Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Curriculum and Structure

for

Electronics Engineering
(Under Graduate Programme)
From
Academic Year 2019-2020

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Second Year B.Tech. Program in Electronics Engineering Semester-III

Course Code	Curriculum component	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Marks Max	Marks Min	
UELN0301	BS	Engineering Maths-III	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0302	PC	Electronic Devices and Circuits	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0303	PC	Digital Design using HDL	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0304	PC	Network Analysis	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0305	PC	Electronic Measurement and Instrumentation	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0361	Audit-I	Environmental Studies	2	-	-	-	-	100	40	40
UELN0331	PC	Electronic Devices and Circuits LAB	-	-	2	1	ISE	50	20	
							ESE (POE)	50	20	
UELN0332	PC	Electronic Measurement and Instrumentation LAB	-	-	2	1	ISE	50	20	
UELN0333	PC	Digital Design using HDL LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0334	PC	Computer Aided Design LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0351	PRJ	Micro project- I LAB	-	-	2	1	ISE	50	20	
Total			15+2	2	10	22	-	900 (+100 Audit)	360(+40 Audit)	

Total Credits: 22

Total Contact Hours/Week: 29Hrs

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Second Year B.Tech. Program in Electronics Engineering Semester-IV

Course Code	Curriculum compo-	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Marks		
								Max	Min	
UELN0401	PC	Linear Integrated Circuits	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0402	PC	Analog Circuit Design	4	-	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0403	PC	Control System Engineering	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0404	PC	Analog Communication	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0405	PC	Signals & Systems	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0461	Audit -II	Content Creation using Information and web Technologies	2	-	-	-	ESE	100	40	40
UELN0431	PC	Linear Integrated Circuits LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0432	PC	Analog Circuit Design LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0433	PC	Analog Communication LAB	-	-	2	1	ISE	50	20	
							ESE (POE)	50	20	
UELN0434	PC	Control System Engineering LAB	-	-	2	1	ISE	50	20	
UELN0451	PRJ	Micro project-II LAB	-	-	2	1	ISE	50	20	
Total			16+2	1	10	22	-	900 (+100 Audit)	360 (+40 Audit)	

Total Credits: 22

Total Contact Hours/Week: 29 Hrs

Note:

- **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **ISE:** In Semester Evaluation.
- **HS:** Humanities, Social science and Management, **BS: Basic sciences including mathematics**
- **ES:** Engineering Science,**PC:** Professional Core,**PE:** Professional Elective
- **OEL:** Open elective, **PRJ**: Project work, Seminar, Internship in industry etc.
- ** :Course code for Open Elective
- XX : Course code for Professional Elective
- $$: Course code for Audit Course

List of Audit Courses

Year	Course Code	Audit Course	Audit Course
Second Year B.Tech-I	UELN0361	Audit Course-I	Environmental Studies
Second Year B.Tech-II	UELN0461	Audit Course-II	Content Creation using Information and web Technologies

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Third Year B.Tech. Program in Electronics Engineering Semester-V

Course Code	Curriculum	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Weightage		
								Max	Min	
UELN0501	PC	Electromagnetic Engineering	3	1	-	4	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0502	PC	Digital Communication	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0503	PC	Power Electronics	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0504	PC	Microcontrollers	4	-	-	4	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN05XX	PE	Professional Elective-I	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0561	Audit-III	Industry 4.0	2	-	-	-	ESE	100	40	40
UELN0531	PC	Digital Communication LAB	-	-	2	1	ISE	50	20	
							ESE(OE)	50	20	
UELN0532	PC	Power Electronics LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0533	PC	Microcontroller LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN05XX	PE	Professional Elective-I LAB	-	-	2	1	ISE	50	20	
UELN0551	PRJ	Micro project-III LAB	-	-	2	1	ISE	50	20	
Total			16+2	1	10	22	-	900 (+100 Audit)	360 (+40 Audit)	

Total Credits: 22

Total Contact Hours/Week: 29Hrs

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Third Year B.Tech. Program in Electronics Engineering Semester-VI
(Third Year B.Tech-II)

Course Code	Curriculum component	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Weightage		
								Ma	Min	
UELN0601	PC	Computer Architecture and Operating System	4	-	-	4	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0602	PC	Digital Signal Processing	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0603	PC	Data Structures and Algorithms	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UOEL06**	OE	Open Elective-I	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN06XX	PE	Professional Elective-II	3	-	-	3	ISE-I	10	-	40
							MSE	30		
							ISE – II	10		
							ESE	50	20	
UELN0661	Audit-IV	Aptitude Enhancement with Vedic Maths	2	-	-	-	ESE	100	40	40
UELN0641	PRJ	Mini Project	-	-	2	1	ISE	25	10	
							ESE(OE)	50	20	
UELN0631	PC	Computer Architecture and Operating System LAB	-	-	2	1	ISE	50	20	
UELN0632	PC	Model Based Design LAB	-	-	4	2	ISE	25	10	
							ESE (OE)	50	20	
UELN0633	PC	Data Structures and Algorithms LAB	-	-	2	1	ISE	50	20	
							ESE (POE)	50	20	
UELN0634	PC	Digital Signal Processing LAB	-	-	2	1	ISE	50	20	
							ESE (POE)	50	20	
Total			16+2	-	12	22	-	900 (+100 Audit)	360 (+40 Audit)	

Total Credits: 22

Total Contact Hours/Week: 29 Hrs

Note:

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- **ES:** Engineering Science,**PC:** Professional Core,**PE:** Professional Elective
- **OEL:** Open elective, **PRJ**: Project work, Seminar, Internship in industry etc.
- ** :Course code for Open Elective
- XX : Course code for Professional Elective
- $$: Course code for Audit Course

List of Professional Electives

Year	Professional Elective	Course Code	Communication Stream	Course Code	Embedded VLSI Stream	Course Code	Systems and Technologies Stream
Third Year B.Tech -I	Professional Elective-I	UELN0521	Wireless Communication Networks	UELN0522	CMOS VLSI Design	UELN0523	Automotive Electronics
Third Year B.Tech -II	Professional Elective-II	UELN0621	Digital Image Processing	UELN0622	Embedded System Programming	UELN0623	Bio-Medical Electronics

List of Professional Electives LAB

Year	Professional Elective	Course Code	Communication Stream	Course Code	Embedded VLSI Stream	Course Code	Systems and Technologies Stream
Third Year B.Tech-I	Professional Elective-I	UELN0534	Wireless Communication Networks LAB	UELN0535	CMOS VLSI Design LAB	UELN0536	Automotive Electronics LAB

List of Audit Courses

Year	Course Code	Audit Course	Audit Course
Third Year B.Tech-I	UELN0561	Audit Course-III	Industry 4.0
Third Year B.Tech-II	UELN0661	Audit Course-IV	Aptitude Enhancement with Vedic Maths

List of Open Electives

Year	Course Code	Open Elective-I
Third Year B.Tech-II	UOEL0625	Microcontroller Architectures and Programming
	UOEL0626	Industrial Automation

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Final Year B.Tech. Program in Electronics Engineering Semester-VII
(Final Year B.Tech-I)

Course Code	Curriculum component	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Weightage		
								Max	Min	
UELN0701	PC	Embedded System Design	4	-	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0702	PC	Computer Networks	4	-	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UOEL07**	OE	Open Elective-II	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN07XX	PE	Professional Elective-III	3		-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0703	ES	Scripting Languages	1	-	-	1	ISE	50	20	20
UELN0761	Audit-V	Smart Manufacturing	2	-	-	-	ESE	100	40	40
UELN0731	PC	Embedded System Design LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0732	ES	Scripting Languages LAB	-	-	2	1	ISE	50	20	
UELN0733	PC	Computer Networks LAB	-	-	2	1	ISE	50	20	
							ESE(POE)	50	20	
UELN0751	PRJ	Project-I	-	-	4	2	ISE	50	20	
							ESE(OE)	50	20	
Total			15+2	0	10	20	-	800 (+100 Audit)	320(+40 Audit)	

Total Credits: 20

Total Contact Hours/Week: 27 Hrs

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

Final Year B.Tech. Program in Electronics Engineering Semester-VIII
(Final Year B.Tech-II)

Course Code	Curriculum compo-	Course	Teaching scheme				Evaluation Scheme			
			L	T	P	Credits	Scheme	Weightage	Min	
UELN08XX	PE	Professional Elective-IV	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN08XX	PE	Professional Elective -V	1	-	-	1	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
UELN0861	Audit-VI	Audit Course-VI (Online Course)	2	-	-	-	-	100	40	40
UELN0851	PRJ/WI	Project-II and Winter Internship (WI)	-	-	12	6	ISE-I	50		80
							ISE-II	50	20	
							ESE (OE)	100	40	
UELN08XX	PE	Professional Elective -IV LAB	-	-	2	1	ISE	50	20	40
							ESE(POE)	50	20	
UELN08XX	PE	Professional Elective -V LAB	-	-	2	1	ISE	50	20	40
							ESE(OE)	50	20	
Total			4+2	0	16	12	-	600 (+100 Au-	240(+40 Audit)	

Total Credits: 12
Total Contact Hours/Week: 22 Hrs

Note:

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- **ES:** Engineering Science,**PC:** Professional Core,**PE:** Professional Elective
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- ** : Course code for Open Elective
- XX : Course code for Professional Elective
- $$: Course code for Audit Course

