3	3	2	2	2	-	-	-	-	1	-	2	2	2	-
CO5	3	3	2	2	2	-	-	-	-	1	-	2	2	2	-
AVG	3	3	2	2	2	-	-	-	-	1	-	2	2.4	2.4	1

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

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COMPUTER VISION

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching and Alignment
- To become familiar with feature based alignment and motion estimation.
- To develop skills on 3D reconstruction.
- To understand image based rendering and recognition

UNIT-I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 6

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-II FEATURE DETECTION, MATCHING AND ALIGNMENT 6

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 6

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT-IV 3D RECONSTRUCTION 6

Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT-V OBJECT RECOGNITION AND APPLICATIONS 6

Object detection, Object Modeling, Model-based Object Recognition, Scene and Object Recognition, Shape based Object Recognition, Face Recognition using PCA, Scene Understanding, Action Recognition, Augmented Reality.

THEORY : 30 PERIODS

PRACTICAL EXERCISES :

Software needed:

OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis,
3. Blob detection
4. Image Annotation - Drawing lines, text circle, rectangle, ellipse on images
5. Image Enhancement - Understanding Color spaces, color space conversion, Histogram
6. Equalization, Convolution, Image smoothing, Gradients, Edge Detection

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7. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB
Image features, Feature matching, cloning, Feature matching based image alignment
8. Image segmentation using Graphcut / Grabcut
9. Camera Calibration with circular grid
10. Pose Estimation
11. 3D Reconstruction – Creating Depth map from stereo images
12. Object Detection and Tracking using Kalman Filter, Camshift

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand basic knowledge, theories and methods in image processing and computer vision.
- CO2:** Implement basic and some advanced image processing techniques in OpenCV.
- CO3:** Apply various feature detection method.
- CO4:** Apply 3D image reconstruction techniques
- CO5:** Design and develop innovative image processing and computer vision applications.

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS:

1. R Szeliski, "Computer vision: algorithms and applications", Springer Science & Business Media, 2010.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

E-RESOURCES:

1. <http://www.ius.cs.cmu.edu/demos/facedemo.html>
2. https://onlinecourses.nptel.ac.in/noc19_cs58/preview

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	-	-	-	1	1	-	3	3	3	1
CO2	3	3	1	1	3	-	-	-	1	1	-	3	3	3	1
CO3	3	3	1	1	2	-	-	-	1	1	-	3	3	2	1
CO4	2	3	1	-	2	-	-	-	1	1	-	3	2	2	1
CO5	2	1	1	-	2	-	-	-	1	1	-	3	2	1	1
AVG	2.6	2.6	1	1	2.4	-	-	-	1	1	-	3	2.6	1.8	1

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

23ECE27

WAVELETS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Learn adequate knowledge by different types of transform.
- To Understand the concepts of continuous wavelet transform
- To Improve problem solving skills using discrete wavelet transform and filter banks
- To apply the concepts of Multi resolution analysis.
- To Learn the various applications of wavelet.

UNIT-I INTRODUCTION TO FOURIER TRANSFORM

9

Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal, Wigner-Ville transform.

UNIT-II CONTINUOUS WAVELET TRANSFORM

9

Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain

UNIT-III DISCRETE WAVELET TRANSFORM AND FILTERBANKS

9

Orthogonal and bi-orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

UNIT-IV MULTI RESOLUTION ANALYSIS

9

Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets.

UNIT-V APPLICATIONS OF WAVELET

9

Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission.

THEORY : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Learn adequate knowledge by different types of transform.
- CO2:** Understand the concepts of continuous wavelet transform.
- CO3:** Improve problem solving skills using discrete wavelet transform and filter banks.
- CO4:** Understand the concepts of Multi resolution analysis.
- CO5:** Learn the various applications of wavelet.

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TEXT BOOKS:

1. S. Mallat , "A Wavelet Tour of Signal Processing", 2nd edition, Academic Press, 2020.
2. M. Vetterli, J. Kovacevic , "Wavelets and Sub band Coding", Prentice Hall, 2019.
3. Raghuveer rao ,Ajit S.Bopardikar, " Wavelet transforms: Introduction, Theory and applications", Pearson Education Asia, 2000.

REFERENCE BOOKS:

1. J.C. Goswami, A.K. Chan, " Fundamentals of Wavelets: Theory, Algorithms, and Applications", 3rd ed., Wiley, 2015.
2. Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John , "Wavelets and their Applications", Wiley & Sons, 2010 .
3. J S Walker, "A premier on Wavelets and their scientific applications", CRC press, 2018.

E-RESOURCES:

1. <http://www.digimat.in/nptel/courses/video/108101093/L69.html>
2. <https://www.wavelet.org/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO5	3	3	2	1	1	-	-	-	-	-	-	-	2	-	-
AVG	3	3	2	1	1	-	-	-	-	-	-	-	2	1	-

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

23ECE28	OPTICAL COMPUTING AND SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Fourier Optics and image processing
- To know about Spatial Light Modulator
- To analysis the optical switching devices
- To learn about the optical interconnections.
- To know the concepts of optical neural networks

UNIT-I FOURIER OPTICS AND IMAGE PROCESSING 9

A short history of the Field of Optical Computing – Fourier Optics – Correlation and Convolution – Fourier Transform with lenses – Grating filters – Complex transform filters – Fourier holograms – Optical image processing.

UNIT-II OPTICAL COMPUTING WITH SPATIAL LIGHT MODULATOR 9

Introduction – Liquid crystal light valve – Micro channel Spatial Light Modulator – Numerical optical computing basics – Logic gates using SLMs – Flip-flops – Optical binary temporal integrator – optical circuits – Optical switching network – Optical matrix computations – Optical matrix vector multiplier – Matrix-Matrix Multiplier.

UNIT-III OPTICAL SWITCHING DEVICES 9

Types of switching devices – some requirements of switching devices – Networks – Role of optical switching – Implications of optical switching – Circuit switches – Four port Directional coupler switches and switch matrices – active path optical switches with electrical control – optical logic devices for switching – The electronics-optics interface.

UNIT-IV OPTICAL INTERCONNECTIONS 9

Introduction – Types of optical interconnections – Specific properties of optical interconnections – Power requirements of optical interconnections – Fan-in and Fan-out properties of Optical interconnections – Multistage interconnections

UNIT-V OPTICAL NEURAL NETWORKS 9

Optical computing and neural networks – Optical linear neural nets – Non-linear neural networks- Auto associative and self-organizing networks – Recent advances

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Learn about optical computing and application of Fourier optics in image processing.
- CO2:** Educated about liquid crystal light valve, micro-channel spatial light modulator, logic gates using SLMs, etc.
- CO3:** Gain knowledge in types of switching devices, circuit switches, and electronics-optics interface.
- CO4:** Gain knowledge in types of optical interconnections.
- CO5:** Learn about optical computing and neural networks

TEXT BOOKS:

1. M. A. Karim and A.A.S. Awwal, "Optical Computing: An Introduction", Wiley India, 2010.
2. H.H.Arsenault, T.Szoplik and B.Macukow, "Optical Processing and Computing", Academic Press, 2012.

REFERENCE BOOKS:

1. Dror G. Fritelson, "Optical Computing", The MIT Press, 1988.
2. B.S. Wherrett, and F.A.P. Toole, "Optical Computing", CRC Press, 1989-

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee04/preview
2. <https://www.mdpi.com/2079-4991/12/13/2171>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	-	-	2	1	1	2
CO2	3	2	1	2	1	-	-	-	-	-	-	2	1	1	-
CO3	1	2	1	1	1	-	-	-	-	-	-	2	1	-	-
CO4	1	-	1	1	-	-	-	-	-	-	-	2	1	-	-
CO5	1	-	1	1	-	-	-	-	-	-	-	2	1	-	-
AVG	1.8	2	1	1	2	-	-	-	-	-	-	2	1	1	2

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

23ECE31

RF TRANSCEIVERS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To enable the student to understand the specification parameters of a radio frequency system
- To know about the parameters of impedance matching network
- To learn about the amplifiers in RF systems
- To enable the students to verify the basic principles in filters and mixers used in RF systems
- To understand the operation of Frequency Synthesizers and oscillators used in RF design

UNIT-I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 6

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes

UNIT-II IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS 6

Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs

UNIT-III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 6

Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric

UNIT-IV FILTERS AND MIXERS 6

Overview - basic resonator and filter configuration, special filter realizations, filter implementation, basic characteristics of mixers, Passive down conversion Mixers, Active Down conversion Mixers, single and double-balanced mixers

UNIT-V FREQUENCY SYNTHESIZERS AND OSCILLATORS 6

Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers, Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Measurement of S-parameters for impedance matching circuits, and RF filters using network analyzer
2. Design of RF inductor and capacitor
3. Design and characterization of LNA

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4. Design of impedance matching network
5. Design of low-pass and band-pass filter at RF
6. Design and characterization of mixer

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Interpret the nonlinear effects in RF circuits
- CO2:** Design RF circuits
- CO3:** Analyze the performance of RF circuits
- CO4:** To discuss design and analysis of filters and mixers used in RF systems.
- CO5:** To comprehend the operation of Frequency Synthesizers and oscillators

TEXT BOOKS:

1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2019
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012

REFERENCE BOOKS:

1. Ludwig R, Bogdanov G, RF Circuit Design, Theory and Applications, Pearson Education Inc, Second Edition, 2013
2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015.

E-RESOURCES:

1. <https://www.analog.com/en/product-category/integrated-transceivers-transmitters-receivers.html#category-detail>
2. https://www.globalspec.com/learnmore/telecommunications_networking/rf_microwave_wireless_components/rf_transceivers

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	1	-	2	1	1	3
CO2	3	3	3	2	2	-	-	-	-	1	-	2	1	1	2
CO3	3	3	2	2	2	-	-	-	-	1	-	2	2	2	2
CO4	3	3	3	3	2	-	-	-	-	1	-	2	3	2	2
CO5	3	2	3	3	2	-	-	-	-	1	-	2	2	2	2
AVG	3	3	3	3	2	-	-	-	-	1	-	2	2	2	2

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

23ECE32

SIGNAL INTEGRITY

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To understand characteristic impedance of transmission line and impedance matching techniques.
- To understand plain signal reflection and cross talk noise in the transmission line, and also explain the mathematical analysis method.
- To explore High Frequency response of a circuit for differential signals.
- To know spectrum of signals in Time and frequency domain.
- To learn Jitter analysis and jitter decomposition.

UNIT-I SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE 6

Phenomenon of signal reflection. Signal reflection at transmitting end. Signal reflection at branch point. Multiple reflections in transmission line. Prevention of signal reflection by using impedance matching technique.

UNIT-II CROSSTALK NOISE 6

Crosstalk definition and classification. Crosstalk mechanism. Analysis of crosstalk noise in transmission line. Main factor of causing crosstalk noise.

UNIT-III DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT. 6

Pros and cons of using differential signaling compared with that of single-ended signaling. High-speed differential interfaces. Theory of differential signaling. Differential signal termination techniques

UNIT-IV TIME & FREQUENCY DOMAIN ANALYSIS 6

The Time Domain, Sine waves in the Frequency domain, Sine wave features, The spectrum of repetitive signal, The spectrum of an Ideal Square wave, Effect of bandwidth on rise time, Bandwidth on real signals, Bandwidth of a Measurement, Effect of inadequate sampling rate.

UNIT-V JITTER ANALYSIS 6

Jitter Definition and Types of Jitter; Jitter decomposition, Jitter and phase noise in basic circuits, Linear Time-variant Analysis, Eye diagram analysis and related measurement.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Generating 1GHz Differential signal from AWG
2. Getting Eye on oscilloscope and conduct various measurement on Eye as well Timing parametric such as rise/fall times, pulse width, and duty cycle Programmable software clock recovery including software PLL.
3. Accurate jitter analysis using the spectral and Q-scale methods for detailed decomposition of jitter components, including the extraction of industry standard dual-dirac model parameters
4. Generate LVDS signal and conduct signal integrity measurement

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Familiarize with High Speed design and related issues.
- CO2:** Understanding on critical design aspect
- CO3:** Apply High Speed Frequency response of a circuit for differential signals.
- CO4:** Construct the spectrum of signals in Time and frequency domain .
- CO5:** Identify Jitter and related measurements which is critical for design.

TEXT BOOKS:

- Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition,2018
- High Speed Signal Propagation and Howard Johnson, Prentice Hall, 3rd Edition,2020
- 3.Understanding Jitter and Phase Noise , A Circuits and Systems Perspective, NICOLA DA DALT, Cambridge University Press,2018 .

REFERENCE BOOKS:

- High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall,1st Edition,1993

E-RESOURCES:

- <https://nptel.ac.in/courses/108105375>, "Signal Integrity", Prof. Amitabha Bhattacharya
- <https://resources.pcb.cadence.com/blog/2021-signal-integrity-fundamentals-in-pcb-layout>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

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

23ECE33

ANTENNA DESIGN AND WAVE GUIDE

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To introduce the basic concepts of antenna arrays for smart antenna design
- To discuss the random variables and processes for angle of arrival (AOA) estimation
- To describe different algorithms used for AOA estimation
- To understand the concept of antenna arrays and special antennas
- To learn the various radio wave propagation.

UNIT-I ANTENNA FUNDAMENTALS

6

Antenna Field Regions, Power density, Antenna pattern, Antenna Boresight, Principal plane patterns, Magnetic vector potential and the far field, Linear antenna-Infinitesimal dipole, Finite length dipole, Loop antennas-Loop of constant phasor current

UNIT-II ANTENNA ARRAY FUNDAMENTALS

6

Linear arrays: Two element and Uniform N element array – Array weighting: Beam steered and weighted arrays – Circular arrays – Rectangular planar arrays – Fixed beam arrays – Butler Matrices – Fixed sidelobe cancelling – Retrodirective arrays: Passive and active retrodirective arrays.

UNIT-III ANGLE OF ARRIVAL ESTIMATION

6

Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix - AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate, Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate.

UNIT-IV SPECIAL ANTENNAS AND ANTENNA MEASUREMENTS

6

Antenna for terrestrial mobile communication systems - GPR - Embedded antennas - UWB - Plasma antenna - Smart antennas. Antenna measurements: Radiation pattern, Gain, Directivity, Polarization, Impedance, Efficiency

UNIT-V WAVE GUIDES

6

General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Write a MATLAB code to estimate the radiation pattern of a linear array and N element uniform array
2. Write a MATLAB code to estimate the AOA using MUSIC and ESPRIT algorithm
3. Write a MATLAB code to estimate the weights of the array. Using the final weights estimate the array factor and the mean square error.
4. Write a MATLAB code to dynamically alter the main lobe direction based on the information of AOA.

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Describe the basics of antennas.
CO2: Understand the fundamentals of antenna arrays.
CO3: Estimate the weights of the antenna array based on the angle of arrival
CO4: Apply the fixed weight beam forming in smart antennas
CO5: Construct wave guide in smart antennas

TEXT BOOKS:

1. Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2018.
2. S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2016.

REFERENCE BOOKS:

1. T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 2017.
2. Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011.
3. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2019

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee20/preview, "Antenna Design", Prof. Girish Kumar
2. <https://www.antenna-theory.com/tutorial/waveguides/waveguide.php>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	-	-	-	1	-	2	3	2	2
CO2	3	2	2	2	2	1	-	-	-	1	-	2	3	2	2
CO3	3	3	2	2	1	2	-	-	-	1	-	2	3	2	2
CO4	3	3	2	3	2	1	-	-	-	1	-	2	3	2	2
CO5	3	2	3	2	2	1	-	-	-	1	-	2	3	2	2
AVG	3	3	2	2	2	1	-	-	-	1	-	2	3	2	2

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

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MICs AND RF SYSTEM DESIGN

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To study the characteristics of Active components and applications.
- To design the RF filter and analyze the circuits operated at millimeter wavelength
- To understand the basics of Microwave integrated circuits
- To learn the concepts of non reciprocal components for MICs
- To design the antenna and analyze its performance using measurement techniques

UNIT I ACTIVE RF COMPONENTS AND APPLICATIONS

6

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks-impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

UNIT II RF FILTER DESIGN

6

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

UNIT III INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS

6

Overview of ABCD and S parameters - Overview of Planar transmission lines (Strip line, Microstripline, Slot line, CPW, Fin line)-Design Parameters for Strip Line And Microstripline-Active Device Technologies- Design Approaches Multichip Module Technology- Substrates

UNIT IV NON RECIPROCAL COMPONENTS FOR MICs

6

Microstrip on Ferrimagnetic substrates, Microstrip circulators, Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.