List of Professional Electives

Year	Professional Elective	Course Code	Communication Stream	Course Code	Embedded VLSI Stream	Course Code	Systems and Technologies Stream
Final Year B.Tech-I	Professional Elective-III	UELN0721	Antennas and Wave Propagation	UELN0722	SOC Design and Testing	UELN0723	Soft Computing
Final Year B.Tech-II	Professional Elective-IV	UELN0821	Microwave Theory and Techniques	UELN0822	Mixed Signal Design	UELN0823	Modern Power Electronics
Final Year B.Tech-II	Professional Elective-V	UELN0824	Digital TV	UELN0825	IOT and Cloud Computing	UELN0826	PLC and SCADA

List of Professional Electives LAB

Year	Professional Elective	Course Code	Communication Stream	Course Code	Embedded VLSI Stream	Course Code	Systems and Technologies Stream
Final Year B.Tech-II	Professional Elective-IV	UELN0834	Microwave Theory and Techniques LAB	UELN0835	Mixed Signal Design LAB	UELN0836	Modern Power Electronics LAB
Final Year B.Tech-II	Professional Elective-V	UELN0837	Digital TV LAB	UELN0838	IOT and Cloud Computing LAB	UELN0839	PLC and SCADA LAB

List of Audit Courses

Year	Course Code	Audit Course	Audit Course
Final Year B.Tech-I	UELN0761	Audit Course-V	Smart Manufacturing
Final Year B.Tech-II	UELN0861	Audit Course-VI	Online

List of Open Electives

Year	Course Code	Open Elective-II
Final Year B.Tech-I	UOEL0725	Artificial Intelligence
	UOEL0726	Introduction to Control systems

Title of the Course: Electromagnetic Engineering	L	T	P	Credit
Course Code:UELN0501	3	1	--	4

Course Pre-Requisite: Knowledge of Basic coordinate systems, vector algebra

Course Description: This course provides the foundations of electromagnetic theory, with applications in electrical and electronic engineering. Topics include: vector algebra, electrostatics, magneto statics, Faraday's law of electromagnetic induction, differential and integral forms of Maxwell's equations, boundary field conditions, electromagnetic waves, propagation of electromagnetic waves, transmission lines.

Course Objectives:

1. Students recall concepts from vector calculus, integral and differential equations in the analysis of electromagnetic problems
2. Students will able to define, identify, differentiate, illustrate and simulate electric and magnetic fields
3. Students recognize and analyze Maxwell's equations
4. Students describe, recognize and manipulate plane electromagnetic waves in dielectric and conducting media
5. Students determine fundamental characteristics of simple transmission lines in the time domain and analyze it

Course Learning Outcomes:

1. The students will be able to design the transmission line.
2. Students will be able to understand the basic concepts of electromagnetic engineering
3. Able to analyze the parameters of plane waves and transmission lines.

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Relate** vector calculus to static electric, magnetic fields in diff. Engineering situations.	**II**	**Understanding**
CO2	**Solve** problems in electrostatic, magneto static, plane waves and transmission lines	**III**	**Applying**
CO3	**Analyze** the Maxwell's equations in different mediums, different forms and apply them to diverse engineering problems.	**IV**	**Analyzing**
CO4	**Explain** the phenomena of wave propagation in different media and Design transmission line by inputting different parameters	**V**	**Evaluating**

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Vector Algebra Review of vector Analysis and Cartesian, Cylindrical and spherical coordinate systems, Basic vector algebra, Point and Unit vector transformations, Dot product, Cross product, curl, divergence, Gradient.	06 **Hrs.**
Unit 2:--- Electrostatics Coulomb's law & electric field, field due to distributed charges, Flux density, Gauss's law and its applications, divergence theorem, Electrostatic potential, potential gradient, electric dipole, Electrostatic energy density, Boundary conditions for electrostatic field.	06 **Hrs.**
Unit 3:--- Steady Magnetic Field BiotSavarts law, Ampere's circuital law, Stoke's Theorem, Magnetic flux density & Vector magnetic potential, Current carrying conductors in magnetic fields, Torque on loop, Energy stored in magnetic field, Boundary conditions for magneto static field.	07 **Hrs.**
Unit 4:--- Maxwell's Equations Inconsistency of Ampere's law, Faraday's law, Maxwell's equations for static field, time varying field & harmonically varying fields and in word statement, Comparison of field & circuit theory.	04 **Hrs.**
Unit 5:--- Electromagnetic Waves Wave propagation in dielectric & conducting media, Modification in wave equations for sinusoidal time variations, Characteristics of plane wave in a) pure dielectric media, b) Conducting media, Reflection of electromagnetic wave for normal incidence, Polarization. Poynting theorem.	09 **Hrs.**
Unit 6:--- Transmission Lines Types of transmission lines, equivalent circuit, Transmission line equations, primary and secondary constants of transmission line, Transmission line parameters, terminated uniform transmission line, Reflection coefficient, VSWR, group velocity, phase velocity, Applications of Smith chart for Impedance matching Technique a) Single stub b) Double stub.	08 **Hrs.**

Textbooks:

1. "Electromagnetics", John D. Kraus, Tata McGraw-Hill.
2. "Principles of Electromagnetics", S. C. Mahapatra and SudiptaMahapatra, Tata McGraw - Hill, 2011.
3. Sadiku, "Elements of Electromagnetics" 4th edition, Oxford University Press.
4. Electromagnetic waves – R K Shevgaonkar, Tata mc-Graw Hill 1st Ed, 2005.
5."Problems and Solutions in Electromagnetics" W H Hayt and J A Buck Tata mc-Graw Hill

References:

1] WilliamHayt, Buck, "Engineering Electromagnetics", Mc Graw Hill.
2] "Electromagnetic Waves and Radiating Systems", E. C. Jordan & K. Balman, 2nd edition, PHI.
3] "Field and Wave Electromagnetics", David K. Cheng, Pearson Education.
4] "Electromagnetics with Applications" Kraus &Fleisch, 5th Edition, McGraw Hill International Edition

Unit wise Measurable students Learning Outcomes:

1. Comprehend the principles of electric and magnetic field. (L1, L2 and L3)
2. Apply the fundamentals of electromagnetic to **analyze** the performance of transmission Lines and antennas. (L5 and L6)
3. Compare and contrast difference between static and time- varying electromagnetic fields. (L3)
4. Design the impedance matching network for maximum power transmission. (L4 and L5)
5. Test, debug and evaluate the performance of a typical transmission line in terms of VSWR, reflection coefficient using Smith Chart. (L5)
6. Work in team to prepare a report based on survey of effects of radiation (EMI) from cell phone, transmitters, antennas etc.

Title of the Course: Digital Communication	L	T	P	Credit
Course Code:UELN0502	3	-	-	3

Course Pre-Requisite: Mathematical Analysis Skills, Probability theory, Concept of Modulation, Sampling Theorem

Course Description: This course is dedicated to understand and analyze different Digital Communication techniques, its modulation-demodulation schemes and SNR.

Course Objectives:

1. To study and understand the basic concepts of random and stochastic processes
2. To study basics of modern digital communication system design and to evaluate the performance of digital signalling schemes for communication channels.
3. To review the key characteristics and salient features of various digital carrier modulation and schemes for various receiver and transmitter requirements used in different applications.
4. To understand the concepts of minimizing the effects of errors due to noise, with various modulation techniques with basic knowledge for designing, analyzing, and comparing different digital communication schemes

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Understand** the basic concepts of digital communications with an insight into field/practical applications.	II	**Understanding**
CO2	**Evaluate** different Digital modulation schemes to meet the desired performance parameters.	V	**Evaluating**
CO3	**Understand** and mitigate the digital communication problems (ISI, Cross talk etc)	II	**Understanding**
CO4	**Comparative Study** of different modulation-demodulation techniques	II	**Understanding**

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3													
CO2	1				3									
CO3		3	1											
CO4				3							3			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- : Probability Theory Concept of experiment, event, sample space, and probability, Axioms and Laws of Probability, conditional Probability and its properties, concept of total probability and Bay's Theorem, numerical on all the topics	5 -- **Hrs.**
Unit 2:--- Random Variables Concept of random Variables, types of random variables, concept of Distribution function, Cumulative Distribution Function(CDF), Probability Mass Function, Probability Density Function(PDF), Joint CDF and joint PDF, concept of Expectation, MSV, MVS, Variance, and standard Deviation, concept and types of distribution/density functions, study of some standard distribution/density functions viz. binomial, uniform, Geometric, exponential, Rayleigh distribution and Gaussian PDF, numerical on all the topics.	8-- **Hrs.**
Unit 3:--- Random Processes and Noise Concept of Random Process, Time averaging and Ergodicity, Auto correlation, cross correlation, concept of Power spectral density, concept of cross power spectral density, wiener-khintchen-einstein theorem, concept of stationary process, strict-sense and wide-sense stationary process, concept of noise as a random process, noise temperature, noise resistance, its equivalent circuit representation, concept of AWGN and its power spectral density, numerical on all the topics	8-- **Hrs.**
Unit 4:--- Digital Source Coding Quantization: Uniform Quantization, Non uniform Quantization, Companding, Pulse Code Modulation (PCM), Differential Pulse code modulation (DPCM), Delta modulation, Noise in delta modulation, Adaptive delta modulation(ADM), CVSD. Performance of all coding schemes based on, Effect of noise, Bandwidth and Signal to Noise ratio (SNR), numerical on all the topics	6-- **Hrs.**
Unit 5:--- Digital Modulation and Demodulation Schemes Generation, Detection, Signal Space diagram, Spectrum, Bandwidth, Efficiency and probability of error analysis of : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK) , Differential Phase Shift Keying (DPSK), Differentially Encoded Phase Shift Keying (DEPSK), Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK), Quadrature Amplitude Modulation (QAM), duo-binary signalling	10-- **Hrs.**
Unit 6:--- Optimum Receiver Concept of ISI and its mitigation, concept of Eye Pattern, concept of Nyquist filter, Raised cosine filter, Optimum Receiver-Matched Filter& its Properties, Correlation receiver	5 -- **Hrs.**
Textbooks: 1. Modern digital and analog communication, Oxford University Press, 4th edition, B. P. Lathi, Zhi Ding 2. Analog and Digital Communication, TMH Education, T L Singal	
References: 1] Digital Communications, Wiley Publication, Simon Haykin 2] Principals of Communication Systems, McGraw Hill Publication 3] Digital Communications, McGraw Hill Publication, John G Proakis	
Unit wise Measurable students Learning Outcomes: 1. Student should be able to solve the problems based on Probability and theory 2. Student should be able to solve the problems based on random variables 3. Student should understand the concept of random process and model the noise accordingly 4. Student should be able to calculate different performance parameters of source coding schemes 5. Student should understand different digital modulation-demodulation schemes 6. Student should understand the concept of matched filter	

Title of the Course: Power Electronics	L	T	P	Credits
Course Code: UELN0503	3	--	-	3

Course Pre-Requisite: Electronic Devices and circuits. Network analysis, signals and systems.

Course Description:

Power Electronics course introduces the basic concepts of power semiconductor devices and power converters. The course deals with the basic analysis of ac-dc, dc-ac, dc-dc, ac-ac converters.

Course Objectives:

1. To know, identify and define the basic elements of power electronics devices and their characteristics, specifications, operation and protection.
2. To understand fundamentals of controlled rectifier.
3. To analyze working of DC-DC converters (choppers), AC-AC converters, DC-AC converters and control strategies.
4. To discuss the important applications of power devices and provide critical evaluation of the most common types of dc-dc, ac-dc and dc-ac converters.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Cognitive level	Descriptor
CO1	Illustrate working of simple Power Electronic circuits.	II	Understanding
CO2	Analyze phase controlled converters, Choppers and Inverters.	III	Applying
CO3	Experiment applications of power electronic devices and power converters.	III	Applying
CO4	Understand operation of power drives.	II	Understanding

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three units)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three units) covered after MSE.

Course Contents:	
Unit 1: Power Semi Conductor Devices Construction- **: V-**I Characteristics, Dynamic Characteristics during, turn on, turn off, gate triggering Characteristics of SCR,Two transistor analogy – SCR ,Construction, working, & V-I Characteristics of Diac, Triac, Construction, working, & V-I Characteristics GTO, MOSFET, IGBT.	8 **Hrs.**
Unit 2: Firing and commutation Circuits of SCR Turn On methods of SCR: R triggering circuit RC triggering circuit, UJT triggering circuit with design, Cosine based firing circuit and microprocessor based firing circuit for bridge controlled converter. SCR Turn off method: Class A, Class B, Class C, Class D, Class E,& Class F	6 **Hrs.**
Unit 3: AC-DC Converters (1-Phase & 3-Phase Controlled Rectifiers) Derivations of Vdc & Vrms are expected for following configuration: 1 Φ Half Wave Controlled Rectifier with R & RL load. Midpoint converter with RL load. Bridge converter with R , RL and RLE load for continuous current mode of operation with and without freewheeling diode, Semi converter with RL load. Concepts of 3-phase, 3-phase half controlled and full controlled converter with RL load (continuous and discontinuous current mode of operation).Numerical based on performance parameters of above all converter.	7 **Hrs.**
Unit 4: DC-AC Converters(Inverters) Single phase inverter – Principle and operation of half bridge and full bridge inverters. Harmonic reduction techniques of inverter: Quasi square wave, Multiple PWM and sine wave PWM Three Phase inverters (180, 120 degrees conduction modes of operation) – Voltage control techniques for inverters. Harmonic analysis is expected .Numerical based on above.	7 **Hrs.**
Unit 5: Chopper Circuits Introduction to Choppers. Step down chopper with R & RL load. Step up chopper with R & RL load . Classification and quadrant operation of chopper (class A to class F).Voltage control technique of Chopper (frequency modulation & TRC.)	7 **Hrs.**
Unit 6: Cyclo-converters and Fundamentals of Electric Drives. Introduction to cyclo-converters. 1-phase to 1-phase, 3-phase to 1-phase, 3-phase to 3-phase: bridge configuration. Block diagram of an electric drive, parts of electric drive, and selection criteria of electric drives. Comparison of D.C. and A.C. drive. Adjustable speed drive. D.C. Motor: D.C. Shunt and separately excited.	7 **Hrs.**
Text Books: 1. 1.M.H. Rashid, "Power Electronics", 3rd Edition, Pearson. 2. M.D. Singh, K.B. Khanchandani, "Power Electronics", 2nd Edition, Tata- McGraw Hill.	
Reference Books: 1. . Mohan, Undeland, Riobbins, "Power Electronics" 3rd Edition, Wiley. 2. P.C.Sen, "**Power Electronics"**, Tata McGraw-Hill Education. 3. Dr. P. S. Bhimra "Power Electronics" Khanna Publications	

Unit wise Measurable Learning Outcomes:

Unit 1: Power Semi Conductor Devices & Commutation Circuits

Students will be able to

a. Understand the characteristics of electronic elements. .
b. Categorize the various power electronic devices

Unit 2: Firing and commutation Circuits of SCR

Students will be able to

a) Design SCR firing circuits.
b) Analyse different commutation circuits.

Unit 3: AC-DC Converters (1-Phase & 3-Phase Controlled Rectifiers)

Students will be able to

a) Understand rectifier operation and waveforms
b) Develop the basic skills in design and analysis of basic phase controlled converters.

Unit 4: DC-AC Converters(Inverters)

Students will be able to

a) Understand inverter operation and waveforms

Unit 5 : Chopper Circuits

Students will be able to

a. Develop the knowledge about various configurations of chopper.

Unit 6: Cyclo-converters and Fundamentals of Electric Drives.

Students will be able to

a. Understand the operation of cyclo converters.
b. Gain knowledge and understanding of ac & dc drives.

Title of the Course: Microcontrollers	L	T	P	Credit
Course Code:UELN0504	4	-	-	4

Course Pre-Requisite: Number system, logic gates, digital system design, memory types

Course Description: Basic introduction to microcontroller based systems design, development and implementation. It includes microcontroller architecture, programming, I/O Interfacing, Interrupt management and other related topics.

Course Objectives:

1. Understand the architecture of 8051and PIC 16f877 microcontroller
2. Understand the instruction set of 8051 PIC 16f877 microcontroller
3. Understand the peripherals and its programming 8051and PIC 16f877 microcontroller
4. Understand using peripherals to build a useful system

Course Learning Outcomes:

1. Explain von Neumann architecture, Harvard architecture, CISC & RISC architecture of microcontrollers.
2. Demonstrate ON CHIP resources of SOC.
3. Develop assembly language programs.
4. Carry out Interfacing of microcontrollers with off chip resources.
5. Design small applications with KEIL micro vision & MPLAB IDE Tools

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Explain von Neumann architecture, Harvard architecture, CISC & RISC architecture of microcontrollers.**	**II**	**Understanding**
CO2	**Demonstrate ON CHIP resources**	**II**	**Understanding**
CO3	**Develop assembly language programs**	**III**	**Applying**
CO4	**Carry out Interfacing of microcontrollers with off chip resources.**	III	**Applying**
CO5	**Design small applications with KEIL micro vision & MPLAB IDE Tools**	**VI**	**Creating**