UNIT V INTEGRATED ANTENNA DESIGN AND MEASUREMENTS

6

Integrated Antenna Design - Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements -Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Design of low pass, high pass, band pass and band stop filter at RF using any software tool
2. Design of low pass, high pass, band pass and band stop filter at RF Design of low pass, high pass, band pass and band stop filter at RF
3. Design of low pass, high pass, band pass and band stop filter at RF
4. Design of low pass, high pass, band pass and band stop filter at RF

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5. Measurement of S parameters for a) Inductor b) Capacitor c) impedance matching circuits, filters using network analyzer
6. Design a microstrip circuits

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure.
- CO2:** Analyze microwave circuits for filters design.
- CO3:** Evaluate the performance of any Microwave integrated circuits
- CO4:** Create communication circuits and subsystems with practical design parameters for non-reciprocal components in MICs.
- CO5:** Design microwave integrated antenna design circuit for the required Performance using professional software tools.

TEXT BOOKS:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2020.
2. Bharathi Bhat, Shibani K. Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", New Age International Pvt Ltd Publishers, 2017.

REFERENCE BOOKS:

1. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2019.
2. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2020.
3. Roland E. Best, Phase – Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2018

E-RESOURCES:

1. <https://nptel.ac.in/courses/108103141>, "Microwave Engineering", Dr. Ratnajit Bhattacharjee
2. <https://www.worshipfacility.com/2022/03/03/rf-systems-basics-system-components/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO2	3	3	3	2	3	2	2	-	2	1	-	1	3	2	2
CO3	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO4	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO5	3	3	1	2	3	2	2	-	2	1	-	1	3	2	2
AVG	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2

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

23ECE35

EMI/EMC PRE COMPLIANCE TESTING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference
- To teach the importance of measurement device for EMI.
- To explain the EMI coupling & control principles
- To understand receivers & Analyzer functionalities
- To impart knowledge on design issues in EMI/EMC

UNIT I BASICS OF ELECTROMAGNETIC COMPATABILITY

6

Introduction-Visualising the EMI problem-Source of EMI, EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications

UNIT II TYPES OF EMI COUPLING

6

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI

UNIT III MEASUREMENT DEVICES FOR EMI

6

Introduction - Measurement by direct connection, Inductively coupled devices, EMC antennas - Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing

UNIT IV RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT

6

EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge

UNIT V PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS

6

Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC - Developing an approach to EMC design - Process flow chart, - EMC strategy - Self certification; Solutions to avoid EMC: ESD Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Basic spectrum measurement and power measurement with markers
2. Perform environment scan and detect various signals available
3. DPX, Spectrogram and transient capture with mask test and act on violation

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4. EMI spurious detection and measurement against EMI limit lines
5. Use of LISN and measurement concept of Conducted emission

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Perceive the various types and mechanisms of Electromagnetic Interference
- CO2:** Propose a suitable EMI mitigation technique.
- CO3:** Evaluate EMI coupling & control principles
- CO4:** Explain the importance receivers & Analyzer functionalities
- CO5:** Inspect the design issues in EMI/EMC

TEXT BOOKS:

1. David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012
2. Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017

REFERENCE BOOKS:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 2016
2. Paul, C.R., "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley, 2010.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ee67/preview, "EMI /EMC and Signal Integrity: Principles, Techniques and Applications", Prof. Amitabha Bhattacharya
2. <https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-ee17/>, "Electromagnetic compatibility, EMC", Prof. Daniel Mansson

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	1	-	-	1	-	1	2	1	2
CO2	3	3	2	1	3	2	1	-	-	1	-	2	2	2	2
CO3	3	3	3	3	2	2	1	-	-	1	-	2	2	2	2
CO4	3	3	2	2	2	2	1	-	-	1	-	2	2	1	2
CO5	3	-	3	3	2	2	1	-	-	1	-	2	2	2	2
AVG	3	3	2	2	2	2	1	-	-	1	-	2	2	2	2

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

23ECE36

RFID SYSTEM DESIGN AND TESTING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of near field and far field RFID Communications.
- To study various standards and protocols used in RFID systems
- To learn about the operating principles of RFID tag and reader
- To introduce the security aspects and attacks on RFID systems
- To learn about sensors in RFID and the applications of RFID systems

UNIT-I INTRODUCTION

6

Electromagnetic frequency spectrum with applications, RFID principles: Near field and Far field based RFID-Properties of Magnetic field-Properties of Backscatter RF Systems - Modulation techniques-Comparison of the properties of RFID based on frequency.

UNIT-II RFID STANDARDS AND PROTOCOLS

6

Frequency ranges and radio licensing regulations-RFID Industry standards: EPC global - ISO15693 Vicinity cards and RFID - ISO14443 Proximity cards and RFID - The NFC forum - Reading collocated RFID tags: Query Tree protocol - Query Slot protocol

UNIT-III RFID OPERATING PRINCIPLES

6

RFID Tag components: RFID tag types - the 1-Bit Transponder and Chipless Tags - RFID readers and middleware component - Communication fundamentals: Coupling, Data encoding, multi-path effect - Tag, Reader and sensor communication.

UNIT-IV RFID DATA INTEGRITY AND SECURITY

6

The checksum procedure - Multiaccess procedures - Attacks on RFID Systems - Protection by Cryptographic measures

UNIT-V RFID ENABLED SENSORS AND APPLICATIONS

6

RFID enabled Sensors: Antenna design challenges - IC design - Integration of sensors and RFID - Applications: Contactless smart cards - Industrial Automation - Medical applications - Challenges and opportunities.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Design of a passive RFID Tag Antenna
2. Design of an RFID reader antenna
3. Determination of read range of the RFID tag at UHF and Microwave frequencies
4. Determination of RFID tag performance for different standards

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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COURSE OUTCOMES:

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

- CO1:** Classify RFID systems based on frequency, architecture and performance
- CO2:** Define standards for RFID technology
- CO3:** Illustrate the operation of various components of RFID systems
- CO4:** Describe the privacy and security issues in RFID Systems
- CO5:** Learn the application of RFID enabled sensor

TEXT BOOKS:

1. Klaus Finkenzeller, "RFID Handbook", Wiley, 3rd Edition, 2010
2. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010
3. Roy Want, "RFID Explained", Springer, 2022.

REFERENCE BOOKS:

1. Syed Ahson, Mohammad Ilyas, "RFID Handbook", CRC Press, 2008
2. Paris Kitsos, "Security in RFID and Sensor Networks", CRC Press, 2016.

E-RESOURCES:

1. <https://www.techtarget.com/iotagenda/definition/RFID-radio-frequency-identification>, "RFID", Sarah Amsler.
2. <https://nptel.ac.in/courses/108108179>, "RFID DEMO", Prof. T V Prabhakar
3. <https://nptel.ac.in/courses/110105083>, "RFID and its Applications", Prof. Mamata Jenaman

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	-	-	1	-	3	2	3	2
CO2	3	2	3	2	2	2	1	-	-	1	-	3	3	2	2
CO3	3	3	3	2	3	2	1	-	-	1	-	3	2	3	2
CO4	3	3	3	2	2	2	1	-	-	1	-	2	3	2	2
CO5	3	3	2	2	2	2	2	-	-	1	-	3	2	2	2
AVG	3	3	3	2	3	3	1	-	-	1	-	2	3	3	2

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

23ECE38

RF PASSIVE CIRCUITS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Analyze the RF circuits using S-parameters, Signal flow graphs and smith charts.
- To Understand the basics of RF passive components and circuits
- To gain a comprehensive understanding of Impedance matching techniques
- To analyze the performance of a directional coupler in terms of coupling factor, power dividers and phase shifters.
- To understand RF resonators and filters

UNIT-I INTRODUCTION OF RF AND MICROWAVE CIRCUIT DESIGN 9

Radio frequency and Microwave circuit applications, Radio frequency waves, RF and Microwave circuit design considerations, Introduction to component basics, Microstrip line, Formulation and properties of S-parameters, Signal Flow graphs, Smith chart Concepts, Types.

UNIT-II MATCHING NETWORK COMPONENTS 9

Impedance Matching Elements, Transmission line matching elements-Microstrip, coplanar, Lumped Elements- R,L,C, Bond wire Inductors-Single wire, Ground plane effect, Multiple wires, Maximum current handling of wire, Broadband inductors.

UNIT-III IMPEDANCE MATCHING TECHNIQUES 9

Goal of impedance matching, Components for matching, One-port and Two-port Networks, Narrowband Matching Techniques-Lumped Element Matching Techniques, Transmission line Matching techniques, Wideband Matching Techniques -Gain Bandwidth Limitations, Lumped element, Transmission line

UNIT-IV COUPLERS, POWER DIVIDERS AND PHSE SHIFTERS 9

Couplers and Power dividers - Basic properties, Types, Power combining efficiency, Wilkinson Power divider- equal and unequal types, 90° Hybrids, Branch line couplers, N-way combiners, corporate structures, spatial combining, phase shifters - Types, Transmission line type, Reflection types phase shifters.

UNIT-V RF RESONATORS AND FILTERS 9

RF Resonators and Filters - Basic Resonator types, transmission line resonators, Resonant waveguide cavities, Excitation of resonators, RF Filters: Basic filter configurations, Special Filter Realizations, Filter Implementation, Coupled Filter.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Summarize the fundamentals of RF and microwave circuit
- CO2:** Understand the components of matching network
- CO3:** Build the various matching techniques in circuit
- CO4:** Describe about the basic types of couplers and power dividers
- CO5:** Build Special filters and to describe basic resonator types

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TEXT BOOKS:

1. Mathew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education Asia, 2001.
2. Reinhold Ludwig, Pavel Bretchko, "RF circuit design, theory and applications", Pearson Asia Education, 2nd Edition, 2012

REFERENCE BOOKS:

1. D. Pozar, "Microwave Engineering", John Wiley & Sons, New York, 2005.
2. Inder J Bahl, "Fundamentals of RF and Microwave Transistor Amplifiers", John Wiley & sons Inc, 2009

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/117/102/117102012/>
2. https://onlinecourses.nptel.ac.in/noc24_ee75/preview , "RF Transceiver Design", Prof. Darshak Bhatt
3. <https://archive.nptel.ac.in/courses/117/105/117105138/>

CO's – PO's & PSO's MAPPING

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
C02	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
C03	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
C04	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
AVG	2.8	1.8	1	-	-	-	-	-	-	-	-	-	3	2	-

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

23ECE37

ADVANCED RADIATION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The students will have knowledge on the principles of radiating systems
- To analyse and design antenna arrays
- To gain knowledge on synthesis of antennas
- The students will be able to analyse and design of special antennas
- The students will have knowledge on the concepts of smart antennas

UNIT-I FUNDAMENTALS OF RADIATION 9

Retarded vector potential- Heuristic approach and Maxwell's equation approach - Duality theorem -The Lorentz gauge condition - Fields radiated by an alternating current element and half wave dipole - Total power radiated and radiation resistance of alternating current element and half wave dipole

UNIT-II ANTENNA ARRAY 9

N element linear array - uniform amplitude and spacing - Phased arrays - Directivity of Broadside and End fire arrays - Three dimensional characteristics - Pattern multiplication - Binomial arrays and Dolph-Tchebycheff arrays - Circular array - Planar array - array factor, beam width, directivity.

UNIT-III ANTENNA SYNTHESIS 9

Synthesis problem - line source based beam synthesis methods, Fourier transform and Woodward-Lawson sampling methods - Linear array shaped beam synthesis method- Low side lobe, narrow main beam synthesis

UNIT-IV SPECIAL ANTENNAS 9

Aperture antennas - Huygens Principle. Rectangular apertures - Circular apertures and their design considerations - Babinet's principle, Fourier transform in aperture antenna theory. Micro strip antennas: feeding methods - Rectangular patch - transmission line model

UNIT-V SMART ANTENNAS 9

Beam steering - degree of freedom - optimal antenna - adaptive antennas - smart antennas - key benefits of smart antennas technology - wide band smart antennas - Narrow band processing: signal model, conventional beam former, null steering beam former, optimal beam former, optimization using reference signal and beam space processing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Explain the concept of radiation
- CO2:** Analyze and design antenna arrays for given specifications
- CO3:** Synthesize antennas for known excitations and outputs
- CO4:** Describe the different types of antennas
- CO5:** Explain the concepts of smart Antennas.

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TEXT BOOKS:

1. Balanis. A, "Antenna Theory -Analysis and Design", John Wiley and Sons, New York, 4th Edition, 2016.
2. Lal Chand Godara, "Smart Antennas", C.R.C Press, 2018.

REFERENCE BOOKS:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for all applications", 3rd Edition, John Wiley and Sons, New York, 2012.
2. Edward C. Jordan, Keith G. Balmain "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall of India, 2015.
3. Warren L. Stutzman and Gary A. Thiele, "Antenna Theory and Design", 3rd Edition, John Wiley and Sons, New York, 2012.
4. Theodore S. Rappaport, "Smart Antennas: Adaptive Arrays, Algorithms, & Wireless Position Location", IEEE Press, 2011.

E-RESOURCES:

1. <https://link.springer.com/book/10.1007/1-4020-3450-4>
2. <https://nptel.ac.in/courses/112103276>, "Fundamentals of Conduction and Radiation", Prof. Dipankar N. Basu
3. <https://archive.nptel.ac.in/courses/117/107/117107035/>

CO's - PO's & PSO's MAPPING

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	-	2	2	3	-	-	-	-	-	-	-	3	2	-
C02	3	-	2	2	3	-	-	-	-	-	-	-	2	3	-
C03	3	-	-	2	3	-	-	-	-	-	-	-	2	3	-
C04	3	-	2	2	3	-	-	-	-	-	-	-	-	3	-
C05	3	-	-	2	3	2	-	-	-	-	2	-	-	3	-
AVG	3	-	2	2	3	2	-	-	-	-	2	-	2.3	2.8	-

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

23ECE41

WEARABLE SENSOR DEVICES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Study about the Measurements and Sensors
- To know about Transducers
- To Explore Various Idea about Mechanical Transducers
- To Enrich the Knowledge about the applications of wearable devices in the field of medicine
- To understand the communication and security aspects in the wearable devices

UNIT-I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, Types of measured Quantities, Measures of Dispersion, Sample deviation and sample mean, Units and standards, Calibration and errors. General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations, Static and dynamic characteristics of measurement system.

UNIT-II SENSORS AND TRANSDUCERS 9

Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Wearable applications: temperature sensitive fabric, electrochemical sensors. Resistive sensors- Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), thermistors, magneto resistors, light dependent resistor (LDR), resistive hygrometers, resistive gas sensors. Wearable applications: Strain sensor for monitoring Physiological signals, body movement.

UNIT-III MECHANICAL TRANSDUCERS 9

Accelerometers: Characteristics and working principle, Types- Capacitive, Piezoresistive, piezoelectric; Gyroscopes: Characteristics and working principle, Rotor Gyroscope; Diaphragm Pressure Sensor – resistive & capacitive type (micro press sensor). Wearable applications: Motion sensors for fall detection, hemiplegic and PD (Parkinson's disease) patients.

UNIT-IV SMART SENSORS AND APPLICATIONS 9

Integrated and Smart sensors, IEEE 1451 standard & Transducer Electronic Datasheets (TEDs), Overview of various smart sensors: Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22, FC28), IR sensor (FC51), Gas sensor (MQ2, MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335), etc; Structural health monitoring sensors, Introduction to MEMS and Flexible sensors.

UNIT-V WEARABLE DEVICES 9

Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Social Aspects: Interpretation of Aesthetics, Adoption of Innovation, On-Body Interaction; Case Study: Google Glass, health monitoring, Wearables: Challenges and Opportunities, Future and Research Roadmap.

TOTAL: 45 PERIODS**At the end of the course, the students will be able to**

- CO1** Gain the basic idea of measurements, characteristics and the errors associated with measurements.
- CO2** Realize the concept of reactive sensors employed for real life applications

- C03** Outline the role of mechanical transducers in wearable sensor devices
- C04** Understand the working principle of special purpose sensors and the need for developing smart sensors.
- C05** Design and perform experiments on the sensors and develop the projects based on the customer needs

TEXT BOOKS:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 3rd ed., Springer, 2010.
2. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications" Elsevier, 2014

REFERENCE BOOKS:

1. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier Inc., 2005.
2. Subhas C. Mukhopadhyay, "Wearable Electronics Sensors-For Safe and Healthy Living", Springer International Publishing, 2015.
3. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3 rd Edition.