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PS02
CO1	2			1				--	-	--			1	1
CO2	2												1	
CO3	1		3									2	2	1
CO4	2		3									2	1	
CO5	2		3	2	2							3	3	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (nor-

mally last three modules) covered after MSE.	
Course Contents:	
Unit 1:--- 8 BIT MICROCONTROLLER -8051: Introduction to Microcontrollers, Architecture, Functional pin description, Memory organization (Internal and External memory concept),Introduction to ON CHIP resources and respective SFRs ,External Program and Data memory interface , Comparison between different family members (89C52,89C51 RD2,80C535,89C420 and ADUC 812)	**8 Hrs.**
Unit 2:---PROGRAMMING OF 8051 Addressing modes, Instruction set, Assembly language programming, Assembler directives	7 **Hrs.**
Unit 3:--- ON CHIP RESOURCES,PROGRAMMING Interrupt structure, Port structure and operation, Timer/Counters(Internal architecture of different modes and programming),Serial port and its operating modes(hardware details of mode-1 only).	8**Hrs.**
Unit 4:--- Interrupts & Hardware Interfacing with 8051 Timers, serial port, Interrupts, Interfacing of Keypad, Seven Segment display, ADC, DAC, Stepper motor, LCD to 8051. Introduction to Embedded C Programming.	8 **Hrs.**
Unit 5:--- INTRODUCTION TO PIC MICROCONTROLLER-16F877 Architecture, RESET options, Watch DOG timer ,Memory organization ,,Instruction set and simple assembly language programming(small programs to introduce instruction set).	**7 Hrs.**
Unit 6:--- ON CHIP RESOURCES OF PIC 16F877 Overview of I/O Ports (internal structure of PORT A only) ,Timers, CCP, ADC , Interrupt structure. Note: Programming of ON CHIP recourses of PIC16F877 is not expected)	8**Hrs.**
Textbooks: 1."The 8051 microcontroller and embedded systems using assembly and c",--By M A Mazidi and J G Mazidi, R D McKinlay-Pearson Education 2."The 8051 Microcontroller "-By I Scott Mackenzie and R C W Phan,4th edition ,Pearson education 3Desgin with PIC microcontroller By J B Peatman, Pearson education	
References: 1. Intel Handbook on 8 Bit and 16 bit embedded controllers 2. PIC microchip Midrange MCU family reference manual. 3. "The 8051Microcontroller-Archictecture,programming & applications"-K. J. Ayala 4. "microcontrollers theory and Applications"-By Ajay Deshmukh-TATA McGraw Hill	
Unit wise Measurable students Learning Outcomes: 1. Ability to write assembly program for 8051 2. Ability to design simple 8051 based hardware and use peripherals to build an 8051 based system.	

Title of the Course: Professional Elective I Wireless Communication Networks Course Code: UELN0521	L	T	P	Credit
	3	--	--	3

Course Pre-Requisite: Analog Communication, Digital Communication

Course Description: This Course aims to develop the basic concepts of 2G, 3G,4G,5G wireless technologies and networks for voice ,data and multimedia services. The student knows about Multiple access schemes for wireless communication and Frequency spectrum allocation. Student understands different Hand off concepts, channel assignment and frequency reuse concept to provide services to millions and trillions of customers globally. This course helps student to understand different Wireless LAN protocols and communication protocols. This course gives the student to know about latest front end technology like Bluetooth, GPRS,GSM, EDGE etc.

Course Objectives: Course objectives:

1. To elaborate and show how wireless networks are penetrating our daily lives for data, multimedia and voice services.
2. To explain Multiple access schemes for wireless communication -TDMA, FDMA, CDMA, SDMA in accessing, analyzing and transferring of remote end data with high reliability and security.
3. To understand different Hand off concepts, channel assignment and frequency reuse concept.
4. To understand concept of GSM architecture GSM channels and frame structure.
5. To understand different Wireless LAN protocols and communication protocol such as IEE802.11
6. To understand use of CDPD networks, wireless access protocols and WAP security.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Illustrate** applications of multiple access schemes TDMA, FDMA, CDMA, SDMA in cellular systems.	**II**	Understanding
CO2	**Perform** system capacity planning for different conditions and **determine** co & adjacent channel interference	**V**	Evaluating
CO3	**Interpret** use of HLR, VLR, and EAR in GSM call setup and find applications for GSM channel types	**II**	Understanding
CO4	**Understand** different Wireless LAN protocols and communication protocol such as IEE802.11, Bluetooth.	**II**	Understanding
CO5	**Describe** functionality of each block of CDPD/ GPRS system, visualize routing in GPRS, and locate limitations of GPRS	**II**	Understanding

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2
CO1	1												
CO2		1								2		1	
CO3		2											
CO4	1		1										
CO5	2				1								

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:---: INTRODUCTION OF WIRELESS COMMUNICATION. Challenges in wireless networking, Wireless communications standards Overview, evolution of cellular system, Cellular system architecture & operation, Performance criteria. Multiple access schemes for wireless communication -TDMA, FDMA, CDMA, SDMA	-6- **Hrs.**
Unit 2:--- WIRELESS NETWORK PLANNING AND OPERATION Frequencies management, channel assignments, frequency reuse, System capacity & its improvement, Handoffs & its types, roaming, co channel & adjacent channel interference	-6- **Hrs.**
Unit 3:--- DIGITAL CELLULAR NETWORKS GSM (Global System for Mobile Communications,) architecture& interfaces, signal processing in GSM, frame structure of GSM, Channels used in GSM	-7- **Hrs.**
Unit 4:--- WIRELESS LAN AND BLUETOOTH TECHNOLOGY Introduction, Requirements of Wireless LAN, Advantages and Disadvantages of IR LAN and Radio Transmissions, IEEE802.11 Architecture and Services, Bluetooth Architecture , Bluetooth Security, Bluetooth Protocols.	-6- **Hrs.**
Unit 5:--- MOBILE DATA NETWORKS Introduction, Data oriented CDPD (Cellular Digital Packet Data) networks, GPRS (General Packet Radio Service) GSM Physical layer: Speech Coding and decoding, Data transmission in GSM: Data Services, SMS, HSCSD, and EDGE (Enhanced Data rates for GSM Evolution).	-7- **Hrs.**
Unit 6:--- WIRELESS ACCESS PROTOCOL (6 Hrs.) WAP (Wireless Application Protocol) architecture, Wireless Datagram, Wireless Transport layer security, wireless transaction, Wireless Session, Wireless Application Environment, WML	-6- **Hrs.**

Textbooks:

1. . William C.Y.Lee, "**Mobile communication Engg**", Tata McGraw Hill Publications
2. T.S. Rappaport, "**Wireless Communication, principles & practice**", Pearson Education
3. Yi Bang Lin, "**Wireless and mobile network architecture**", Wiley India publication

References:

1. William Stalling, "**Wireless Communication & Networking**"
2. Dr Sunilkumar Manvi, "**Wireless and Mobile Network",** (2nd edition) Wiley India publication
3. Upen Dalal, "**Wireless communication and Network**", Oxford Publication

Unit wise Measurable students Learning Outcomes:

Students are able to explain

1.Concept of Wireless communications standards, evolution of cellular system and concept of Multiple access schemes for wireless communication

2. Frequency reuse in cell Clusters, system Capacity, Hand off process and interference

3. Frame structure of GSM, Channels used in GSM.

4. IEEE802.11 Architecture and Services, Bluetooth Architecture Bluetooth Protocols.

5. Use of Data oriented CDPD (Cellular Digital Packet Data) networks and use of GPRS, and GSM Stack ,Speech Coding and decoding, Data transmission in GSM

6. WAP architecture, Wireless Datagram, Wireless security issues and WML

Title of the Course: Professional Elective I CMOS VLSI Design Course Code: UELN0522	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Student should have knowledge of Basics of Transistors, FET, MOSFET, and Principles of Digital Design.

Course Description: This course gives an introduction to CMOS VLSI Design aspects, Circuit formations, Problems and Advantages associated with CMOS.

Course Objectives:

1. To understand the MOS Transistor Basics and its construction.
2. To introduce the concepts CMOS and its Variants.
3. To Understand construction of different circuits, subsystems using CMOS Technology.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain the structure of CMOS	II	Understanding
CO2	Illustrate different parameters in CMOS design	II	Understanding
CO3	Design and Test CMOS circuits using different Strategies.	VI	Creating
CO4	Design subsystems using CMOS.	VI	Creating

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2													
CO2		2												
CO3			3										1	1
CO4			3										1	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- INTRODUCTION MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory - Introduction MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices.	**5 Hrs**
Unit 2:- CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION Introduction, Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics, CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margining, Reliability.	**8 Hrs.**
Unit 3:--- CMOS CIRCUIT AND LOGIC DESIGN CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design.	**5 Hrs.**

Unit 4:--- SYSTEM DESIGN AND DESIGN METHOD Design Strategies CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, Design Economics, Data Sheets.	**8 Hrs.**
Unit 5:--- TESTING CMOS Testing - Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques, Layout Design for Improved Testability.	**4 Hrs.**
Unit 6:--- CMOS SUB SYSTEM DESIGN Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.	**6 Hrs.**
Textbooks: 1. Nell H. E. Weste and Kamran Eshraghian, **" Principles of CMOS VLSI Design "**, Addision Wesley, II nd edition .	
References: 1. John P . Uyemura **" Introduction to VLSI Circuits and Systems",** Wiley India Edition 2. Jacob Backer, Harry W. Li and David E. Boyce, **" CMOS Circuit Design, Layout and Simulation "**, Prentice Hall of India, 1998.	
Unit wise Measurable students Learning Outcomes: **1. Student would be able to explain what the structure of CMOS is.** **2. Student would be able to explain characterization of CMOS and different performance measures.** **3. Student would be able to design basic logic circuits in CMOS.** **4. Student would be able to identify different tools required for CMOS design.** **5. Student would be able to explain different testing techniques for CMOS.** **6. Student would be able to design different subsystems using CMOS.**	

Title of the Course: Professional Elective I Automotive Electronics Course Code: UELN 0523	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Electronics Instrumentation, Control system basics

Course Description:

This course is designed to understand concepts in automotive electronics namely Power train control systems, sensors interfacing, safety systems and onboard diagnostics. Students will be able to correlate concepts learned in electronics engineering to modern automobiles designs.