E-RESOURCE:

1. <https://archive.nptel.ac.in/courses/108/108/108108147/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
C02	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
C03	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
C04	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
C05	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
AVG	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1

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

23ECE42

MEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts in bio medical engineering.
- To illustrate different types of electrodes to acquire bio-signals.
- To introduce an fundamentals of transducers as applicable to physiology.
- To explore the human body parameter measurements setups.
- To Know different types of bio amplifiers used in medical applications.

UNIT-I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Introduction to biomedical Engineering - Development of Bio medical instrumentation - Biometrics - Introduction and Components of man vs Instrument system - physiological system of the body - problems in measuring living system - Sources of biomedical signal - Basic medical instrumentation system - Intelligent Medical Instrumentation system - Regulation of medical devices.

UNIT-II BIO ELECTRIC SIGNALS AND ELECTRODES 9

Origin of Bio electric signals - ECG - EEG - EMG - Electrodes for ECG - Electrodes for EEG - Electrodes for EMG - Electrical conductivity of Electrode jellies and creams - Micro electrodes - Electrode and Electrolyte interface - polarization.

UNIT-III PHYSIOLOGICAL TRANSDUCERS 9

Introduction to transducers - classifications of transducers - Performance characteristics of transducer - Displacement transducers - Motion transducers - Position transducers - Pressure transducer - temperature measurement transducer - Photoelectric transducer - Bio sensors - Smart sensors.

UNIT-IV RECORDING MODERN IMAGING SYSTEM 9

ECG recorder - VCG recorder - PCG recorder - Digital Stethoscope - EEG - Electromyography - Central monitors - Heart and blood pressure measurement - Basis of Diagnostic Radiology - X-ray machine - Visualization of X-Rays - Portable and Mobile X-Ray Units - Digital X-ray System.

UNIT-V BIO AMPLIFIER AND PATIENT SAFETY 9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier - right leg driven ECG amplifier. Band pass filtering, isolation amplifiers - transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference - Electric Shock Hazards - Leakage Currents - Safety Codes For Electro medical Equipment - Electrical Safety Analyser - Testing Of Biomedical Equipment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Remember the basic concepts in bio medical engineering.
- CO2:** Illustrate different types of electrodes to acquire bio-signals
- CO3:** Understand the physiology of biomedical system
- CO4:** Measure biomedical and physiological information.
- CO5:** Evaluate the safety and efficacy of bio amplifier-equipped medical devices.

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TEXT BOOKS:

1. "Introduction to Biomedical Instrumentation" by Philip J. Kachur (2020)
2. "Medical Instrumentation: Application and Design" by John G. Webster and co-authors (4th Edition, 2020)

REFERENCE BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

E-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/nou23_bt05/preview
2. <http://digimat.in/nptel/courses/video/102104043/L01.html>

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	2	3	-	-
CO2	3	2	3	-	1	-	-	-	-	-	-	2	2	-	-
CO3	3	2	2	-	1	-	-	-	-	-	-	2	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO5	3	2	-	-	1	-	-	-	-	-	-	2	3	2	-
AVG	3	2	2.5	-	1	-	-	-	-	-	-	2	2.5	2	3

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

23BME54

**MEDICAL IMAGING SYSTEMS
(For B.E- ECE and BME)**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the generation of X-ray and principle of Computed Tomography and its uses in Medical imaging.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To know the techniques used for visualizing various sections of the body.
- To understand the basic principles of ultrasound imaging techniques.
- To give an overview of principle of Radio therapy techniques and isotopes.

UNIT-I X-RAYS AND COMPUTED TOMOGRAPHY 9

Principle and production of X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Digital Radiography, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, digital subtraction angiography, mammography, dental X- ray units. Computerized Axial Tomography, Principle, Detectors, image reconstruction, Spiral CT, 3D Imaging.

UNIT-II EMISSION IMAGING 9

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analyzers, Isotopic, Scanners, Principle of PET and SPECT, PET/CT.

UNIT-III MAGNETIC RESONANCE IMAGING 9

Principle of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI instrumentation, Magnets, gradient coils, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT-IV ULTRASOUND IMAGING AND THERMOGRAPHY 9

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes- A, B & M, Principles and theory of image generation. Thermography Principle, detectors and applications.

UNIT-V THERAPY USING X – RAYS AND ISOTOPES 9

Direct and Indirect effects of high energy radiation, Units for radiation Exposure, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, ICRP regulation, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, Protection Methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the principle and working of various radiography and tomography concept and image reconstruction techniques.
- CO2:** Know the concept of nuclear imaging techniques and radiation detectors

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BoS / ECE**

- C03:** Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
- C04:** Describe the basic principle involved in Ultrasound Imaging technique and Thermography.
- C05:** Discuss the effects of radiation, radiation safety and the principle of Radio therapy techniques.

TEXT BOOKS:

1. Dey N, Smart Medical Imaging for Diagnosis and Treatment Planning, Hardcover – 1 Chapman and Hall/CRC , 2024.
2. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000

REFERENCE BOOKS:

1. 1.Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ",Springer-Verlag New York, 2011.
3. 3.Medical Devices and Human Engineering (The Biomedical Engineering Handbook, Joseph D. Bronzino, Donald R. Peterson, CRC Press, 2014.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_bt50/preview
2. <https://archive.nptel.ac.in/courses/102/105/102105090/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1
CO2	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1
CO3	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
AVG	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1

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

23BME55	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
	(For B.E- ECE and BME)	3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of Brain Computer Interfacing (BCI).
- To study the various signal acquisition methods.
- To enhance the understanding on BCI signal Processing and parameter extraction.
- To enable the knowledge on classification of cognitive task from BCI parameter.
- To design the brain computer interface system using brain signals.

UNIT-I INTRODUCTION 9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

UNIT-II BRAIN ACTIVATION 9

Brain activation patterns - Spikes, Oscillatory potential and ERD, slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive task.

UNIT-III FEATURE EXTRACTION METHODS 9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence.

UNIT-IV MACHINE LEARNING METHODS FOR BCI 9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.

UNIT-V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the basic concepts of EEG and BCI.
- CO2:** Analyze event related potentials and sensory motor rhythms.
- CO3:** Select appropriate for feature extraction methods.
- CO4:** Allocate functions appropriately to the human and to the machine.
- CO5:** Implement BCI for various applications.

TEXT BOOKS:

1. Benjamin Evans, The Brain-Computer Interface Revolution: Applications, Ethics, and the Future of Humanity, Paperback – Import, 2024.
2. Azar, A. T. (2015). Brain-Computer Interfaces: Current Trends and Applications. Germany:Springer International Publishing.
3. Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, First edition, 2013.

REFERENCE BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces Principles and practice, Oxford University Press, USA, Edition 1, January 2012.
3. Recent Advances in Brain-Computer Interface Systems. (2011). Croatia: InTech.

E-RESOURCES:

1. <https://nptel.ac.in/courses/108108167>
2. https://onlinecourses.nptel.ac.in/noc24_ee01/preview
3. <http://learn.neurotechedu.com/introtobci/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	2	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	2	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	2	-	-	-	-	-	-	-	1	-	-
AVG	3	2	1	1	2	-	-	-	-	-	-	-	1	2	-

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

23BME63

**BODY AREA NETWORKS
(For B.E- ECE and BME)**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about concepts of body area network
- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To learn about Medical Device Regulations
- To know the applications of BAN in the field of medicine

UNIT I BODY AREA NETWORKS 9

BAN and healthcare, Technical challenges, sensor design, Biocompatibility, energy supply, energy scavenging methods, optimal node placement, number of nodes, networks for BAN, System security and reliability, standards. BAN Architecture

UNIT II HARDWARE FOR BAN 9

Processor, Low Power MCUs, mobile computing MCUs, Integrated processor with radio transceiver, memory types and ranges, Antenna types, PCB antenna, wire antenna, ceramic antenna, external antenna, Sensor interface, power sources, batteries and fuel cells for sensor nodes

UNIT III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand -Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Comprehend and appreciate the significance and role of this course in the present Contemporary world.
- CO2:** Design a BAN for appropriate application in medicine.
- CO3:** Assess the efficiency of communication and the security parameters.
- CO4:** Understand the need for medical device regulation and regulations followed in various regions.
- CO5:** Extend the concepts of BAN for medical applications

TEXT BOOKS:

1. Dr. Kumar Keshamoni, Wireless Body Area Networks for Health Care Supervision, String Production, 2024.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability", Cambridge University Press, 2013
3. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCE BOOKS:

1. Dr. Salma Fauzia, Wireless Body Area Networks and IoT A Design Approach, Weser Books, 2021.
2. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013.
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks", Springer, 2006.
4. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

E-RESOURCES:

1. <https://www.tonex.com/training-courses/wireless-body-area-network-training-wban/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
AVG	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1

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

23BME73

HUMAN ASSIST DEVICES
(For B.E- ECE and BME)

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications

UNIT-I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT-II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT-III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT-IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT-V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL: 45 PERIODS

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

- CO1:** Explain the principles and construction of artificial heart
- CO2:** Understand various mechanical techniques that improve therapeutic technology
- CO3:** Explain the functioning of the membrane or filter that cleanses the blood.
- CO4:** Describe the tests to assess the hearing loss and development of wearable devices for the same.
- CO5:** Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

TEXT BOOKS:

1. Mr. K. Gopal Ram, Mrs. D.K. Kalaivani, Mr. G. Pratheep, Dr. M. Sivaprakash, "Human Assist Devices", San International Scientific Publication, 2024.
2. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2008.
3. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2014

REFERENCE BOOKS:

1. Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 2014.
2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Fourth Edition: Three Volume Set, CRC Press, 2018

E-RESOURCES:

1. <https://www.youtube.com/watch?v=MyW6Hpekffio>
2. <https://archive.nptel.ac.in/courses/112/106/112106248/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
AVG	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-

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

23BME58

**BIO INSPIRED COMPUTING
(FOR B.E-ECE AND BME)**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn adequate knowledge on genetic algorithm.
- To know the steps involve in Ant Colony optimization
- To acquire sound knowledge on particle swarm optimization algorithm
- To be well versed with the concepts of multi-objective optimization method.
- To enlighten about hybrid optimization in the Neural Network Models.

UNIT-I EVOLUTIONARY COMPUTATION & GENETIC ALGORITHM 9

Evolutionary Computation (EC), Features of EC, Genetic Algorithms, Crossover and Mutation Operators, Selection Mechanism – Fitness Proportionate- Ranking and Tournament selection- Building Block – Hypothesis and Schema Theorem- Application

UNIT-II ANT COLONY OPTIMIZATION 9

Ant Colony Optimization - From real to artificial ants, ACO Algorithm, ACO and model based search, ACO Pheromone Updation and Evaporation, Applications

UNIT-III PARTICLE SWARM OPTIMIZATION 9

Particle Swarm Optimization-Anatomy of a Particle, Velocity and Position Updation, PSO topologies, Control Parameters, Application.

UNIT-IV MULTI-OBJECTIVE OPTIMIZATION 9

Multi-Objective Optimization- Ranking and Diversity, Classical Multi-Objective Optimization Methods, Non-Dominated Genetic Algorithm, Strength Pareto Evolutionary algorithm, Performance assessment of Multi-Objective EC Techniques

UNIT-V RECENT ADVANCES IN SWARM INTELLIGENCE TECHNIQUES 9

Grey-Wolf Optimization- Crow Search Optimization, Salp Swarm Algorithm, Case Studies on Hybrid Optimization Methods for Neural Networks Evolution for real-world application..

THEORY : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Implement and apply genetic algorithms.
- CO2:** Build and apply ANT colony optimization technique
- CO3:** Implement and apply particle swarm optimization algorithm.
- CO4:** Implement and apply multi-objective optimization method.
- CO5:** Apply hybrid optimization in the Neural Network Models for real-world applications.

TEXT BOOKS:

1. David E.Goldberg, "Genetic Algorithms in search, Optimization & Machine Learning", Pearson Education,2020.

2. Xin Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland, 2019.
3. Kenneth A De Jong, "Evolutionary Computation A Unified Approach", Prentice Hall of India, New Delhi, 2006

REFERENCE BOOKS:

1. Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, New Delhi, 2004
2. N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2019
3. Engelbrecht, A.P., "Fundamentals of Computational Swarm Intelligence", Wiley, 2020.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs54/preview
2. <http://www.digimat.in/nptel/courses/video/102101068/L19.html>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	-	-	1	-	1	-	-	1	2	-
CO2	3	3	2	3	1	-	-	1	-	1	-	-	1	2	-
CO3	3	3	2	3	1	-	-	1	-	1	-	-	1	-	-
CO4	3	3	2	3	1	-	-	1	-	1	-	-	1	-	-
CO5	3	3	2	3	1	-	-	1	-	1	-	-	1	-	-
AVG	3	2.8	3	3	1	-	-	1	-	1	-	-	1	2	-

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

23BME47

ARTIFICIAL INTELLIGENCE IN HEALTHCARE
(For B.E- ECE and BME)

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the Artificial intelligence and medical visualization and healthcare applications.
- To understand the concept of artificial Intelligence to diagnose and predict cancer.
- To understand the concept of medical imaging applications.
- To apply the concepts of Artificial Intelligence assisted surgery.
- To know the concept of Artificial Intelligence algorithms

UNIT-I INTRODUCTION

9

Artificial intelligence and medical visualization, Intelligent personal health records, Robotics and artificial intelligence-powered devices , Ambient assisted living, Review of state of Artificial Intelligence in Healthcare.

UNIT-II DISEASE DIAGNOSTICS AND TREATMENT DECISIONS USING ARTIFICIAL INTELLIGENCE

9

Machine Learning and Deep learning for disease diagnosis and staging, Artificial intelligence to predict cancer treatment response and cancer recurrence and survival, Alzheimer disease detection, Neuro developmental disorders, Case studies.

UNIT-III ARTIFICIAL INTELLIGENCE FOR MEDICAL IMAGING

9

Artificial Intelligence in Radiology, Data Augmentation, Transfer Learning, Clinical findings in Radiological Images using Deep learning- artificial intelligence in Ultrasound imaging and visualization of Arteries.

UNIT-IV ARTIFICIAL INTELLIGENCE ASSISTED SURGERY

9

Artificial Intelligence in Preoperative diagnosis, Preoperative staging, Intraoperative, Autonomous surgery, Computer vision, and Detection of post-operative complications, Case studies.

UNIT-V REMOTE PATIENT MONITORING USING ARTIFICIAL INTELLIGENCE

9

Remote Patient Monitoring, Sensors, Smart phones, Apps and Devices, Natural language processing, Virtual reality, Augmented reality and voice powered virtual assistants, Monitoring of Dementia and Migraine, Cardiac monitoring, Diabetes prediction and monitoring.

TOTAL: 45 PERIODS

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

- CO1:** Understand the potential of Artificial Intelligence in Healthcare application.
- CO2:** Apply Artificial Intelligence to diagnose and predict cancer treatment response.
- CO3:** Apply Artificial Intelligence for medical imaging applications.
- CO4:** Understand the concepts of Artificial Intelligence assisted surgery.
- CO5:** Develop Artificial Intelligence algorithms for remote patient monitoring.

TEXT BOOKS:

1. Tianhua Chen, Jenny Carter, Mufti Mahmud, Arjab Singh Khuman, "Artificial Intelligence in Healthcare Recent Applications and Developments", Springer, 2022
2. Adam Bohr, Kaveh Memarzadeh, "Artificial Intelligence in Healthcare", Elsevier, 2020.
3. Bernard Nordlinger, Cedric Villani, Daniela Rus, "Healthcare and Artificial Intelligence", Springer, 2020.