Course Objectives:

1. To understand the concepts of Automotive Electronics systems & subsystems
2. To understand sensors and sensor monitoring mechanisms and actuator mechanisms aligned to Automotive systems
3. To understand, design and model various automotive control systems
4. To describe various communication systems, wired and wireless protocols used in vehicle networking
5. To understand automotive Safety standards,
6. To understand vehicle on board and off board diagnostics

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Illustrate use of electronics control system in Automotive power train	2	Understanding
CO2	Discuss sensor and interfaces used in Automotive ECU	2	Understanding
CO3	Summaries various protocols and standards used in ECU communication	2	Understanding
CO4	Outline concepts in automotive safety and on board diagnostics	2	Understanding

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2													
CO2	2													
CO3					3									
CO4							2							

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively. ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

Course Contents:	
Unit 1:-Internal combustion engine fundamentals (6Hrs) Engine types and their operations: Engine Operating Cycles, Engine Components, Spark-Ignition Engine Operation, Examples of Spark-Ignition Engines, Compression-Ignition Engine Operation Engine parameters: Geometrical Properties of Reciprocating Engines, Brake Torque and Power, Indicated Work per Cycle, Mechanical Efficiency, Road-Load Power, Mean Effective Pressure, Specific Fuel Consumption and Efficiency, Air/Fuel Ratios, Automotive transmissions: Transmission fundamentals, Types-MT, AT, CVT and DCT	6 **Hrs.**
Unit 2:---Automotive Control Systems Basic Automotive System, System Components, Evolution of Electronics in Automotive. Fuel control system, Ignition control system. Emission control. Hybrid and Electric power train. Control techniques used in hybrid system, Alternators, battery technology and charging systems, Special Control Schemes: Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air-conditions/Heating.	8 **Hrs.**
Unit 3:- Sensor Technologies In Automotive In-vehicle sensors: Working principles, limitations and use within the automotive context of the following: Temperature sensing e.g. coolant, air intake, Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. manifold, exhaust differential type, Distance sensing e.g. anti-collision, Velocity sensing e.g. speedometer, anti-skid, Torque sensing e.g. automatic transmission, acceleration sensing e.g. Airbags, Flow sensing and measurement e.g. Fuel injection. Use of Actuators: Types, Working principle, limitations and use within the automotive context of each type	6 **Hrs.**
Unit 4:- Automotive Communication Systems Automotive Buses: CAN, LIN, Flex Ray, Recent trends in Automotive buses (Such as, MOST, IE, IELLI, D2B, and DSI)	7 **Hrs.**
Unit 5:- Safety Systems in Automobiles Safety in Automotive: Safety norms and standards. Passenger comfort and security systems A) Active Safety Systems: ABS, TCS, ESP, Brake assist etc B) Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (Lane Departure Warning, Collision Warning, Pedestrian Protection, Headlights Control) C) Functional Safety: Need for safety systems, safety concept, safety process for product life cycle, safety by design, validation.	8 **Hrs.**
Unit 6:- Automotive Diagnostics Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols : KWP2000 and UDS.	7 **Hrs.**
Textbooks: 1. Internal_Combustion_Engines_Fundamentals_by_J.B.Heywood, McGraw-Hill 2. Williams. B.Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication 3. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004	
References: 1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999. 2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005. 3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003. 4. Tom Denton, "Advanced Automotive Diagnosis", 2nd Edition, Elsevier, 2006.	

Unit wise Measurable students Learning Outcomes:

1. Students should be able understand concepts of IC engine and develop engine control algorithms to improve fuel economy, emission and torque.

2.Students should be able to discuss control algorithms used in automotive system

3. Students should be able grasp sensor systems used in automotive system

4. Students should be able describe automotive communication standards and systems

5. Students should be able to specify automotive safety system

6. Students should be able to perceive diagnostic requirements, standards and protocols

Title of the Course: Industry 4.0	L	T	P	Credit
Course Code:UELN0561	2	-	-	-

Course Pre-Requisite: Nil. No prior technical background is required.

Course Description:

The world is at the onset of the Fourth Industrial Revolution and this revolution is very much driven by the smarts in automating decision making and processes. Advancements in IT has resulted in immense improvements in computational power across nearly all electronic devices and enhanced capabilities in connecting the dots in an increasingly networked society. This course provides a comprehensive coverage on, among others, the role of data, manufacturing systems, various Industry 4.0 technologies, applications and case studies. In particular, we also draw input from researchers and practitioners on what are the opportunities and challenges brought about by Industry 4.0, and how organisations and knowledge workers can be better prepared to reap the benefits of this latest revolution

Course Objectives:

1. To understand the concept of Industry 4.0 and its application in business world
2. To gain deep insights to harness smartness from input data describe physical model of basic components
1. To understand what needs to be done in order to overcome business challenges.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Understand drivers and enablers of Industry 4.0	II	Understanding
CO2	Understand the various systems used in a manufacturing plant and their role in an Industry 4.0 world	II	Understanding
CO3	Understand the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits	IV	Understanding
CO4	Analyze the power of Cloud Computing in a networked economy	IV	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														

Assessments :

Teacher Assessment:

one End Semester Examination (ESE) having 100% Weightage.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content 100% Weightage for entire course content.

Course Contents:	
Unit 1: **INTRODUCTION TO INDUSTRY 4.0:** The Various Industrial Revolutions, need of Industry 4.0, industry 4.0 and IIoT data flow chart, industry 4.0 and Indian Business transformation, industry 4.0 in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation	3 Hrs.
Unit 2: COMPONENTS OF Industry 4.0 Software components related to industry 4.0, Hardware components related to industry 4.0 viz. ____, Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, data storage and data analysis, Smart Manufacturing, Smart Devices and Products, Predictive Analytics	4 Hrs.
Unit 3: FUNDAMENTALS OF IO LINK TECHNOLOGY Concept of IO link, various IO link blocks and their functionality, IO link competency, IO link solutions to the real industrial problems, benefits of IO link, IO link masters into industry 4.0 and IIoT, Support System for Industry 4.0, Cloud Computing Basics, Cloud Computing and Industry 4.0,	5 Hrs.
Unit 4: IMPACT OF INDUSTRY 4.0 ON INDIAN BUSINESS DEVELOPMENT Need of adopting industry 4.0 in Indian Business, Impact on quality of growth, smart growth, sustainable growth, inclusive/shared growth, integrated growth, return on investments of mechanical and digital factories	5 Hrs.
Unit 5: BUSINESS AND RELATED ISSUES IN INDUSTRY 4.0 Opportunities and Challenges, Strategies for competing in an Industry 4.0 world, issues related to cyber-physical securities, PLC systems, mobile computing systems etc.	4 Hrs.
Unit 6:- Other Applications and Case Studies Industry 4.0 laboratories, IIoT case studies (International) : Russia's experience, Japan's experience, China's experience, Contrasting interpretations of the British experience, India's experience, German Experience, IIoT case studies (National): related to CNC industry, Milk Processing and Packaging Industries, Manufacturing Industries, Electronic Manufacturing Industries	3 Hrs.

Textbooks:

1. Industry 4.0: Managing The Digital Transformation by Alp Ustundag, Springer Publication
2. Industry 4.0: Industrial Revolution of the 21st Century, by Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz

References:

1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)

Unit wise Measurable students Learning Outcomes:

1. The student will be able to explain basics of Industry 4.0 revolutions and standards.
2. The student will be able to understand different services given by industry 4.0 standards.
3. The student will be able to understand different disciplines and preventive measures followed in industry 4.0
4. The student will able to understand the role of data in cloud computing and the significance of cloud computing in industry 4.0
5. The student will be able to analyze and inculcate the industry 4.0 standards
6. The student will be able to analyze different opportunities, challenges and strategies associated with industry 4.0

Title of the Course: Digital Communication LAB	L	T	P	Credit
Course Code:UELN0531	-	-	2	1

Course Pre-Requisite: Concept of Modulation, Sampling Theorem, ability to handle basic laboratory equipment viz. Function Generator, Power Supply, DSO,

Course Description: This course is dedicated to understand & measure the performance of different Digital Communication techniques, its modulation-demodulation schemes and SNR.