REFERENCE BOOKS

1. Kayvan Najarian, Delaram Kahrobaei, Enrique Dominguez, Reza Soroushmehr, "Artificial Intelligence in Healthcare and Medicine", CRC Press, 2022.
2. Chee Peng Lim, Ashlesh Vaidya, Kiran Jain, Virag U, Mahrokar, Lakhmi C Jain, "Handbook of Artificial Intelligence in Healthcare Vol 1- Advances and Applications, Springer, 2022

E-RESOURCES:

1. <https://www.youtube.com/watch?v=YX-23mwk05E>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3
CO2	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3
CO3	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3
CO4	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3
CO5	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3
AVG	3	2	1	1	1	-	-	-	-	3	-	-	1	1	3

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

23ECE51

UNDERWATER INSTRUMENTATION SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn basics of underwater vehicle control system
- To know the basic sensors and transducers used in underwater vehicles
- To learn the types of communication systems
- To learn different types of underwater vehicles and their applications.
- To learn about subsea battery and power management system

UNIT-I INTRODUCTION ON DATA ACQUISITION AND CONTROL SYSTEM 9

Introduction on PLC & various Input / Output modules, SCADA and HMI, Real time Controller, Signal conditioning circuits and associated components: Ethernet Modem, SMPS, Media converters, Ethernet switches, Fuses & Fuse holders, Power supply units, Power management system, Pressure Compensator, Pressure compensated batteries, Valve amplifiers, Actuators, Types of valves- proportional valves and solenoid valves, Types of relays- Solid State Relay and Electromagnetic relay, Pressure casing for underwater DACS.

UNIT-II UNDERWATER SENSORS AND TRANSDUCERS 9

Navigation and Auxiliary sensors and Transducers: Inertial Navigation System, FOG/RLG, GPS, DGPS, Gyroscope, Motion Reference Unit, Doppler Velocity Log, Acoustic Transponder, Beacon, Positioning System- LBL, SBL, SSBL & Sensors. Scientific Instruments: Acoustic Doppler Current Profiler, Echo sounder, Hydrophones, SONAR, Altimeter, Swell and wave sensor, PH sensor, Turbidity sensor, Oxygen sensor, Water samplers, Nitrogen sensor, CTD

UNIT-III TELEMETRY SYSTEM 9

Telemetry system for tethered vehicles, Fiber optic communication, Single mode fiber, Multimode fiber, Fiber optics in oceanographic applications, Basis of optical fiber transmission, Fiber losses and signal attenuation, Slip rings, Umbilical cables, Underwater cables and connectors, Field installable Termination Assembly Acoustic communication: Acoustic wave propagation, Optical communication, Satellite communication- Iridium, Inmarsat, Argos for surface Tracking.

UNIT-IV TYPES OF UNDERWATER VEHICLES 9

Type of vehicles, manned and unmanned vehicles, Tethered and untethered vehicles, Remotely Operable Vehicle (ROV), Autonomous Underwater vehicle (AUV), Gliders, Solar powered Gliders, Manned submersible, Submarines, Deep Sea Rescue vehicle (DSRV), Various Propulsion systems.

UNIT-V CASE STUDY 9

Design of low power DAC system for portable instrument - Design of power module for autonomous system - Design consideration on wireless sensor network and its important - MEMS systems used in underwater systems and its merits and demerits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Design of DAC system for various underwater Applications.
- CO2:** Knowledge about sensors used underwater and their working principle.
- CO3:** Underwater communication system and their application.
- CO4:** Knowledge about different types of underwater vehicles.
- CO5:** Subsea battery and Battery Management System.

TEXT BOOKS:

1. Mahbub Rashid, "Instrumentation in Underwater, Sixth Edition, Springer, 2022

REFERENCE BOOKS:

1. The Ocean engineering Handbook, Ferial El- Hawary
2. Instrumentation and metrology in Oceanography by Marc Le mann
3. Fundamentals of Marine Vehicle Control, Karl Von Ellenrieder
4. Handbook of ocean and underwater engineering, Myers, J J; Holm, C H; McAllister, R F
5. Underwater communication and Network, Yi Lou, Niaz Ahmed

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	-	-	-	-	-	3	2	3	2
CO2	3	2	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	2	3	2	-	-	-	-	-	3	2	3	2
CO4	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO5	3	3	2	2	2	2	-	-	-	-	-	3	2	2	2
AVG	3	3	3	2	3	3	-	-	-	-	-	2	3	3	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE52

UNDERWATER IMAGING SYSTEMS

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To learn the fundamental components of optical imaging
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of image processing techniques
- To Learn the SONAR Systems and various applications

UNIT-I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM 6

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera: Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle. Image File format: JPEG, PNG, TIFF, BMP, GIF.

UNIT-II OPTICAL IMAGE PROCESSING 6

Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition. Challenges involved in underwater optical imaging.

UNIT-III FUNDAMENTALS OF UNDERWATER ACOUSTICS 6

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems

UNIT-IV SONAR SIGNAL PROCESSING 6

Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signals- Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion

UNIT-V DIFFERENT TYPES OF SONAR SYSTEMS 6

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Generation of discrete time signals and finding its frequency components.
2. Generation of Chirp signals and understanding its time-frequency characteristics.
3. Delaying and summing of signals in time and frequency domain for narrow band signals.
4. Delaying and summing of signals in time and frequency domain for wide band Signals.
5. Matched filtering.

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the techniques for underwater imaging.
CO2: Understand the fundamentals of underwater acoustics and ambient noise
CO3: Exposer for array processing techniques for underwater imaging applications
CO4: Design of Filter and impedance matching circuits
CO5: Know about SONAR system and its applications.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing, 2020
2. Xavier Lurton, "An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer,2010

REFERENCE BOOKS:

1. I.Tinku & Ajoy K. Ray, "Image Processing principles & Applications", First Edition, Wiley-Interscience,2005
2. P.K. Thiruvikraman,"A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing, 2020
3. Don H. Johnson and Dan E. Dudgeon, "Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	-	-	-	-	-	1	2	2	1
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE53

UNDERWATER COMMUNICATION

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To learn about fiber optic communication for underwater application
- To learn underwater MI communication and sensor networking
- To understand underwater acoustic communication
- To understand the challenges in underwater communication
- To learn underwater cables and handling system for various application

UNIT-I UNDERWATER FIBRE OPTICS COMMUNICATION

6

Basics of Fibre Optics communication: Working Principle, Single Mode, Multi-Mode, Effect on Fibre bending, Standard FO Connectors, Cable Requirement for Underwater Application, Cable Characteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E-O cables, Optical slip ring and its application, An insight into Fibre Optic Telemetry.

UNIT-II UNDERWATER OPTICAL COMMUNICATION

6

Introduction, Classification of Underwater Wireless Optical Communication Links, Underwater Optical Communication (UWOC) System: Modulation, Coding, Light Source Technology, Common Lasers in UWOC, Signal Detectors and its merits and demerits, Alignment and Compensation, UWC Network, Absorption and Scattering Losses, UWOC Channel Modeling, UWOC Link Turbulence, Noise in the UWOC Channel. UWOC Networks.

UNIT-III UNDERWATER MI COMMUNICATION & SENSOR NETWORKS

6

Fundamental Principles of Magnetic Induction, Basic Element of Magnetism, Magnetic Induction, Lenz's Law, Mutual and Self Induction, Inductive and Capacitive Reactance of the coil, MI Communication System: MI Coil, Matching Network, Communication Block: MI Wireless Sensor Networks: UW sensor network Application and Its Architecture, Localization, Medium Access protocols, Routing Protocols, Cross-layer Protocols, Recent trend on MI communication.

UNIT-IV BASIC PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION

6

Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC System: Basic Structure of UWAC System, Performance Indicators of UWAC System, Characteristics of the UWA Channel.

UNIT-V UNDERWATER ACOUSTIC NETWORK TECHNOLOGY

6

Basics on Underwater Acoustic Modem and its construction, Bandwidth and its limitations, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Comparison study on RF, Optical and Acoustic Communication in Underwater. Underwater telephone, Acoustic Positioning System, Underwater beacon.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Conducting an experiment for testing of optical communication in water tank with clear and turbid water.
2. Measure the insertion loss of different FO connectors, bending loose using optical power meter.
3. Testing of MI communication and Sensor network.
4. Testing of hydrophone and acoustic communication with different operating frequency.
5. Design a MI coil and testing it for Inductive communication

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** To get an explore to different underwater communication system
CO2: Students will be able to classify different types of underwater optical communication links and understand their specific applications and constraints.
CO3: To know the important of underwater communication and its challenges
CO4: To understand the strength of Underwater acoustic communication
CO5: To understand the sensor network concepts and its application

TEXT BOOKS:

1. Yi Lou, Niaz Ahmed, Underwater Communications and Networks, First Edition, Springer,2021.

REFERENCE BOOKS:

1. Ferial El-Hawary, The Ocean Engineering Hand book, First Edition, CRC Press, 2001
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition, Springer,2003
3. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing,2013
4. Rahul Sharma, Deep Sea Mining Handbook, First Edition, Springer,2017

E-RESOURCES:

1. <https://archive.nptel.ac.in>.
2. <https://ieeaccess.ieee.org/closed-special-sections/underwater-wireless-communications-networking/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	3	3	3	3	2	3	2	-	-	-	-	1	3	3	3
CO4	3	2	3	1	3	3	2	-	-	-	-	1	2	3	2
CO5	2	2	2	3	3	3	2	-	-	-	-	1	2	2	2
AVG	2	2	2	2	2	3	2	-	-	-	-	1	2	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE54

UNDERWATER WIRELESS SENSOR NETWORKS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To learn about of Underwater Wireless Sensor Networks (UWSNs)
- To learn about underwater communication techniques
- To learn routing protocols and sensor networking
- To understand the challenges in underwater communication
- To learn underwater cables and handing system for various application

UNIT-I INTRODUCTION TO UNDERWATER WIRELESS SENSOR NETWORKS 6

Introduction to fundamentals of UWSNs, applications. challenges faced in underwater communication, long propagation delays, limited bandwidth, high error rates, and energy constraints. The architecture of UWSN, Autonomous Underwater Vehicles (AUVs), layered network architecture.

UNIT-II UNDERWATER COMMUNICATION TECHNIQUES 6

Acoustic communication, Challenges of acoustic modems, limited bandwidth and high propagation delay, optical and electromagnetic communication, Different communication techniques.

UNIT-III ROUTING PROTOCOLS IN UWSNS 6

Routing protocols, including proactive (table-driven), reactive (on-demand), and geographic routing strategies, energy-efficient routing protocols, Delay-Tolerant Networking (DTN).

UNIT-IV ENERGY EFFICIENCY AND RESOURCE MANAGEMENT 6

Energy-efficient Medium Access Control (MAC) protocols sleep scheduling, and duty cycling, emerging energy harvesting methods that leverage solar, wave, and thermal energy. Furthermore, node localization techniques and time synchronization challenges in USN.

UNIT-V APPLICATIONS 6

Applications of UWSNs, oil and gas exploration, underwater surveillance, and disaster prevention. Security concerns in underwater networks, secure communication protocols.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Simulation of Underwater Acoustic Communication
2. Energy-Efficient Routing Protocol Implementation
3. Implement time synchronization protocols in an USN.
4. To simulate a virtual underwater wireless sensor network using NS-2/NS-3.
5. To combine data from multiple sensors in UWSNs using a data fusion algorithms.

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

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Chairman
BoS / ECE

COURSE OUTCOMES:

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

- CO1:** To get an explore to different underwater communication system
- CO2:** To know the important of underwater communication and its challenges
- CO3:** Design and Implement Routing Protocols
- CO4:** To understand the energy constraints and optimize network performance
- CO5:** To understand the sensor network concepts and its application

TEXT BOOKS:

1. Yi Lou, Niaz Ahmed, Underwater Communications and Networks, First Edition, Springer,2021.
2. KazemSohraby, Daniel Minoli, & TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.

REFERENCE BOOKS:

1. Ferial El-Hawary, The Ocean Engineering Hand book, First Edition, CRC Press, 2001
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition, Springer,2003
3. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing,2013

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CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	3	3	3	3	2	3	2	-	-	-	-	1	3	3	3
CO4	3	2	3	1	3	3	2	-	-	-	-	1	2	2	3
CO5	2	2	2	3	3	3	2	-	-	-	-	1	3	2	2
AVG	2	2	2	2	2	3	2	-	-	-	-	1	3	2	3

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE55

UNDERWATER NAVIGATION SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about basic of underwater communication
- To understand the relationship between autonomy, sensing, navigation and control on an un-manned marine subsea vehicle.
- To understand about various types of navigational equipment & sensors
- To understand the basic communication methods and signal losses, attenuation.
- To understand the types of Acoustic transponders, Beacon and Responder

UNIT- I BASICS OF UNDERWATER COMMUNICATION

9

Introduction to underwater acoustics, Understanding Thermoclines in Ocean Waters, subsea communication sensors, Instruments and applications, Sound propagation in the ocean – Sound Velocity Profiles (SVP) in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell's law, target strength; Laser communication and limitations.

UNIT- II UNDERWATER NAVIGATION & ITS AIDING SENSOR AND DEVICES

9

Different types of navigational sensors, Accelerometers, Fiber Optic Gyroscopes (FOGs), Ring Laser Gyroscope (RLG) types and Working principles, and their applications, Doppler Velocity Log, Error sources in subsea navigation, Calibration overview for subsea navigation. Attitude Heading and Reference Systems (AHRS) & IMU.

UNIT- III ACOUSTIC POSITIONING SYSTEMS

9

Subsea navigation possible solutions, Vehicle positioning, Acoustic Positioning systems, Short Base Line (SBL), Super Short Base Line (SSBL), Long Base line (LBL) Configurations and Positioning overview.

UNIT- IV SUBSEA VEHICLE NAVIGATION

9

Subsea navigation, Basics of underwater navigation, Types of underwater Navigations, Aided navigational systems, Inertial Navigational systems, role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF) and Invariant extended Kalman filters for navigation.

UNIT- V CASE STUDY

9

Tethered vehicle deployment guidelines and preparedness - AUV /ROV based search operation requirements and planning, Tethered crawling vehicle sensors, data acquisition and maneuvering, Acoustic positioning system transponder deployment and recovery, Aided and unaided navigation system study,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** To know about the Underwater Navigation System
- CO2:** To know about the INS and its aiding sensor
- CO3:** To know about the challenges involved in underwater navigation
- CO4:** To study about how navigation system is integrated with manned and unmanned underwater vehicles
- CO5:** To know about underwater positioning system

TEXT BOOKS:

1. Underwater Acoustic Positioning Systems by Robert D. Christ, Robert L. WernliSr., in the ROV Manual (Second Edition), 2014.
2. Fundamentals of ocean acoustics by L.M.Brekhovskikh and Yu. P. Lysanov, 1982.

REFERENCE BOOKS:

1. Electronic and Acoustic Navigation systems for Maritime Studies by Norvald Kjerstad NTNU Norwegian University of Science and Technology, 2016.
2. Guidance & Control of Ocean Vehicles by TT Fossen, 1994.
3. Underwater Acoustic Positioning Systems by P. H. Milne, Gulf Publishing Company, 1983.

E-RESOURCES:

1. <https://archive.nptel.ac.in>.

CO's – PO's & PSO's MAPPING

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CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE56

OCEAN ACOUSTICS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To enable the student to understand the importance of ocean acoustics for marine applications.
- To understand the physics of sound propagation and the factors affecting sound signal in the ocean
- To study the types and characteristics of acoustic transducers and arrays
- To understand the sources of ambient noise present in the sea and impacts of sound on marine diversity
- To expose the student in the basics of underwater acoustic signal processing and image processing

UNIT-I FUNDAMENTALS OF UNDERWATER ACOUSTICS

6

Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell's law, target strength; SONAR systems- active, passive SONAR equations and system parameters.

UNIT-II UNDERWATER ACOUSTIC TRANSDUCERS AND DEVICES

6

Principles of transduction and SONAR transducer design; Electromechanical Analog circuits, coupling coefficient, efficiency, Directivity characteristics of receivers, frequency response characteristics of transducers, Transducer measurement techniques; Physical geometry of arrays - linear, planar, cylindrical, spherical, beam patterns, array gain.

UNIT-III AMBIENT NOISE IN THE OCEAN

6

Sources of noise, Natural and Physical sounds - Seismic, Wind, Wave, Rain and Turbulence; Biological sounds - Dolphin, Whales, Fishes; Man made Noises- Shipping Machinery noises, Pile driving, Wind Mills; Variability of Ambient noises; Frequency Bands, Noise levels of all above; Impacts of Sound on Marine Animals.

UNIT-IV PROCESSING OF UNDERWATER ACOUSTIC SIGNALS AND IMAGES

6

Representations of the signals – Fourier representations, Spatial filtering; Matched filters and Autocorrelations, Temporal resolution; Signal to Noise Ratio, Estimation of Auto Covariance, Cross Covariance; Power spectra of different Underwater Signals, Classification of signals; Concept and Types of beamforming techniques; Image segmentation, Filtering, Equalization and Restoration.

UNIT-V UNDERWATER ACOUSTIC INSTRUMENTS AND ITS APPLICATION

6

Principles of Sonar systems, Echosounder – single beam, multi beam; Side scan sonars – Imaging, Underwater acoustic camera; Sub bottom profilers –Sediment classification; Acoustic modem – Tsunami systems; Acoustic Positioning system - Transponders, USBL, SSBL systems, HiPAP; Underwater telephone; Underwater noise recorders; Underwater Beacons.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

Applying sonar equations in the design of ocean instruments

1. Simulation of transmission loss in the ocean
2. Frequency Analysis of underwater ambient noise data
3. Comparison of sound velocity gradients for different ocean depths
4. Acoustic characterization of ship machinery noises
5. Acoustic characterization of whale / any marine animal sound
6. Underwater image enhancement - filtering
7. Underwater image enhancement - color enhancement

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the basics of underwater sound and its propagation in ocean
- CO2:** To simulate / design any underwater SONAR systems for ocean application
- CO3:** To identify different kinds of noises present in the ocean and its impacts on the marine biodiversity
- CO4:** Ability to get exposure in analyzing and applying suitable techniques for underwater acoustic signals and images
- CO5:** To recognize different types of SONAR systems used practically

TEXT BOOKS:

1. Robert J Urick,—Principles of underwater sound, Third Edition, Peninsula Publishing,2013
2. Herman Medwin and Clarence S. Clay, —Fundamental of acoustical oceanography, First Edition, Academic Press,1998.

REFERENCE BOOKS:

1. L.M. Brekhovskikh and Yu. P. Lysanov,—Fundamentals of ocean acoustics, Third Edition, Springer,2003
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, —Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020.

E-RESOURCES:

1. <https://archive.nptel.ac.in>.

CO's - PO's & PSO's MAPPING

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CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	1	2	2
CO4	3	3	3	2	3	2	-	-	-	-	-	2	2	3	3
CO5	3	3	3	3	3	2	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE57

UNDERWATER SIGNAL PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Classification of sonar systems and modern versions.
- Signal processing, filtering and noise impact on sonar systems.
- To learn about the OFDM modulation techniques.
- To learn about the acoustic modem.
- To learn underwater cables and handing system for various application

UNIT-I

TYPES OF SONAR SYSTEMS

9

Active and passive - sonar equations - propagation characteristics of the medium - transmission loss and spreading effects - beam forming and steering - detection threshold - square law detector - cross-correlation detector.

UNIT-II

CORRELATION RECEIVERS AND MATCHED FILTERS

9

Advanced Sonar Signal Processing functions - adaptive beam forming - synthetic aperture arrays - automated decision making.

UNIT-III

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

9

Key features, characteristics and principle of operation of OFDM, Channel coding and interleaving System model, Enhancement of spectral efficiencies, Transmission/ Reception of OFDM - OFDM Simulations.

UNIT-IV

ACOUSTIC MODEM

9

Underwater Wireless Modem- Sweep spread carrier signal-transmission characteristics in shallow water channel-separation of time varying multipath arrivals-Typical acoustics modems-characteristics and specifications- Applications, Acoustic Releases-Real time wireless current monitoring system.

UNIT-V

UNDERWATER SENSOR NETWORK

9

Underwater Networking- Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in design of Underwater Sensor Networks, Factors that affect the UWSN- Sensor Node Architecture- GIBS, VRAP, DABSRAPT. etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the techniques for sonar system.
- CO2:** Design and implement adaptive beamforming algorithms to optimize sonar array performance under dynamic environmental conditions.
- CO3:** Apply channel coding and interleaving to enhance the reliability and robustness of OFDM-based systems.
- CO4:** Analyze the effectiveness of different acoustic modem specifications and their suitability for specific underwater applications.
- CO5:** Design and develop underwater sensor networks for diverse applications.

TEXT BOOKS:

1. Yi Lou, Niaz Ahmed, Underwater Communications and Networks, First Edition, Springer, 2021

REFERENCE BOOKS:

1. SONAR for Practicing Engineers, A.D. Waite John, Wiley & Sons, Ltd., (1998).
2. Andreas Antoniou, "Digital Filters, Analysis, Design & Applications", Tata McGraw-Hill, 1999.
3. 'Underwater Acoustics Sensor Network: Research Challenges: Ian F Akyildiz et al, Elsevier, 3 (2005), pp 257-279.
4. 'Data Collection, Storage and Retrieval with an Underwater Sensor Network, Vasilescu, et al, Sensys' 05, Nov. 2-4, 2005, San Diego, CA.

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	3	3	3	3	2	3	2	-	-	-	-	1	3	3	3
CO4	3	2	3	1	3	3	2	-	-	-	-	1	3	3	3
CO5	2	2	2	3	3	3	2	-	-	-	-	1	3	3	3
AVG	2	2	2	2	2	3	2	-	-	-	-	1	3	3	3

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

23ECE58

UNDERWATER ACOUSTIC COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about the basic of underwater acoustic communication
- Basics, Challenges and Issues in underwater acoustic propagation
- Different communication channels related to sea
- Architecture and the modeling of WSN scenario for underwater communication
- Applications and designing of underwater wireless models

UNIT-I

INTRODUCTION TO ACOUSTIC COMMUNICATION

9

Overview – Peculiarities of underwater acoustic communication channels relative to radio communication channels – Explorations establishing an innovative digital underwater acoustic communication signal processing system – Communication sonar equation.

UNIT-II

ACOUSTIC PROPERTIES AND ELEMENTS

9

Acoustic waves in water – The wave equation in various coordinate systems – radiation of a spherical source – Reciprocity – Oceanographic and physical properties – Reflection and transmission in multi-layered media – Ray acoustics and ray tracing – Normal modes – Acoustic transducers and antennas – Hydro acoustics.

UNIT-III

UNDERWATER ACOUSTIC COMMUNICATION CHANNELS

9

Theoretical methods of underwater acoustic fields – Sound transmission loss in the sea – Multipath effects in underwater acoustic communication channels– Fluctuation of transmitted sound in underwater acoustic communication channels – Noise in the sea.

UNIT-IV

UNDERWATER WIRELESS SENSOR NETWORKS

9

Architecture – Propagation phenomena of underwater sensor network – Issues and challenges – Radio communication model for underwater WSN. Case Study: Optimal Node Placement in underwater WSN.

UNIT-V

DESIGN AND APPLICATIONS

9

ROV: Modeling, Design and Control – AUV: Design Essentials and Concepts – Modeling and control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Explain the basic properties of underwater acoustic channels and signal processing systems
- CO2:** Discuss the acoustic properties and its respective elements with respect to wave equation and ray acoustics.
- CO3:** Describe the relationship between different communication channels in relation to the sea.
- CO4:** Demonstrate the solutions for the challenges in building underwater WSN.
- CO5:** Design and model the different underwater communication scenarios.

TEXT BOOKS:

1. Lufen Xu and Tianzeng Xu, "Digital Underwater Acoustic Communications", Academic Press, 2016.
2. Jens M Hovem, "Marine acoustics: The physics of sound in underwater environments", Los Altos Hills: Peninsula publishing, 2012.

REFERENCE BOOKS:

1. 'K. M. Awan, P. A. Shah, K. Iqbal, S. Gillani, W. Ahmad, and Y. Nam, "Underwater Wireless Sensor Networks: A Review of Recent Issues and Challenges", WCMC, 2019.
2. Emad Felemban, Faisal Karim Shaikh, Umair Mujtaba Qureshi, Adil A. Sheikh, and Saad Bin Qaisar, "Underwater Sensor Network Applications: A Comprehensive Survey", IJDSN, Vol.11, 2015.

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	3	3	2	1	1	2	2	2	1	2
CO2	3	2	1	2	2	2	3	2	-	3	2	3	3	2	2
CO3	3	-	-	2	1	2	2	1	2	3	2	2	1	2	2
CO4	2	3	3	3	2	3	2	1	2	3	2	2	2	3	1
CO5	3	-	3	1	3	1	3	2	3	1	3	3	2	2	2
AVG	3	2	2	2	2	2	3	2	2	2	2	2	2	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE61

ADVANCED DRIVER ASSISTANCE SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce Autonomous and Intelligent Vehicle Technology
- To elaborate ADAS system architecture and features
- To recognize the electronically controlled system used in driving mechanics
- To understand the basics of control system used in automobiles
- To illustrate the need of automated transport systems

UNIT-I INTRODUCTION

9

Introduction to ADAS, General Block Diagram, Role of ADAS in Autonomous vehicle, Integration of ADAS Technology into Vehicle Electronics, Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation, Intelligent Vehicles. Prototype, Test, Evaluate and Validate ADAS : Generic dynamic and distributed architecture, Environment and climatic conditions , Modeling of perception sensors: Optical Sensor, RADAR, LIDAR, GNSS.

UNIT-II DRIVELINE CONTROL SYSTEM

9

AI for ADAS: The construction of the intelligent vehicle's basic building blocks employing AI methods, Vision sensors, Vision algorithms, Automated Guided Autonomous Car Using Deep Learning and Computer Vision, Deep Learning for Obstacle Avoidance in Autonomous Driving, Functional Calibration, Calibration of ADAS and Automated Driving Features, Calibration Environment for Automated Driving Vehicles, Calibration over Diagnostics Interface.

UNIT-III SAFETY AND SECURITY SYSTEM

9

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system, Safety Systems in ADAS , Blind Spot Detection, Parking Assistance System, Intelligent Head Light Control, Occupant Protection System, Pedestrian Protection System, Evasive Steering Support.

UNIT-IV COMFORT SYSTEM

9

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

UNIT-V INTELLIGENT TRANSPORTATION SYSTEM

9

Traffic routing system - Automated highway systems - Lane warning system - Driver Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems - vision enhancement system - In-Vehicle Computing -Vehicle Diagnostics system - Hybrid / Electric and Future Cars - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the importance of ADAS in Autonomous and intelligent vehicle
- CO2:** Recognize the electronically controlled system used in driving mechanics.
- CO3:** Develop models for safety system in autonomous vehicles.
- CO4:** Identify the control system used in hybrid and electrical vehicles.
- CO5:** Illustrate the need of automated transport systems.

TEXT BOOKS :

1. Steve Zack , Kurt Shadbolt , Scott Brown, Advanced Driver Assistance Systems (ADAS), 1st Edition, Goodheart-Willcox, 2023.
2. Plato Pathrose - ADAS and Automated Driving_ A Practical Approach to Verification and Validation-SAE International 2022.
3. Abdelaziz Bensrhair (editor), Thierry Bapin (editor) - From AI to Autonomous and Connected Vehicles Advanced Driver-Assistance Systems (ADAS)-Wiley-ISTE (2021)

REFERENCE BOOKS:

1. Robert Bosch GmbH, Automotive Handbook, 11th Edition, Wiley, 2022.
2. Yan Li, Hualiang Shi - Advanced Driver Assistance Systems and Autonomous Vehicles_ From Fundamentals to Applications-Springer 2022.
3. Harald Waschl, Ilya Kolmanovsky , Frank Willems, Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions: Development, Testing and Verification, 1st Edition, Springer, 2019.

E-RESOURCES:

1. <https://www.udemy.com/course/advanced-driver-assistance-systems/>
2. <https://www.ti.com/applications/automotive/adas/overview.html>
3. <https://www.synopsys.com/glossary/what-is-adas.html>
4. <https://www.valeo.com/en/assistance-systems/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	-	-	-	-	-	2	3	3	3
CO3	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	2	2	2	1	-	-	-	-	-	3	3	2	2
AVG	3	3	2.6	2.4	2	1.8	-	-	-	-	-	2.4	2.6	2.4	2.4

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

23ECE62

IoT BASED SYSTEMS DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.

UNIT-I INTRODUCTION TO INTERNET OF THINGS 9

Rise of the machines , Evolution of IoT , Web 3.0 view of IoT , Definition and characteristics of IoT , IoT Enabling Technologies , IoT Architecture , Fog, Edge and Cloud in IoT , Functional blocks of an IoT ecosystem , Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT-II MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview , Horizontal Architecture Approach for IoT Systems , SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M ,Interoperability challenges of IoT, Protocols for RFID,WSN,SCADA,M2M, Zigbee, KNX, BACNet, MODBUS , Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems.

UNIT-III COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, and LoRaWAN , Network Layer: IP versions, Constrained Nodes and Constrained Networks , Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT.

UNIT-IV IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT-V APPLICATIONS AND CASE STUDIES 9

Home automations, Smart cities, Environment, Energy, Agriculture, Industry, Health and life style, Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Articulate the main concepts, key technologies, strength and limitations of IoT.
- CO2:** Identify the architecture, infrastructure models of IoT.
- CO3:** Analyze the networking and how the sensors are communicated in IoT.
- CO4:** Analyze and design different models for IoT implementation.
- CO5:** Identify and design the new models for market strategic interaction.

TEXT BOOKS :

1. Alice James , Avishkar Seth , Subhas Chandra Mukhopadhyay , Smart Sensors, Measurement and Instrumentation, 1st Edition Springer Nature Switzerland AG 2022.
2. Rolando Herrero, Fundamentals of IoT Communication Technologies, 1st Edition Springer 2022.
3. Milan Milenkovic , Internet of Things: Concepts and System Design, 1st Edition Springer 2020.

REFERENCE BOOKS:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. David Hanes , Gonzalo Salgueiro , Patrick Grossetete , Robert Barton , Jerome Henry , IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition Cisco Press 2017.
3. Gary Smart, Practical Python Programming for IoT: Build advanced IoT projects using a Raspberry Pi 4, MQTT, RESTful APIs, WebSockets, and Python 3, 1st Edition Packt Publishing 2020.

E-RESOURCES:

1. <https://www.coursera.org/courses?query=understanding%20iot%20technologies>
2. <https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT>
3. <https://www.techtarget.com/iotagenda/definition/IoT-gateway>
4. <https://www.coursera.org/courses?query=fundamental%20iot%20concepts>

CO's - PO's & PSO's MAPPING

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	-	-	-	-	2	3	3	3	3
CO 2	3	3	2	2	1	-	-	-	-	-	1	2	3	3	3
CO 3	3	3	3	2	1	2	-	-	-	-	3	2	3	2	3
CO 4	3	3	2	2	3	-	-	-	-	-	-	1	3	3	2
CO 5	3	2	3	3	2	1	-	-	-	-	2	1	3	2	2
AVG	3	2.8	2.4	2.2	1.6	2	-	-	-	-	2	1.8	3	2.6	2.6

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

23ECE63

ADHOC AND WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

UNIT-I ADHOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS 9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols.

UNIT-II SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture.

UNIT-III WSN NETWORKING CONCEPTS AND PROTOCOLS 9

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols - LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT-IV SENSOR NETWORK SECURITY 9

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS.

UNIT-V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Know the basics of Ad hoc networks and Wireless Sensor Networks
- CO2:** Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
- CO3:** Apply the knowledge to identify appropriate physical and MAC layer protocols
- CO4:** Understand the transport layer and security issues possible in Ad hoc and sensor networks.
- CO5:** Be familiar with the OS used in Wireless Sensor Networks and build basic modules

TEXT BOOKS :

1. Jingjing Wang , Chunxiao Jiang , Flying Ad Hoc Networks: Cooperative Networking and Resource Allocation, 1st Edition, Springer, 2022.
2. Edgar H. Callaway Jr, Wireless sensor networks architectures and protocols, 1st Edition, Auerbach Publications, 2021.
3. Hai Liu , Yiu-Wing Leung , Xiaowen Chu, Ad Hoc and Sensor Wireless Networks: Architectures, Algorithms and Protocols, 1st Edition, Bentham Science Publishers, 2018.

REFERENCE BOOKS:

1. Sharddha Zanjat , Vishwajit K Barbudhe , "Introduction to Wireless Sensor Network", Lap Lambert Academic Publishing, 2024.
2. Sirajudeen Ameer John, "Wireless Sensor Networks: Architecture, Protocols and its applications ", Lap Lambert Academic Publishing, 2019.
3. Agus Kurniawan, "Practical TinyOS: Programming for Wireless Sensor Networks", Apress 2018.