Course Objectives:

1. To study and understand the basic concepts of random and stochastic processes
2. To study basics of modern digital communication system design and to evaluate the performance of digital signalling schemes for digital communication channels.
3. To review the key characteristics and salient features of various digital carrier modulation and schemes for various receiver and transmitter requirements used in different applications.
4. To understand the concepts of minimizing the effects of errors due to noise, with various modulation techniques with basic knowledge for designing, analyzing, and comparing different digital communication schemes

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Understand** the basic concepts of digital communications with an insight into field/practical applications.	II	**Understanding**
CO2	**Evaluate** different Digital modulation schemes to meet the desired requirement.	V	**Evaluating**
CO3	**Understand** and mitigate the digital communication problems (ISI, Cross talk etc)	II	**Evaluating**
CO4	**Study** different modulation-demodulation techniques	II	**Studingy**

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3													
CO2	1				3									
CO3		3	1											
CO4				3							3			
CO4	1													

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE (OE)	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1:--- Study of Pulse Code Modulation **Aim and Objectives:** to study the Pulse Code Modulation **Outcomes:** student understood the need and the process of PCM **Theoretical Background**: Pulse code modulation **Experimentation:** **Results and Discussions:** **Conclusion:**	2 -- **Hrs.**

Experiment No. 2:--- Study of Delta Modulation **Aim and Objectives:** Study Delta Modulation **Outcomes:** students understood the advantages of DM over PCM **Theoretical Background:** The output of a delta modulator is a bit stream of samples, at a relatively high **Experimentation:** **Results and Discussions:** **Conclusion:**	2 -- **Hrs.**
Experiment No. 3:--- Study of Adaptive Delta Modulation **Aim and Objectives:** Study Adaptive Delta Modulation **Outcomes:** the advantages of ADM over DM studied **Theoretical Background:** It's an Advanced version of DM and is devised to over-come Slope Overload and Granular Noise error in DM **Experimentation:** **Results and Discussions:** **Conclusion**	2 -- **Hrs.**
Experiment No. 4:--- Study of Amplitude Shift Keying **Aim and Objectives:** Study Amplitude Shift Keying **Outcomes:** student understood modulation of digital signal **Theoretical Background:** Amplitude shift keying (ASK) **Experimentation:** **Results and Discussions:** **Conclusion:**	2 -- **Hrs.**
Experiment No. 5:--- Study of Frequency Shift Keying **Aim and Objectives:** Study FSK **Outcomes:** students understood the advantage of FSK over ASK **Theoretical Background:** concept of FSK **Experimentation:** **Results and Discussions:** **Conclusion:**	2 -- **Hrs.**
Experiment No. 6:--- Study of Phase Shift Keying **Aim and Objectives:** Study PSK **Outcomes:** students understood the advantage of PSK over FSK & ASK **Theoretical Background:** study of PSK **Experimentation:** **Results and Discussions:** **Conclusion:**	2 -- **Hrs.**
Experiment No. 7:--- Study of Quadrature Phase Shift Keying **Aim and Objectives:** Study QPSK **Outcomes:** The students understood the need of QPSK in digital communication **Theoretical Background:** QPSK basics **Experimentation:** **Results and Discussions:** **Conclusion:**	
Experiment No. 8:--- Study of Standard Random Variables Density Distribution Function **Aim and Objectives:** Study Standard Random Variables Density Distribution Func-tion **Outcomes: Students** understood the concept of CDF and PDF **Theoretical Background:** **Experimentation:** study experiment **Results and Discussions: Conclusion:**	
Textbooks: 1. modern digital and analog communication, Oxford University Press, 4th edition, B. P. Lathi, Zhi Ding 2. Analog and Digital Communication, TMH Education, T L Singal	

References:

1] Digital Communications, Wiley Publication, Simon Haykin
2] Principals of Communication Systems, McGraw Hill Publication
3] Digital Communications, McGraw Hill Publication, John G Proakis.

Experiment wise Measurable students Learning Outcomes:

1. Students understood PCM modulation-demodulation scheme
2. Students understood Delta Modulation
3. Students understood Adaptive Delta Modulation
4. Students understood Amplitude Shift Keying
5. Students understood Frequency Shift Keying
6. Students understood Phase Shift Keying
7. Students understood Quadrature Phase Shift Keying
8. Students understood Standard Random Variables Density/Distribution Function

Title of the Course: Power Electronics LAB	L	T	P	Credit
Course Code : UELN0532	-	-	2	1

Course Pre-Requisite:
Basic knowledge of Electronic devices and circuits, Network analysis. Signals and Systems.

Course Description:
Power Electronics Lab course demonstrate the basic power devices and power converters which is the foundation for power transmission, distribution and utilization of the Electrical Engineering discipline. The course deals with the basic analysis of ac-dc, dc-ac, dc-dc, ac-ac converters.

Course Objectives:

5. To know, identify and define the basic elements of power electronics devices and their characteristics, specifications, operation and protection.
6. To understand fundamentals, phase controlled rectifiers (1ph and 3ph) and line commutated inverters.
7. To have the ability to analyze working of DC-DC converters (choppers), AC-AC converters, DC-AC converters and control strategies.
8. To discuss the important applications of power devices and provide critical evaluation, of the most common types of dc-dc, ac-dc and dc-ac converters

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Demonstrate simple Power Electronic circuits.	II	Understanding
CO2	Develop the practical skills in analysis of basic phase controlled converters, Choppers and Inverters.	III	Applying
CO3	Demonstrate the various applications of power electronic devices and power converters.	II	Understanding
CO4	Understand chopper operation and waveforms.	II	Understanding

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3								2					
CO2	3	3	3											
CO3	2													
CO4	1												1	

Assessments :

Teacher Assessment:
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE are based on practical performed/ Quiz/ Lab assignments/ Presentations/ Group Discussions/ Internal oral etc.
ESE: Assessment is based on oral examination and lab experimentation.

Course Contents:

Experiment No. 1:--- **Aim and Objectives:** To Study of VI characteristics of SCR. **Outcomes:** The students will be able toplot V-I Characteristics of the SCR for the Forward **Theoretical Background:** Theoryof V-I characteristics of diode. **Experimentation:** Characteristics of SCR. **Results and Discussions:** Observed and noted analysis Parameters **Conclusion:**Implemented circuit and observed the result	2**Hrs.**

Experiment No. 2:--- **Aim and Objectives:** To Study of Triggering circuits of SCR. **Outcomes:** The students will be able demonstrate working of different triggering circuits of SCR.(R, R-C, UJT Triggering circuits) **Theoretical Background:** Theory ofTriggering methods of SCR. **Experimentation: Tiggering methods of SCR.** **Results and Discussions:** Observed Waveforms and noted analysis Parameters. **Conclusion:**Implemented circuit and observed the result.	2**Hrs.**
Experiment No. 3:--- **Aim and Objectives:** Commutation method of SCR **Outcomes:** The students will be able to demonstrate working of commutation technique of SCR by observing waveforms. **Theoretical Background:**Theory and operation of commutation techniques of SCR. **Experimentation:** Analysis of commutation techniques of SCR. **Results and Discussions:** observed Waveforms and noted analysis Parameters **Conclusion:**Implemented commutation circuit.	2**Hrs.**
Experiment No. 4:--- **Aim and Objectives:** To Study step-down chopper. **Outcomes:** The students will be able to demonstrate working of step-down chopper. **Theoretical Background:**Theory and operation step-down chopper. **Experimentation:** Analysis and implementation of step-down chopper. **Results and Discussions:** observed Waveforms and noted analysis Parameters **Conclusion:**Implemented step-down chopper.	2**Hrs.**
Experiment No. 5:--- **Aim and Objectives:** To Study single phase HWR with R and RL load. **Outcomes:** The students will be able to demonstrate working of single phase HWR. **Theoretical Background:**Theory and operating principle single phase HWR for R and RL load. **Experimentation:** Analysis of outwaveforms and o/p voltage for R and RL load. **Results and Discussions:** observed Waveforms and noted analysis Parameters. **Conclusion:**Implemented single phase HWR.	2**Hrs.**
Experiment No. 6:--- **Aim and Objectives:** To Study of single phase FWR with R and RL load. **Outcomes:** The students will be able to demonstrate working of single phase FWR. **Theoretical Background:**Theory and operation principle single phase FWR. **Experimentation:** Analysis of outwaveforms and o/p voltage for R and RL load. **Results and Discussions:** observed Waveforms and noted analysis Parameters **Conclusion:**Implemented FWR for R and RL Loads.	2**Hrs.**
Experiment No. 7:--- **Aim and Objectives:** To Study of single phase semiconverter with R and RL load. **Outcomes:** The students will be able to demonstrate working of single phase FWR. **Theoretical Background:** Theory and operation principle single phase FWR. **Experimentation:** Analysis of outwaveforms and o/p voltage for R and RL load. **Results and Discussions:** Observed Waveforms. **Conclusion:** Implemented semiconverter for R and RL Loads.	2**Hrs.**
Experiment No. 8:--- **Aim and Objectives:** To Study 1-phase to 1-phase cycloconverter. **Outcomes:** The students will be able to demonstrate working principle of 1-phase to 1-phase cycloconverter. **Theoretical Background:** Theory and operation principle cycloconverter. **Experimentation:** Analysis of o/p waveforms. **Results and Discussions:** Observed Waveforms. **Conclusion:** Implemented 1-phase to 1-phase cycloconverter.	2**Hrs.**
Experiment No. 9:--- **Aim and Objectives:** To study 3 phase inverter for R and RL load. **Outcomes:** The students will be able to demonstrate working principle of 3-phase inverter with R and RL load.	2**Hrs.**

Theoretical Background: Theory and operation principle of 3 phase inverter. **Experimentation:** Analysis of 3 phase inverter from o/p waveforms. **Results and Discussions:** Observation of output waveforms and analysis. **Conclusion:** Implemented 3 phase inverter and observe and analysis of output waveforms.	
Experiment No. 10:--- **Aim and Objectives:** To study four quadrant chopper fed DC drive. **Outcomes:** The students will be able to plot different o/p waveforms for four quaderent DC drive. **Theoretical Background:** Theory and operation principle of four quaderent chopper. **Experimentation:** Analysis of output waveforms of four quaderent chopper circuit. **Results and Discussions:** Observation of output waveforms and analysis. **Conclusion:** Implemented 3 phase inverter and observe and analysis of output waveforms.	2**Hrs.**
Textbooks: 1. 1.M.H. Rashid, "Power Electronics", 3rd Edition, Pearson. 2. M.D. Singh, K.B. Khanchandani, "Power Electronics", 2nd Edition, Tata- McGraw Hill. 3. Dr. P. S. Bhimra "Power Electronics" Khanna Publications	
References: 1. M.H. Rashid, "Power Electronics", 3rd Edition, Pearson. 2. Mohan, Undeland, Riobbins, "Power Electronics" 3rd Edition, Wiley. 3. P.C.Sen, "**Power Electronics"**, Tata McGraw-Hill Education.	
Experiment wise Measurable students Learning Outcomes: 1. The students will be able to plot V-I characteristics of SCR. 2. The students will be able to demonstrate different Triggering circuits of SCR. 3. The students will able to demonstrate working principle of HWR with R and RL load. 4. The students will able to demonstrate working principle of FWR with R and RL load. 5. The students will able to demonstrate working principle of semiconverter with R and RL load. 6. The students will able to demonstrate working principle of commutation circuit of SCR. 7. The students will able to demonstrate working principle of 1-phase to 1-phase cycloconverter. 8. The students will able to demonstrate working principle of 3 phase inverter for R and RL load. 9. The students will able to demonstrate working principle of step-down chopper. 10. The students will able to demonstrate working principle of four quadrant DC drive.	