E-RESOURCES:

1. <https://www.geeksforgeeks.org/wireless-sensor-network-wsn/>
2. <https://www.sciencedirect.com/topics/engineering/wireless-sensor-network>
3. <https://nptel.ac.in/courses/106/105/106105160/>
4. <https://cse.iitkgp.ac.in/~smisra/course/wasn.html>

CO's - PO's & PSO's MAPPING

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	2	1	-	-	-	-	2	2	3	1	1
CO 2	3	3	2	2	2	1	-	-	-	-	-	2	3	2	2
CO 3	3	3	3	2	2	1	-	-	-	-	-	3	3	2	2
CO 4	3	3	3	3	2	2	-	-	-	-	-	2	2	1	2
CO 5	2	1	1	1	3	2	-	-	-	-	-	2	2	2	1
AVG	2.8	2.6	2.2	2	2.2	1.4	-	-	-	-	2	2.2	2.6	1.6	1.6

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

23ECE64

INDUSTRIAL IoT AND INDUSTRY 4.0

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To learn IoT Nodes & Sensors
- To understand IoT Gateways
- To learn IoT Cloud Systems
- To understand the IoT Cloud Dashboards
- To challenges in IoT system design – Hardware & Software

UNIT-I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM 6

IoT Definition, Importance of IoT, Applications of IoT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics.

UNIT-II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM 6

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.

UNIT-III IOT PHYSICAL DEVICES AND SENSORS 6

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming , Python program with Raspberry PI with focus on interfacing external gadgets.

Sensors, Light sensor, temperature sensor with thermistor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT-IV CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM 6

IoT Enabling Technologies , Domain Specific IoTs , IoT and M2M , IoT System Management with NETCONF , YANG , IoT Platform Design, IoT Reference Model , Domain Model , Communication Model , IoT Protocols , MQTT.

UNIT-V CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE 6

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.

THEORY:30 PERIODS

PRACTICAL EXERCISES

1. Designing and Debugging Complex Mixed Signal Devices (analog, digital, and RF)

- Write a program to interface Bluetooth and implement DC Motor.
- Write a program to control LEDs using Alexa Echo Dot.
- Write a program to control Buzzer using Alexa Echo Dot.
- Write a program to control DC motor using Google Assistance.
- Write a program to control Stepper motor using Google Assistance

2. Understanding Development Platforms

- Introduction and Architecture to IoT
- Measurement of Temperature and Pressure using ESP32
- Modules and Sensors Interfacing (IR Sensor, Ultrasonic Sensor, Soil Moisture Sensor) using ESP32.
- Modules and Actuators Interfacing (Relay, Motor, Buzzer) using ESP32
- Demonstration of MQTT Communication
- Device Control using mobile Apps or through Web pages

3. Understanding Modulation Techniques

- Understanding of ASK, FSK Modulation and measurements
- Capturing the live ASK Signal and decoding it.
- Understanding the BPSK, QPSK & QAM Modulation Techniques and analysis.
- Understanding the APSK & APCO modulation & analysis.

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications.
- CO2:** Use processors & peripherals to design & build IoT hardware.
- CO3:** Assess, select and customize technologies for IoT applications.
- CO4:** Connect numerous IOT applications with the physical world of humans and real life problem solving.
- CO5:** Design and implement IOT applications that manage big data.

TEXT BOOKS :

1. Vilson Gruber , Roderval Marcelino , Luan Casagrande IOT and Industry 4.0: Fundamentals and application in education, 1st Edition, Our Knowledge Publishing,2024.
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0,1st Edition ,CRC Press.2020.
3. S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT, 1st Edition ,Cambridge University Press, 2020.

REFERENCE BOOKS:

1. Simon Monk, Raspberry Pi Cookbook: Software and Hardware Problems and Solutions, 4th Edition, O'Reilly Media, 2023.
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Editors Ovidiu Vermesan.
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

E-RESOURCES:

1. <https://www.epicor.com/en/blog/technology-and-data/what-is-industry-4-0/>
2. <https://fisenautomation.com/services/industrial-iot/>

CO's - PO's & PSO's MAPPING

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	1	2	-	-	-	-	-	2	3	2	2
CO 2	3	2	2	2	1	2	-	-	-	-	-	2	3	3	2
CO 3	3	2	2	2	2	2	-	-	-	-	-	2	3	3	2
CO 4	3	2	3	2	3	2	-	-	-	-	-	2	3	3	2
CO 5	3	3	3	3	3	3	-	-	-	-	-	1	3	2	3
AVG	3	2.2	2.4	2.2	2	2.2	-	-	-	-	-	1.8	3	2.6	2.2

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

23ECE65

MEMS DESIGN

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To understand the basic electrical and mechanical concepts of MEMS design
- To understand the design aspects of electrostatic sensors and actuators
- To understand the design aspects of thermal sensors and actuators
- To understand the design aspects of piezoelectric sensors and actuators
- To understand the design aspects of magnetic sensors and actuators

UNIT-I ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS

6

Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor.

UNIT-II ELECTRO STATIC SENSING AND ACTUATION

6

Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, inter digitated finger capacitors, applications of comb drive devices.

UNIT-III THERMAL SENSING AND ACTUATION

6

Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Thermal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors.

UNIT-IV PIEZOELECTRIC SENSING AND ACTUATION

6

Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials ,Quartz, PZT,PVDF, ZnO , Applications , Acoustic sensors, Tactile sensors

UNIT-V MAGNETIC SENSING AND ACTUATION

6

Concepts and principles- magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators.

THEORY: 30 PERIODS

PRACTICAL EXERCISES

- Design and simulation of piezoelectric cantilever
- Design and simulation of thermo couples
- Design and simulation of comb drive actuators
- Simulation of micro machined structures
- Simulation of accelerometers
- Simulation of micro mirror
- Simulation MEMS structures using sacrificial layer method
- Simulation of MEMS sensors.
- Simulation study of integration of circuits and MEMS

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of MEMS design aspects.

CO2: Apply the knowledge in the development of electro static sensors and actuators.

CO3: Apply the knowledge in the development of thermal sensors and actuators.

CO4: Apply the knowledge in the development of piezoelectric sensors and actuators.

CO5: Apply the knowledge in the development of magnetic sensors and actuators.

TEXT BOOKS:

1. Ville Kaajakari , Practical MEMS, 2nd Edition, Small Gear Publishing, 2024.
2. Tai Ran Hsu, MEMS And Microsystems: Design And Manufacture, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Chris Binns, Introduction to Nanoscience and Nanotechnology, 2nd Edition, Wiley, 2021.
2. Michael Huff, Process Variations in Microsystems Manufacturing , 1st Edition, Springer 2020
3. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures', 1st Edition, CRC Press, 2018.

E-RESOURCES:

1. <https://eda.sw.siemens.com/en-US/ic/ic-custom/mems-design/resources/>
2. <https://blog.matric.com/mems-design-guide-pcb-electromechanical-assemblies>
3. <https://www.st.com/en/development-tools/mems-studio.html>

CO's - PO's & PSO's MAPPING

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO 2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO 3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO 4	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO 5	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
AVG	3	3	2.8	2	2	2	-	-	-	-	-	1.8	3	2	2

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

23ECE66

VEHICULAR TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Understand different aspects of car body
- To Study various Bus Body details and their types.
- To Optimize the Commercial vehicle details.
- To Understand Vehicular Aerodynamics
- To know Body Materials & Mechanisms.

UNIT-I CAR BODY DETAILS

9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car -car body terminology - Visibility- regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car Body Construction -Various panels in car bodies. Safety: Safety design, safety equipment for cars.

UNIT-II BUS BODY DETAILS

9

Types of bus body: based on capacity, distance travelled and based on construction. - Bus body lay out, floor height, engine location, entrance and exit location. Types of metal sections used - Regulations - Constructional details: Conventional and integral.

UNIT-III COMMERCIAL VEHICLE DETAILS

9

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of Flat platform body, Tipper body and Tanker body - Dimensions of driver's seat in relation to controls - Driver's cab design.

UNIT-IV VEHICLE AERODYNAMICS

9

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels - Principle of operation, Types.

UNIT-V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR

9

Types and properties of materials used in body construction and insulation -Such as steel sheet, timber, plastics and GRP, Insulation materials. Body trim items-body mechanisms. Hand tools power tools for body repair.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the different aspects of car body.
- CO2:** Differentiate the various bus body details.
- CO3:** Describe the role of various vehicle body design.
- CO4:** Identify the materials used in body building.
- CO5:** Select hand tools for body materials and Body repair Mechanisms..

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TEXT BOOKS:

1. Dieler Anselm., The passenger car body, SAE International, 2020.
2. James E Duffy, Body Repair Technology for 4-Wheelers, Cengage Learning, 2019.
3. Powloski, J., Vehicle Body Engineering, Business Books Ltd., 2018.

REFERENCE BOOKS:

1. Braithwaite, J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 2019.
2. Giles, G.J., Body construction and design, Illiffe Books Butterworth & Co., 1991
3. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London, 2012.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee44/preview

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	1	1	2	2	2	1	1
CO2	2	2	2	1	1	-	-	-	1	1	2	2	2	1	1
CO3	2	2	2	1	1	-	-	-	-	1	2	2	2	1	1
CO4	2	2	2	1	1	-	-	-	-	1	2	1	2	1	-
CO5	2	2	2	1	1	-	-	-	-	1	2	1	1	1	-
AVG	2	2	2	1	1	-	-	-	1	1	2	1	2	1	1

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

23ECE67

SENSORS AND ACTUATOR DEVICES FOR IOT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of sensors and transducers.
- To get knowledge about the various thermal energy by IoT.
- To familiarize themselves with various radiation sensors techniques.
- To know the implementation of IoT with sensors.
- To understand the various sensor applications in IoT.

UNIT-I SENSORS AND TRANSDUCERS

9

Principles, Classification, Characterization, Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Inductive Sensors, Capacitive Sensors- Parallel plate & Serrated plate types, Ultrasonic Sensors.

UNIT-II THERMAL SENSORS

9

Introduction, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Junction Semiconductor Types, Magnetic Sensors: Introduction, Sensors and the Principles Behind, Force & displacement Sensors.

UNIT-III RADIATION SENSORS

9

Introduction – Basic Characteristics – Types of Photo Sensistor, Photo detectors– X-ray and Nuclear Radiation Sensors – Fiber Optic Sensors.

UNIT-IV SMART SENSORS

9

Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation.

UNIT-V SENSOR APPLICATIONS AND ACTUATORS

9

Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Medical Diagnostic Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring Actuators: Pneumatic and Hydraulic Actuation Systems, Valves, Rotary actuators, Mechanical Actuation Systems, Electrical Actuation Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Illustrate the working principles of different types of sensors and actuators.
- CO2:** Analyse the phenomena that define behaviour of various sensors and actuators.
- CO3:** Apply the concepts in common methods for converting a physical parameter into an electrical quantity.
- CO4:** Identify suitable sensors and code processing techniques.
- CO5:** Analyse the various applications in sensors and actuator.

TEXT BOOKS:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, 1st Edition, Cambridge University Press, 2022.
2. Ashish Khanna, Deepak Gupta, Purnima Lala Mehta, Victor Hugo C. de Albuquerque, Smart Sensors for Industrial Internet of Things: Challenges, Solutions and Applications, Springer Nature Switzerland AG, 2021.
3. Mohammad Hammoudeh Mounir Arioua, Sensors and Actuators in Smart Cities, 1st Edition, Mdpi AG, 2018.

REFERENCE BOOKS:

1. Francisco André Corrêa Alegria, Sensors and Actuators, 1st Edition, World Scientific, 2023.

E-RESOURCES:

1. https://nptel.ac.in/content/syllabus_pdf/108108147.pdf
2. <https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT>

CO's - PO's & PSO's MAPPING

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	3	-	-	-	-	2	3	3	3	3
CO 2	3	2	2	2	1	-	-	-	-	-	1	2	2	3	3
CO 3	3	2	3	2	1	2	-	-	-	-	3	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	-	-	-	1	2	3	2
CO 5	3	2	3	3	2	1	-	-	-	-	2	1	2	2	2
AVG	3	2	2.4	2.2	1.6	2	-	-	-	-	2	1.8	2.2	2.6	2.6

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

23ECE68

FOUNDATION OF ROBOTICS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT-I FUNDAMENTALS 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).

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.

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-Effector Commands, and simple programs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Interpret the features of robots and technology involved in the control.
- CO2:** Apply the basic engineering knowledge and laws for the design of robotics.
- CO3:** Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
- CO4:** Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
- CO5:** Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

1. A. B. Bhattacharya, Debasish Roy, Foundations of Robotics Automation, 1st Edition, Khanna Book Publishing, 2024.
2. Damith Herath, David St-Onge, Foundations of Robotics: A Multidisciplinary Approach with Python and ROS, Springer, 2022.
3. Kailash Chandra Mahajan, Robotics For Engineers- Concepts And Techniques, 1st Edition, Vikas Publishing House, 2016.

REFERENCE BOOKS:

1. John Craig, Introduction to Robotics, 4e, Fourth Edition, Pearson Education, 2022.

E-RESOURCES:

1. <https://nptel.ac.in/courses/112105249>
2. https://onlinecourses.nptel.ac.in/noc20_de11/preview

CO's – PO's & PSO's MAPPING

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	1	2	3	3	3
CO 2	3	2	1	1	1	-	-	-	-	-	1	2	2	2	2
CO 3	3	2	1	1	2	-	-	-	-	-	1	2	2	2	2
CO 4	3	2	1	1	1	-	-	-	-	-	-	2	2	2	1
CO 5	3	2	1	1	1	-	-	-	-	-	1	1	1	2	1
AVG	3	2	1	1	1.4	-	-	-	-	-	1	1.8	2.0	2.2	1.8

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

23ECE71

RADAR TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics Principles of Radar and Radar equation
- To understand the different types of Radar
- To understand tracking Radar
- To understand the various signal processing in Radar
- To understand the Subsystems in Radar

UNIT-I INTRODUCTION TO RADAR EQUATION

9

The Origins of Radar ,Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Integration of RadarPulses, Radar Cross Section of Targets,Transmitter Power,Pulse Repetition Frequency,Antenna Parameters, System losses.

UNIT-II CW, MTI AND PULSE DOPPLER RADAR

9

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMT), Pulse Doppler Radar. Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar.

UNIT-III TRACKING RADAR

9

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction , state estimation, Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT-IV RADAR SIGNAL PROCESSING

9

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.

UNIT-V RADAR TRANSMITTERS AND RECEIVERS

9

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver, Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas - Phase Shifters.

TOTAL: 45 PERIODS

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

- CO1:** Identify the Radar parameters
- CO2:** Differentiate various radar types
- CO3:** Evaluate different tracking and filtering schemes
- CO4:** Apply signal processing in target detection
- CO5:** Design Radar transmitter and receiver blocks

TEXT BOOKS:

1. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012

REFERENCE BOOKS:

1. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition, 2007.
2. M.I. Skolnik, "Introduction to Radar Systems", Tata McGraw Hill 2006.
3. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/108/105/108105154/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	-	2	2	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	2	2	2	2	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2	1	2	3
CO4	3	3	3	2	3	2	-	-	-	-	1	2	2	1	2
CO5	3	2	2	2	3	2	-	-	-	-	1	2	2	2	1
AVG	3	3	3	3	2	2	-	-	-	-	2	2	2	2	2

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

23ECE72

AVIONICS SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the needs for avionics for both Civil and military aircraft and Understand the aircraft control systems.
- To understand the functioning of MIL-STD-1553B Data Bus.
- To impart knowledge understand the various cockpit displays and human interfaces.
- To impart knowledge on the concepts of flight control systems, FMS and their importance.
- To impart knowledge on different navigation aids and need for certification

UNIT-I INTRODUCTION TO AVIONICS

9

Basics of Avionics-Basics of Cockpits - Need for Avionics in civil and military aircraft and space systems - Integrated Avionics Architecture -Military and Civil system - Typical avionics System and Sub systems - Design and Technologies - Requirements and Importance of illities of Avionic Systems.

UNIT-II DIGITAL AVIONICS BUS ARCHITECTURE

9

Evolution of Avionics architecture- Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC- 429, ARINC-629, AFDX/ARINC-664, and ARINC-818 - Aircraft system Interface.

UNIT-III COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION

9

Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) -Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, and HOTAS - Glass cockpit.

UNIT-IV FLIGHT CONTROL SYSTEMS

9

Introduction to Flight control systems and FMS- Longitudinal control - Lateral Control - Autopilot - Flight planning - Radar Electronic Warfare - Certification-Military and civil aircrafts.

UNIT-V NAVIGATION SYSTEMS

9

Overview of navigation systems - Communication Systems - Radio navigation - Types & Principles- Fundamentals of Inertial Sensors - INS - GNSS -- GPS - Approach and Landing Aids - ILS & MLS - Hybrid Navigation.

TOTAL: 45 PERIODS

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

- C01:** Explain the different of Avionics Systems and its need for civil and military aircrafts consideringthe reliability and safety aspects
- C02:** Select a suitable architecture and data bus based on the requirements
- C03:** Compare the different display technologies used in cockpit
- C04:** Explain the principles of flight control systems and the importance of FMS
- C05:** Explain the communication and navigation techniques used in aircrafts

TEXT BOOKS:

1. R.P.G. Collinson, "Introduction to Avionics", Springer Publications, Third Edition, 2011.

REFERENCE BOOKS:

1. Cary R.Spitzer, "The Avionics Handbook", CRC Press, 2000.

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2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Myron Kayton, Walter R. Fried "Avionics Navigation Systems" 2nd Edition, Wiley Publication, 2008.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ae05/preview

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
CO5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 -low, 2-medium, 3-high, '-'-nocorrelation

23ECE73

POSITIONING AND NAVIGATION SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain the fundamentals of navigation systems.
- To understand the inertial navigation systems
- To acquire knowledge on radio navigation.
- To have an overview of global positioning systems
- To learn the hybrid navigation systems.

UNIT-I NAVIGATION CONCEPTS

9

Fundamentals of navigation systems and Position Fixing – Categories of navigation - Geometric concepts of Navigation – The Earth in inertial space - Different Coordinate Systems – Coordinate Transformation - Quaternion formulation.

UNIT-II INERTIAL NAVIGATION SYSTEMS

9

Inertial sensors - Gyroscopes -Types - Mechanical - Electromechanical-Optical Gyro -Ring Laser gyro- Fiber optic gyro- Accelerometers – Pendulous type – Force Balance type – MEMs - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system - Rate Corrections - Acceleration errors – Schuler Tuning.

UNIT-III RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT

9

Different types of radio navigation- ADF, VOR, DME, TACAN,VORTAC - Doppler – Hyperbolic Navigations – Air Traffic Management – RADAR Surveillance - Airborne Collision Avoidance Systems.

UNIT-IV GLOBAL POSITIONING SYSTEM

9

Overview of GPS: Basic concept, system architecture, , GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture -GPS error sources-clock error, ionospheric error estimation using dual frequency GPS receiver.

UNIT-V HYBRID NAVIGATION & RELATIVE NAVIGATION SYSTEMS

9

Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals - Relative positioning - Point positioning and differential positioning - Differential GPS (DGPS) and Space based Augmentation system (SBAS)- Concepts - Relative GPS -Formation Flying - Figure of Merit (FOM).

TOTAL: 45 PERIODS

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

- CO1:** Understand the advanced concepts of Positioning and Navigation systems and exposure onvarious Navigation systems
- CO2:** Know about Gyroscopes and accelerometers and Inertial Navigation systems and its typesand Mechanisation.
- CO3:** Explain the different Radio Navigation aids and its usage for civil and military aircrafts andsatellites
- CO4:** Explain the Satellite Navigation – GPS and its usage in aircraft and spacecraft applications

CO5: Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and Relative navigation in a spacecraft.

TEXT BOOKS:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2nd edition, 1997.
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.

REFERENCE BOOKS:

1. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
2. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
3. Paul. D. Groves. 'Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems', Artech House, 2013.

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/107/105107194/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

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

23ECE74

SATELLITE COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of satellite orbits
- To understand the satellite segment and earth segment
- To understand Link Power budget calculation
- To understand the various satellite access and coding technology
- To understand the applications of satellite

UNIT-I SATELLITE ORBITS

9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse- Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT-II SPACE SEGMENT

9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.

UNIT-III SATELLITE LINK DESIGN

9

Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.

UNIT-IV SATELLITE ACCESS AND CODING TECHNIQUES

9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.

UNIT-V SATELLITE APPLICATIONS

9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites(DBS/DTH).

TOTAL: 45 PERIODS

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

- CO1:** Identify the satellite orbits
- CO2:** Analyze the satellite subsystems
- CO3:** Evaluate the satellite link power budget
- CO4:** Identify access technology for satellite
- CO5:** Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017.
2. Timothy Pratt, Charles, W.Bostain,Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications,2021.

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REFERENCE BOOKS:

1. Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education 2017.
2. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd edition, Prentice Hall/Pearson, 2013.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Boston London, 2003.

E-RESOURCES:

1. <https://archive.nptel.ac.in/courses/117/105/117105131/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	3	3	2	3	1	1	-	1	-	1	3	2	1
C02	3	2	2	3	2	3	-	-	-	-	-	1	3	2	2
C03	3	3	3	2	1	3	-	-	-	-	-	1	3	2	2
C04	3	3	2	3	2	3	-	-	-	-	-	1	3	1	1
C05	3	2	3	2	2	1	-	-	-	-	-	1	3	1	2
AVG	3	3	3	3	2	3	1	1	-	1	-	1	3	1.6	1.6

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

23ECE75

REMOTE SENSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics concepts of remote Sensing
- To understand the EMR interaction and atmospheric regions.
- To understand the various concepts of the orbits and platforms
- To understand the various types of sensors.
- To understand the applications of remote sensing and data products

UNIT-I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition - components of RS - History of Remote Sensing - Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum - Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchhoff's law - Radiation sources: active & Passive - Radiation Quantities.

UNIT-II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile - main atmospheric regions and its characteristics - interaction of radiation with atmosphere - Scattering, absorption and refraction - Atmospheric windows - Energy balance equation - Specular and diffuse reflectors - Spectral reflectance & emittance- Spectroradiometer - Spectral Signature concepts - Typical spectral reflectance curves for vegetation, soil and water - solid surface scattering in microwave region.

UNIT-III ORBITS AND PLATFORMS 9

Motions of planets and satellites - Newton 's law of gravitation - Gravitational field and potential - Escape velocity - Kepler 's law of planetary motion - Orbit elements and types - Orbital perturbations and maneuvers - Types of remote sensing platforms - Classification of satellites - Sun synchronous and Geosynchronous satellites - Legrange Orbit.

UNIT-IV SENSING TECHNIQUES 9

Classification of remote sensors - Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners - Optical-infrared sensors - Thermal sensors - microwave sensors - Calibration of sensors - High Resolution Sensors - LIDAR, UAV - Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT-V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products - Types, levels and open-source satellite data products - selection and procurement of data - Visual interpretation: basic elements and interpretation keys - Digital interpretation - Concepts of Image rectification, Image enhancement and Image classification.

TOTAL: 45 PERIODS

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

- CO1:** Understand the principles of electromagnetic radiation.
- CO2:** Analyze the atmospheric radiation interactions.
- CO3:** Explain the laws of planetary motion.
- CO4:** Analyze the different types of resolution.
- CO5:** Understand the concepts of digital interpretation

TEXT BOOKS:

1. Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image Interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCE BOOKS:

1. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 2022 first edition.
2. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob VanZyl, 2021 Edition, Wiley Publication
3. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

E-RESOURCES:

1. <https://nptel.ac.in/courses/105108077/>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	1	2	1	3	2	3	2	-	-	-	-	1	3	3	3
CO4	1	2	3	1	3	3	2	-	-	-	-	1	3	3	3
CO5	2	2	2	-	3	3	2	-	-	-	-	1	3	3	3
AVG	2	2	2	2	2	3	2	-	-	-	-	1	3	3	3

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

23ECE76

ROCKETRY AND SPACE MECHANICS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand fundamental aspects of rocket motion along with detailed estimation of rocket trajectories.
- To know the imparts knowledge on optimization of multistage rockets.
- To provides the basics of space mechanics required for an aeronautical student
- To provide with the basics of orbit transfer of satellites.
- To gain knowledge on various control methods of rockets.

UNIT-I ORBITAL MECHANICS

9

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points – Estimation of orbital and escape velocities.

UNIT-II SATELLITE DYNAMICS

9

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.

UNIT-III ROCKET MOTION

9

Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields– determinations of range and altitude – simple approximations to burnout velocity.

UNIT-IV ROCKET AERODYNAMICS

9

Description of various loads experienced by a rocket passing through atmosphere – Boat-tailing in missiles – performance at various altitudes – rocket stability – rocket dispersion – launching problems.

UNIT-V STAGING AND CONTROL OF ROCKET VEHICLES

9

Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.

TOTAL: 45 PERIODS

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

- CO1:** To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.
- CO2:** To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.
- CO3:** To familiarize themselves with trajectory calculations for planar motion of rockets.
- CO4:** To determine forces and moments acting on airframe of a missile.
- CO5:** To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.

TEXT BOOKS:

1. Cornélisse, JW, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.
2. Parker, ER, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

REFERENCE BOOKS:

1. Suresh. B N & Sivan. K, "Integrated Design for Space Transportation System", Springer India, 2015.
2. Sutton, GP, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.
3. Van de Kamp, "Elements of Astromechanics", Pitman Publishing Co., Ltd., London, 1980.

E-RESOURCES:

1. <https://nptel.ac.in/courses/101105030/>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 -low, 2-medium, 3-high, '-'-nocorrelation

23ECE77

SPACECRAFT SENSORS AND INSTRUMENTATION

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide an overview of the different types of sensors and instruments flown on Spacecraft
- To provide students with an appreciation and understanding of the development of the design processes involved for different instruments.
- Understand the concept measurements of electric fields and magnetic fields
- To explain, how the sensors and instruments interface with the spacecraft platform
- To understand the concept of Satellite Orbits in spacecraft systems.

UNIT-I INTRODUCTION

8

Scientific Background - Parameters to be observed - Sensing platforms (rocket engine, satellites) - introduction to various sensors and instrumentation needed for satellite mission function.

UNIT-II MEASUREMENTS OF CHARGED AND NEUTRAL PARTICLES

10

Pulse and Current modes - Pulse height spectra and analysis - Counting curves and plateaus -Energy resolution - Detector efficiency - Dead time -Detectors: Solid state, Scintillation counters, Electron multipliers - Actual instruments - Analog or pulse height spectroscopy electronics - Digital techniques - Power supplies - Neutral particle imagers.

UNIT-III MEASUREMENT OF MAGNETIC AND ELECTRIC FIELDS

9

Fluxgate magnetometer - Search coil magnetometer - Optical absorption magnetometer. Electric Fields: Double probe technique - Beam experiments - Observation of electric fields parallel to the magnetic field.

UNIT-IV PHOTON COUNTING SENSORS AND IMAGERS

9

Auroral imagers: Optical, UV, X-ray - X-ray sensors and imagers - Detection techniques, Grazing incidence optics - Charged Coupled Devices - Other imaging techniques - tomography.

UNIT-V SPACECRAFT SYSTEMS AND SATELLITE ORBITS

9

Subsystems - Testing and Qualifications - Trade-offs - Role of orbit to investigation - Unusual orbital techniques: L1 orbit, double lunar swing.

TOTAL: 45 PERIODS

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

- C01:** Explains how mathematics, physics, and engineering-based concepts are used to develop and design a sensor which complies with a set of specific requirements.
- C02:** Discusses essential topics such as Pulse height spectra and analysis, Detectors, noise pulse height spectroscopy used in space operation.
- C03:** Identify the available electric fields parallel to the magnetic field in space.
- C04:** Covers a range of typical sensors used in the spacecraft industry such as infrared, passive microwave, radars and space-based GPS sensors.
- C05:** Spacecraft Sensors is an invaluable resource for engineers, technical consultants, those in the business division, and research scientists associated with spacecraft projects.

TEXT BOOKS:

1. Genta, Giorgio, "Spacecraft Sensors and Instrumentation: Principles and Applications", Chichester, England; Hoboken, NJ: J. Wiley, 2023.
2. Kohichiro Oyama, Chio-Zong Cheng, "An introduction to space instrumentation", Tokyo, Japan:Terrapub, 2013.
3. Abid, Mohamed M., "Spacecraft Sensors", Chichester, England; Hoboken, NJ: J. Wiley, 2005.

REFERENCE BOOKS

1. Yuri Surkov, "Exploration of Terrestrial Planets from Spacecraft: Instrumentation, Investigation, Interpretation", Wiley-Praxis Series in Astronomy & Astrophysics, Ellis Horwood Ltd, 2nd Ed., 1990..

E-RESOURCES:

1. <https://nptel.ac.in/courses/101106033>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	2	-	1	1	1	-
CO2	3	2	1	1	1	-	-	-	-	2	-	1	1	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	1	1	-
CO4	3	2	1	1	1	-	-	-	-	2	-	1	1	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	1	-
AVG	3	2	1	1	1	-	-	-	-	2	-	1	1	1	-

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

23ECE78

ORBITAL MECHANICS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the concept of orbital mechanics to find the trajectory/orbit of a space vehicle or a satellite.
- To determine perturbation of satellite orbits and its mathematical background.
- To explain the concepts of transfer of spacecraft from one orbit to another.
- To explain the trajectory of various spacecrafts.
- To learn the concept of orbital mechanics to free flight phase of ballistic missiles.

UNIT-I INTRODUCTION 9

Celestial sphere, Ecliptic, Right ascension and Declination, Vernal equinox, Solar time and Sidereal time, Kepler's laws of planetary motion, Keplerian Orbital elements.

UNIT-II TWO-BODY PROBLEM AND ORBIT PERTURBATIONS 9

Two-body problem, Orbit equation, Orbital velocity and Orbital energy, Kepler's equation and Time of flight, Orbit perturbations, Special and General Perturbation methods.

UNIT-III ORBITAL MANEUVERS 9

Orbit transfer, In-plane orbit changes, Hohmann transfer, Bi-elliptic transfer, Out-of-plane orbit changes, Delta-v requirement and propellant mass for maneuvers.

UNIT-IV INTERPLANETARY AND LUNAR TRAJECTORIES 9

Sphere of Influence, Patched conic approximation with simplified example, Realistic of interplanetary mission, Locating the planets, Design of departure and arrival trajectories, the Gravity-assist maneuvers, Design of departure and arrival lunar trajectories.

UNIT-V APPLICATION OF ORBITAL MECHANICS TO BALLISTIC MISSILES 9

General ballistic missile problem, Geometry of ballistic missile trajectory, Free flight range, Flight path angle, Maximum range trajectory, Time of free flight, Effect of launching errors, Influence coefficients, Effect of earth rotation.

TOTAL: 45 PERIODS

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

- C01:** Apply the concepts of orbital mechanics to find the trajectory/orbit of a space vehicle or a satellite.
- C02:** Discuss the perturbation of satellite orbits and its mathematical background.
- C03:** Calculate the delta-v required for transferring a spacecraft from one orbit to another.
- C04:** Design an approximate trajectory for interplanetary and lunar spacecraft.
- C05:** Apply the concepts of orbital mechanics to free flight phase of ballistic missiles.

TEXT BOOKS:

SVHEC-R2023

R. S. W.
Chairman
BoS/ECE

1. Wie, Bong W., "Fundamentals of Astrodynamics and Applications", 4th ed., Chichester, England; Hoboken, NJ: Springer, 2023.
2. Howard D. Curtis, 'Orbital Mechanics for Engineering Students', Third Edition (Revised), Butterworth-Heinemann, 2013.
3. David A. Vallado and James Wertz (Ed.), 'Fundamentals of Astrodynamics and Applications', Fourth Edition, Microcosm Press, 2013.

REFERENCE BOOKS

1. Charles D. Brown, 'Elements of Spacecraft Design', First Edition, AIAA Education Series, 2002.
2. Roger R. Bate, Donald D. Mueller, and Jerry E. White, 'Fundamentals of Astrodynamics', Dover Publications Inc., 1971.
3. Vladimir A. Chobotov, 'Orbital Mechanics', Third Edition, AIAA Education Series, 2002.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ae06/

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	2	-	1	3	1	1
CO2	3	2	1	1	1	-	-	-	-	2	-	1	3	1	1
CO3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
CO4	3	2	1	1	1	-	-	-	-	2	-	1	3	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
AVG	3	2	1	1	1	-	-	-	-	2	-	1	3	1	1

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

23ECE81

OPTICAL COMMUNICATION & NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Study About The Various Optical Fiber Modes, Configuration Of Optical Fibers
- To Study Transmission Characteristics of Optical Fibers.
- To Learn About The Various Optical Sources, Detectors And Transmission Techniques.
- To Explore Various Idea About Optical Fiber Networks.
- To Understand the components and design principles of point-to-point fiber optic links, including link types, configurations, and system architecture.