Title of the Course: Microcontrollers LAB	L	T	P	Credit
Course Code:UELN0533	-	-	2	1

Course Pre-Requisite: KEIL microvision software, MPLAB IDE, C programming

Course Description: Basic introduction to microcontroller based systems design, development and implementation. It includes microcontroller architecture, programming, I/O Interfacing, Interrupt management and other related topics.

Course Objectives:

1. Understand the architecture of 8051and PIC 16f877 microcontroller
2. Understand the instruction set of 8051& PIC 16f877 microcontroller
3. Understand the peripherals and its programming 8051and PIC 16f877 microcontroller
4. Understand the embedded C language
5. Understand using peripherals to build a useful system

Course Learning Outcomes:

1. Demonstrate ON CHIP resources of soc
2. Develop assembly language & embedded c programs
3. Carry out Interfacing of microcontrollers with off chip resources.
4. Design small applications with KEIL micro vision & MPLAB IDE Tools

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Demonstrate ON CHIP resources of soc	II	Understanding
CO2	Develop assembly language & embedded c programs	III	Applying
CO3	Carry out Interfacing of microcontrollers with off chip resources.	V	Evaluating
CO4	Design small applications with KEIL micro vision & MPLAB IDE Tools	VI	Creating

CO-PO Mapping:

CO	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	PS 02
CO1	2												1	
CO2	1		3									2	2	1
CO3	2		3									2	1	
CO4	2		3	2	2							3	3	1

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE (POE)	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on Practical and oral examination

Course Contents:

Experiment No. 1:--- Assembly language programming. **Aim and Objectives:** Understand the instruction set of 8051 **Outcomes:** Develop assembly language **Theoretical Background: 8051 architecture & instruction set of 8051** **Experimentation: Based on keil microvision software** **Results and Discussions: --** **Conclusion:**	02 **Hrs .**
Experiment No. 2:--- Port programming **Aim and Objectives:** Understand the architecture of 8051 **Outcomes:** Demonstrate ON CHIP resources of soc **Theoretical Background:** 8051 architecture	02 **Hrs.**

Experimentation: Based on keil microvision software **Results and Discussions: --** **Conclusion:**	
Experiment No. 3:--- Port programming **Aim and Objectives:** Understand the architecture of 8051 **Outcomes:** Demonstrate ON CHIP resources of soc **Theoretical Background: 8051 architecture & instruction set of 8051** **Experimentation: Based on keil microvision software** **Results and Discussions: --** **Conclusion:**	02 **Hrs.**
Experiment No. 4:---Timer programming **Aim and Objectives:** Understand the peripherals and its programming 8051(Timmer section) **Outcomes:** Demonstrate ON CHIP resources of soc **Theoretical Background: 8051 architecture & instruction set of 8051** **Experimentation: Based on keil microvision software** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 5:---Serial port programming **Aim and Objectives:** Understand the peripherals and its programming 8051(Serial communication section) **Outcomes:** Demonstrate ON CHIP resources of soc **Theoretical Background: 8051 architecture & instruction set of 8051** **Experimentation: Based on keil micro vision software** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 6:--- LED interfacing **Aim and Objectives:** Understand the OFF chip peripherals and its programming **Outcomes:** Demonstrate Off CHIP resources of soc **Theoretical Background: Port structure of 8051 ,current sink & current source capacity of port pins** **Experimentation: Based on 89V51RD2 development kit.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 7:--- 7 Segment displays interfacing with 8051. **Aim and Objectives:** Understand the off chip peripherals and its programming. **Outcomes:** Demonstrate Off CHIP resources of soc **Theoretical Background: Types of 7 segment displays, various interfacing techniques of 7 seg. displays** **Experimentation: Based on 89V51RD2 development kit.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 8:--- LCD interfaces with 8051. **Aim and Objectives:** Understand the off chip peripherals and its programming . **Outcomes:** Demonstrate Off CHIP resources of soc **Theoretical Background: Types of LCD displays, various interfacing techniques of LCD displays** **Experimentation: Based on 89V51RD2 development kit.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 9:-- Assembly language programming OF pic 16f877 **- Aim and Objectives:** Understand the instruction set of PIC 16F877 **Outcomes:** Develop assembly language program **Theoretical Background: PIC 16F877 architecture & instruction set.** **Experimentation: Based on MPLAB IDE software.** **Results and Discussions: --**	02 **Hrs.**

Conclusion	
Experiment No. 10:--- :-- Assembly language programming of PIC 16f877 **- Aim and Objectives:** Understand the instruction set of PIC 16F877 **Outcomes:** Develop assembly language programs **Theoretical Background: PIC 16F877 architecture & instruction set.** **Experimentation: Based on MPLAB IDE software.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No. 11:-- Port programming of PIC 16f877 **- Aim and Objectives: :** Understand the on chip peripherals and its programming of PIC 16F877 **Outcomes:** Develop assembly language programs **Theoretical Background: PIC 16F877 architecture & instruction set.** **Experimentation: Based on MPLAB IDE software.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment No.12:-- 7 segment display interfacing with pic 16f877 **-Aim and Objectives:** Understand the peripherals and its programming pic 16f877 **Outcomes:** Demonstrate Off CHIP resources of soc **Theoretical Background: PIC 16F877 architecture & instruction set.** **Experimentation: Based on 16F877 development kit.** **Results and Discussions: --** **Conclusion**	02 **Hrs.**
Experiment wise Measurable students Learning Outcomes: 1. Ability to write assembly program for 8051 & PIC 16F877 2. Ability to design simple 8051 based hardware and use peripherals to build an 8051 based system using C language 3. Ability to design simple PIC 16F877 based hardware and use peripherals to build an 8051 based system using C language	

Title of the Course: Professional Elective –I LAB Wireless Communication Networks LAB Course Code: UELN0534	L	T	P	Credit
	--	--	2	1

Course Pre-Requisite: Analog Communication, Digital Communication

Course Description: This Course aims to develop the basic concepts of 2G, 3G,4G,5G wireless technologies and networks for voice ,data and multimedia services. The student knows about Multiple access schemes for wireless communication and Frequency spectrum allocation. Student understands different Hand off concepts, channel assignment and frequency reuse concept to provide services to millions and trillions of customers globally. This course helps student to understand different Wireless LAN protocols and communication protocols. This course gives the student to know about latest front end technology like Bluetooth, GPRS,GSM, EDGE etc.

Course Objectives: Course objectives:

1. To elaborate and show how wireless networks are penetrating our daily lives for data, multimedia and voice services.
2. To explain Multiple access schemes for wireless communication -TDMA, FDMA, CDMA, SDMA in accessing, analyzing and transferring of remote end data with high reliability and security.
3. To understand different Hand off concepts, channel assignment and frequency reuse concept.
4. To understand concept of GSM architecture GSM channels and frame structure.
5. To understand different Wireless LAN protocols and communication protocol such as IEE802.11
6. To understand use of CDPD networks, wireless access protocols and WAP security.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Illustrate** applications of multiple access schemes TDMA, FDMA, CDMA, SDMA in cellular systems.	II	Understanding
CO2	**Perform** system capacity planning for different conditions and **determine** co & adjacent channel interference	V	Evaluating
CO3	**Interpret** use of HLR, VLR, and EAR in GSM call setup and find applications for GSM channel types	II	Understanding
CO4	**Understand** different Wireless LAN protocols and communication protocol such as IEE802.11, Bluetooth.	II	Understanding
CO5	**Describe** functionality of each block of CDPD/ GPRS system, visualize routing in GPRS, and locate limitations of GPRS	II	Understanding

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	1												
CO2		1								2		1	
CO3		2											
CO4	1		1										
CO5	2				1								

Assessments :

Teacher Assessment: One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50% weights respectively