UNIT-I INTRODUCTION TO OPTICAL FIBERS

9

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics- Optical Fiber Modes and Configurations. Mode theory of Circular Waveguides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes Single-Mode Fibers.

UNIT-II SIGNAL DEGRADATION OPTICAL FIBERS

9

Attenuation, Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination. Group Delay- Material Dispersion, Waveguide Dispersion, Polarization Mode dispersion, Intermodal dispersion, Mode Coupling.

UNIT-III FIBER OPTICAL SOURCES AND DETECTORS

9

Direct and indirect Band gap materials -LED- lasers Diodes - Quantum efficiency-PIN and APD diodes-Photo detector noises, SNR, Detector Response time, Comparison of Photo detectors.

UNIT-IV OPTICAL NETWORK COMPONENTS

9

Couplers, Isolators, Switches, Wavelength Converters, Circulators, Filters, Multiplexers, WDM, Optical Amplifiers-EDFA - Basic on concepts of SONET/SDH Network.

UNIT-V SYSTEM DESIGN AND MANAGEMENT

9

Point to Point links System considerations, Power budget, time budget- bandwidth budget calculations, Noise Effects on System Performance- OTDR -Attenuation and dispersion, Field Measurements. Network Management- Performance and fault management, Configuration Management

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Implement the behavior of different optical medium (fibers) and performance of signal Propagation.
- CO2:** Demonstrate the issues in propagation of optical signals resulting from signal degradation mechanism of optical fiber media.

- C03:** Analyze the performance of optical sources, detectors and the concept for choice of light sources, detectors for the given optical link.
- C04:** Attribute the working of optical components in the design of optical networks. optical links.
- C05:** Analyse the power loss and signal dispersive nature of optical media and apply the result to identify appropriate transmitter, receiver, on line.

TEXT BOOKS:

1. John M.Senior, "Optical Fiber Communication", Pearson Education, Fourth Edition.2010.

REFERENCE BOOKS:

1. Optical Fiber Communication by Gerd Keiser, Springer Nature Singapore, March 2021
2. Optical Networks: A Practical Perspective by Rajiv Ramaswami and Kumar Sivarajan Morgan Kaufmann, 2010.
3. Optical Communication, Principles and Practice by J.Senior Prentice Hall of India, Third edition published 2009.

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	2	3	3	1	-	-	-	-	-	1	2	1	2
C02	3	3	2	1	3	2	-	-	-	-	-	2	2	2	2
C03	3	3	3	3	2	1	-	-	-	-	-	1	2	2	2
C04	3	3	2	2	2	1	-	-	-	-	-	1	2	1	2
C05	3	3	3	3	2	1	-	-	-	-	-	1	2	2	2
AVG	3	3	2	3	3	1	-	-	-	-	-	1	2	1	2

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

23ECE82

WIRELESS BROAD BAND NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks
- To study the architecture and interference mitigation techniques in 3G standards
- To learn about 4G technologies and LTE-A in mobile cellular network.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network.

UNIT-I WIRELESS PROTOCOLS

9

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer- Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.

UNIT-II 3G EVOLUTION

9

IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN - architecture, High Speed Packet Data-HSDPA, HSUPA.

UNIT-III 4G EVOLUTION

9

Introduction to LTE-A - Requirements and Challenges, network architectures - EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT-IV LAYER-LEVEL FUNCTIONS

9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation - CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT-V 5G EVOLUTION

9

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Design and implement the various protocols in wireless networks.
- CO2:** Analyze the architecture of 3G network standards.
- CO3:** Analyze the difference of LTE-A network design from 4G standard.
- CO4:** Design the interconnecting network functionalities by layer level functions.
- CO5:** Explore the current generation (5G) network architecture.

TEXT BOOKS:

1. Kaveh Pahlavan, "Principles of wireless networks", Prentice-Hall of India, 2008

REFERENCE BOOKS:

1. L.Vijay K.Garg, "Wireless Network Evolution - 2G & 3G". Prentice Hall, 2008.
2. Clint Smith,P.E, Dannel Collins, "3G Wireless Networks" Tata McGraw- Hill, 2nd Edition, 2011.
3. Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.
4. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

E-RESOURCES:

1. <https://archive.nptel.ac.in>

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	-	-	-	-	2	3	3	1	1
CO2	3	3	2	1	3	2	-	-	-	-	-	-	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	-	3	3	2	2
CO4	2	3	3	3	2	2	-	-	-	-	-	3	2	1	2
CO5	2	-	3	3	2	2	-	-	-	-	-	3	2	2	1
AVG	2.6	2.75	2.6	2.6	2.4	1.6	-	-	-	-	2	3	2.6	1.6	1.6

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE83

5G AND BEYOND COMMUNICATION NETWORKS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks.

UNIT-I EVOLUTION OF WIRELESS NETWORKS

6

Networks evolution: 2G, 3G, 4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core (NG-core), virtualized Evolved Packet core (vEPC).

UNIT-II 5G CONCEPTS AND CHALLENGES

6

Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-III NETWORK ARCHITECTURE AND THE PROCESSES

6

5G architecture and core, network slicing, multi access edge computing (MEC) visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.

UNIT-IV DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES

6

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves. Security: Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

UNIT-V BEYOND 5G COMMUNICATION NETWORKS

6

Overview of Beyond 5G (B5G) and 6G, 6G requirements and vision, 6G core network architecture, Network deployment types, Security, challenges in 6G.

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. 5G-Compliant waveform generation and testing
2. Modeling of 5G Synchronization signal blocks and bursts
3. Channel modeling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation
6. Development of 5G New Radio Polar Coding

PRACTICAL: 30 PERIODS

TOTAL (30+30) = 60 PERIODS

COURSE OUTCOMES:

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

- CO1:** To understand the evolution of wireless networks.
- CO2:** To learn the concepts of 5G networks.
- CO3:** To comprehend the 5G architecture and protocols.
- CO4:** To understand the dynamic spectrum management.
- CO5:** To learn the security aspects in 5G networks

TEXT BOOKS:

1. 5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019
2. An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020.

REFERENCE BOOKS:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019.

E-RESOURCES:

1. <https://archive.nptel.ac.in>.

CO's - PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	-	1	1	3
CO2	3	3	3	2	2	-	-	-	-	-	-	-	1	1	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	2	2	3
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO5	3	2	3	3	2	-	-	-	-	-	-	-	2	2	2
AVG	3	2.8	2.6	2.6	2	-	-	-	-	-	-	-	1.8	1.6	2.2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE84

SOFTWARE DEFINED NETWORKS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT-I SDN: BACKGROUND AND DATA PLANE

6

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – Open Flow Logical Network Device – OpenFlow Protocol.

UNIT-II SDN CONTROL PLANE

6

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – Open Daylight – REST – Cooperation and Coordination among Controllers.

UNIT-III NETWORKING

6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- -Mobility and Wireless – Information-centric Networking.

UNIT-IV NETWORK FUNCTION VIRTUALIZATION

6

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV.

UNIT-V NETWORK VIRTUALIZATION

6

Virtual LANs – Open Flow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight's Virtual Tenant Network – CoSoftware-Defined Infrastructure

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

1. Installing Mininet simulator
2. Creating a 1 controller, 3 node topology, POX controller
3. Ability to view, read/write Flow table rules (for different applications - say firewall, Learning switch etc.), POX, Open vSwitch
4. Building a SDN based application

PRACTICAL: 30 PERIODS

TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Describe the motivation behind SDN and its data plane
- CO2:** Identify the functions of control plane
- CO3:** Apply SDN to networking applications
- CO4:** Apply various operations of network function virtualization
- CO5:** Explain various use cases of SDN

TEXT BOOKS:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.

REFERENCE BOOKS:

1. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
2. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
3. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

E-RESOURCES:

1. <https://archive.nptel.ac.in>.

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
CO5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

23ECE85

MASSIVE MIMO NETWORKS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

UNIT-I MASSIVE MIMO NETWORKS

6

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model.

UNIT-II THE MASSIVE MIMO PROPAGATION CHANNEL

6

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels.

UNIT-III SINGLE-CELL SYSTEMS

6

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion- Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing - Limiting Factors: Number of Antennas and Mobility.

UNIT-IV MULTI-CELL SYSTEMS

6

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion - Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT-V CASE STUDIES

6

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies

THEORY: 30 PERIODS

PRACTICAL EXERCISES:

Implementation of (Using Matlab)

1. Massive MIMO hybrid beamforming
2. Single cell massive MIMO downlink communications
3. Multicell massive MIMO downlink communications.
4. Precoding in massive MIMO single cell and multicell downlink communications
5. Channel estimation in massive MIMO system

PRACTICAL: 30 PERIODS
TOTAL (30+30) =60 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand and explain massive MIMO networks.
CO2: Analyze massive MIMO propagation channels and their capacity bounds
CO3: Examine channel estimation techniques for single cell system.
CO4: Analyze channel estimation techniques for multi cell system.
CO5: Explain the concepts underlining the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V)
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I)

REFERENCE BOOKS:

1. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017.

E-RESOURCES:

1. <https://archive.nptel.ac.in>
2. CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO4	3	3	2	2	2	2	-	-	-	-	-	1	3	1	3
CO5	3	2	2	2	2	2	-	-	-	-	-	2	3	3	2
AVG	3	2.4	1.8	1.8	2	2	-	-	-	-	-	1.4	3	2	2

1 -low,2-medium,3-high,'-'-nocorrelation

SVHEC-R2023

R.97M
 Chairman
 BoS / ECE

23ECE86 ADVANCED WIRELESS COMMUNICATION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the evolving paradigm of cooperative communication.
- To understand concepts related to green wireless communication.
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components.
- To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT-I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks; Cooperative communications in OFDM and MIMO cellular relay networks; issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT-II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT-III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT-IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations, Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications.

UNIT-V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks; Energy performance in TDD-CDMA multihop cellular networks; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** The student would be able to appreciate the necessity and the design aspects of cooperative communication
- CO2:** The student would be able to appreciate the necessity and the design aspects of green wireless communication.
- CO3:** The student would be able to evolve new techniques in wireless communication
- CO4:** The students would be able to demonstrate the feasibility of using mathematical models using simulation tools.
- CO5:** The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.

TEXT BOOKS:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , "Cooperative Cellular Wireless Networks", Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.

REFERENCE BOOKS:

1. F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012.
2. Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers, 2010.
3. Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.

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1. <https://archive.nptel.ac.in/>

CO's - PO's & PSO's MAPPING

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CO4	3	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO5	3	3	3	2	1	2	-	-	-	-	-	2	2	3	1
AVG	3	2.8	2.8	2	1.6	1.2	-	-	-	-	-	2	3	2	2

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

23ECE87

GREEN RADIO COMMUNICATION TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the basics of green radio network.
- To understand the principles of green modulation and coding schemes tailored for energy-efficient wireless communications.
- To understand concepts related to green wireless communication.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT-I

INTRODUCTION TO GREEN RADIO NETWORKS

9

Fundamental Tradeoffs on the Design of Green Radio Networks: Insight from Shannon's capacity formula - impact of practical constraints - latest research and directions; Algorithms for Energy Harvesting Wireless Networks: Energy harvesting technologies - PHY and MAC layer optimization for energy harvesting wireless networks.

UNIT-II

GREEN MODULATION AND CODING

9

Modulation: Green modulation and coding schemes in energy constrained wireless networks - energy consumption of uncoded scheme - energy consumption analysis of LT coded modulation.

UNIT-III

CO-OPERATIVE TECHNIQUES

9

Co-operative Techniques for Energy Efficient Wireless Communications: Energy efficiency metrics for wireless networks - co-operative networks - optimizing the energy efficiency performance of co-operative networks - energy efficiency in co-operative base stations.

UNIT-IV

BASE STATION POWER MANAGEMENT TECHNIQUES

9

Base Station Power Management Techniques for Green Radio Networks: Opportunistic spectrum and load management for green radio networks - energy saving techniques in cellular wireless base stations - power management for base stations in a smart grid environment.

UNIT-V

WIRELESS ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS

9

Cross Layer Design: Adaptive packet scheduling for green radio networks - energy efficient relaying for cooperative cellular wireless networks - energy performance in TDD CDMA multihop cellular networks - resource allocation for green communication in relay based cellular networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Design and optimize PHY and MAC layer protocols to maximize the efficiency and performance of energy harvesting wireless systems.
- CO2:** The student would be able to appreciate the necessity and the design aspects of green wireless communication.
- CO3:** The student would be able to evolve new techniques in wireless communication

CO4: Develop the power consumption models.

CO5: The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.

TEXT BOOKS:

1. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.
2. Jinsong Wu Sundeep Rangan, Honggang Zhang, "Green Communications Theoretical fundamentals, Algorithms and Applications " CRC press,2013.

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1. Jinsong Wu, SundeepRangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2016.
2. Ekram Hossain, Vijay K. Bhargava and Gerhard P. Fettweis, "Green Radio Communication Networks", Cambridge University Press, 2012.
3. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access", GRIN Verlag, 2012.

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CO3	3	2	2	1	2	1	-	-	1	2	2	2	2	1	1
CO4	3	3	3	3	2	1	-	-	2	2	2	2	3	1	2
CO5	3	3	3	2	1	2	-	-	1	2	2	2	2	2	1
AVG	3	3	3	2	2	1	-	-	2	2	2	2	3	2	2

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23ECE88

MULTICARRIER WIRELESS COMMUNICATION

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the basics of OFDM principles.
- To understand and analyze the effects of frequency and timing errors on system performance.
- To understand the principles and benefits of adaptive modulation in OFDM systems.
- To study the processes of OFDM Channel Estimation
- To learn the instructional activities.

UNIT-I

OFDM PRINCIPLES

9

System Model: Block diagram of OFDM system - generation of sub carrier using IFFT - guard time - cyclic extensions - windowing - choice of OFDM parameters - signal processing - bandwidth efficiency - peak to average power ratio - peak power problem - PAPR properties of OFDM signals; PAPR reduction techniques: Signal distortion techniques - multiple signaling and probabilistic techniques - coding techniques.

UNIT-II

OFDM TIME AND FREQUENCY DOMAIN SYNCHRONIZATION

9

System performance with frequency and timing errors; Synchronization algorithms - comparison of frequency acquisition algorithms - BER performance with frequency synchronization.

UNIT-III

ADAPTIVE SINGLE AND MULTIUSER OFDM TECHNIQUES

9

Adaptive modulation for OFDM : Adaptive OFDM speech system - pre-equalization ; Comparison of adaptive techniques - near optimum power and bit allocation in OFDM - multiuser AOFDM - Multiuser systems - Maximum likelihood enhanced sphere decoding of MIMO OFDM.

UNIT-IV

CHANNEL ESTIMATION IN OFDM SYSTEMS

9

Pilot Based OFDM Channel Estimation-Example; Comb Type Pilot (CTP) Transmission - example; Channel estimation in time/ frequency domain; Frequency Domain Equalization (FDE).

UNIT-V

INSTRUCTIONAL ACTIVITIES

9

BER Vs E_b/N_0 for OFDM in AWGN channel- OFDM channel estimation using LS, LMMSE, and lower complexity LMMSE methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1:** Understand the concept and design of a cellular system.
- CO2:** Analyze the impact of frequency and timing errors on overall system performance.
- CO3:** Evaluate the operation and challenges of multiuser adaptive OFDM systems.
- CO4:** Understand and implement pilot-based OFDM channel estimation techniques.
- CO5:** Optimize channel estimation to enhance system performance and computational efficiency.

TEXT BOOKS:

1. Rappaport, T.S., "Wireless communications", Pearson Education, Second Edition, 2010.
2. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.

REFERENCE BOOKS:

1. Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 2011.
2. Van Nee, R., Ramji Prasad, "OFDM for Wireless Multimedia Communications", Artech House, 2000.
3. Upena Dalal, "Wireless Communication and Networks", Oxford University Press, 2015.

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CO4	3	3	3	3	2	1	-	-	2	3	1	2	3	1	2
CO5	3	3	3	2	1	2	-	-	2	3	1	2	2	2	1
AVG	3	3	3	2	2	1	-	-	2	3	1	2	3	2	2

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