Assessment	Marks
ISE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:	
Experiment No-1- **Understanding of Path loss** - To understand the path loss prediction formula.	-1- **Hrs.**
Experiment No-2 Pathloss **with Shadowing**- To understand the effect of shadowing on pathloss formula.	-1- **Hrs.**
Experiment No-3- **Horizontal and Vertical Beam Pattern** - To find the 3dB beam width of a base station antenna.	-2- **Hrs.**
Experiment No-4- **Calculation of Boundary Coverage Probability** -The objective is to calculate the probability that the received signal level crosses a certain sensitivity level.	-2- **Hrs.**
Experiment No-5- **Calculation of SINR including Beam Tilt** -To understand the concept of co-channel interference and hence Signal to Interference and Noise Ratio. A: **Downlink**-To calculate & plot SINR vs. distance at the MS for adaptation of the following parameters: • Shadowing effect, • Vertical Beam Pattern, • Tilt Angle variation B: **Uplink** - To calculate & plot SINR vs. distance at the MS for adaptation of the following parameters: • Shadowing effect, • Vertical Beam Pattern, • Tilt Angle variation.	-2- **Hrs.**
Experiment No-6- **Frequency Reuse** - To understand the cellular frequency reuse concept fulfilling the following objectives: A: Finding the **co-channel cells** for a particular cell. B: Finding the **cell clusters** within certain geographic area.	-6- **Hrs.**
Experiment No-7- **Sectoring** - The aim of the experiment is to understand the impact of many different parameters influence the downlink C/I ratio.	2- **Hrs.**
Experiment No-8-**Handoff** - To understand the handover mechanism.	2- **Hrs.**
Experiment No-9- **Flat Fading** - To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC.	2- **Hrs.**
10) **Frequency Selective Fading** - To study the effect of delay spread on frequency selectivity.	2- **Hrs.**

Textbooks:

1. . William C.Y.Lee, "**Mobile communication Engg**", Tata McGraw Hill Publications
2. T.S. Rappaport, "**Wireless Communication, principles & practice**", Pearson Education
3. Yi Bang Lin, "**Wireless and mobile network architecture**", Wiley India publication

References:

1. William Stalling, "**Wireless Communication & Networking**"
2. Dr Sunilkumar Manvi, "**Wireless and Mobile Network",** (2nd edition) Wiley India publication
3. Upen Dalal, "**Wireless communication and Network**", Oxford Publication

Unit wise Measurable students Learning Outcomes:

Students are able to explain

1.concept of Wireless communications standards, evolution of cellular system and concept of Multiple access schemes for wireless communication

2. frequency reuse in cell Clusters,system Capacity, Hand off process and interference

3. frame structure of GSM, Channels used in GSM.

4. IEEE802.11 Architecture and Services,Bluetooth Architecture Bluetooth Protocols.

5. use of Data oriented CDPD (Cellular Digital Packet Data) networks and use of GPRS, and GSM Stack ,Speech Coding and decoding, Data transmission in GSM

6. WAP architecture, Wireless Datagram, Wireless security issues and WML

Title of the Course: Professional Elective –I LAB CMOS VLSI Design LAB Course Code: UELN0535	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Student should have knowledge of Basics in Transistors, FET's, MOSFET, Logic Gates, Adders, Digital Design.

Course Description: This LAB gives hands on to Design and analysis of Building Blocks of Digital Design using CMOS VLSI Technology. The design will be assessed with DRCs available with tool. The Design Functionalities will be tested using available Standard Libraries and Evaluate performance is terms of Speed Power Area.

Course Objectives:

1. To Design digital design blocks using open source VLSI Design Tool chain.
2. To Perform design verification using DRC.
3. To Simulation of Design using Technology Libraries.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Construct Layout of the given Digital Circuits.	VI	Creating
CO2	Test for the functionality of given Digital Circuit.	IV	Analyzing
CO3	Simulate and Analyze performance parameters of design in terms of Speed Power Area.	IV	Analyzing

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1			3										2	2
CO2				2										
CO3		2												

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	Marks
ISE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents: Minimum 10 Experiments on CMOS circuit design and testing using Open source Software.

Experiment List:

1. MOSFET

Objective: To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel MOSFET.

2. CMOS Inverter

Objective: To design and plot the static (VTC) and dynamic characteristics of a digital CMOS inverter.

3. Ring Oscillator

Objective: To design and plot the output characteristics of a 3-inverter ring oscillator.

4. Logic Gates

Objective: To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.

5. 4x1 Multiplexer

Objective: To design and plot the characteristics of a 4x1 digital multiplexer using pass transistor logic.

6. Latches
Objective: To design and plot the characteristics of a positive and negative latch based on multiplexers.

7. Registers
Objective: To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers.

Textbooks:
1. Nell H. E. Weste and Kamran Eshraghian, **" Principles of CMOS VLSI Design "**, Addision Wesley, II nd edition .

References:
1. John P . Uyemura **" Introduction to VLSI Circuits and Systems",** Wiley India Edition
2. Jacob Backer, Harry W. Li and David E. Boyce, **" CMOS Circuit Design, Layout And Simulation "**, Prentice Hall of India, 1998.

Unit wise Measurable students Learning Outcomes:
1. Student would be able to Construct the structure of CMOS.
2. Student would be able to characterize of CMOS and Measure different performance measures.
3. Student would be able to Use tool chain required for CMOS design.
4. Student would be able to Use different testing techniques for CMOS design.

Title of the Course: Professional Elective-I LAB Automotive Electronics LAB Course Code: UELN0536	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Student should have knowledge of Basics in Automotive sub systems, Sensors, Instrumentation, Communication protocols, C programming etc.

Course Description:

This LAB gives hands on sensor used in developing electronics control units. The lab gives opportunity to interface sensors to ECU, used by automotive industry to derive better torque along with best fuel economy, pollution control. Automotive industry uses serial communication protocol to exchange data between ECUs. CAN bus is the most popularly used protocol by industry. Students can test and study CAN bus protocol using evaluation kit. The present performance of the vehicle is assessed by OBD II standard. Using OBD II port students can assess engine present state and performance using blue tooth connectivity with smart phones.

Course Objectives:

1. To study characteristics of sensors used in automobiles.
2. To Study serial communication protocol used by automotive industry.
3. To Study OBD II protocol
4. To study body electronics used by automotive industry

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Illustrate characteristics of sensors used by automobiles	II	Understanding
CO2	Analyze CAN protocol	IV	Analyzing
CO3	Analyze OBD II standard	IV	Analyzing
CO4	Design door/ wiper control module using suitable microcontroller	VI	Creating

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2												1	
CO2			2										2	
CO3			2										2	
CO4				3										2

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	Marks
ISE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents: Minimum 10 Experiments on Automotive electronics

List of experiments

1. Study and characterize Coolant temperature sensor
2. Study and characterize Manifold Absolute Pressure sensor
3. Study and characterize Oxygen sensor
4. Study and characterize Knock sensor
5. Study and characterize Mass air flow sensor
6. Study and characterize Throttle position sensor
7. Study and characterize Crank shaft position sensor
8. Design Door control module to meet requirements
9. Understanding CAN bus protocol using evaluation kits
10. Observe engine state and performance using OBD II
11. Visit to Authorized well equipped service center of four wheeler

Textbooks:

1. Williams. B.Ribbens, “Understanding Automotive Electronics”, 6th Edition, 2003, Elsevier Science, Newness Publication
2. Robert Bosch, “Automotive Electronics Handbook”, John Wiley and Sons, 2004

References:

1. Ronald K Jurgen, “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 1999.
2. James D Halderman, “Automotive Electricity and Electronics”, PHI Publication 2005.
3. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
4. Tom Denton, “Advanced Automotive Diagnosis”, 2nd Edition, Elsevier, 2006.

Unit wise Measurable students Learning Outcomes:

1. Student would be able to characterize sensors used in modern vehicles.
2. Student would be able to Analyze CAN bus protocol
3. Student would be able to practice OBD II.
4. Student would be able to design DCM.

Title of the LAB: Micro project-III	L	T	P	Credit
Course Code: - UELN0551	-	-	2	1

LAB Pre-Requisite:
Digital system design, Skill of C programming with suitable IDE, Basics of electronics (Bread boarding, soldering, testing) etc.

LAB Description:
This lab prepares students to develop thinking process to solve engineering problems by application of microcontrollers in innovative manner. The group of students not more than 3 should identify Industry, Medical, Social, Safety, security, problems, perform requirement analysis. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of micro-project. As per requirements the group should develop specifications of final outcome of the project. The students should think critically and undertake design of the project with skills available with them to meet the requirements and specifications. The group is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester. The student is expected to exert on design, development and testing of the proposed work as per the schedule. The working model of the project should be demonstrated for internal submission.

Completed micro project and documentation in the form of micro project report is to be submitted at the end of semester. The project should complete in 12 weeks including field trails if any.

The probable areas of the project work (but not only restricted to, Industry, medical field, Biotechnology, renewable energy utilities, biomedical engineering, accident prevention, , smart city, smart transportation.

Course Objectives:
1. Evaluate needs of industry.
2. Identify suitable problem that can be solved using Microcontroller knowledge and basic knowledge of electronics engineering and C programming. .
3. Design and implement the solution using hardware / software or both
4. Testing of the implementation
5. Write project report as per standard format

Course Learning Outcomes:

CO	After the completion of the course the student will able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	**Identify** industry problem that can be implantable using microcontroller and skills like, C Programming, basics of electronics (components soldering and testing using test equipment)	II	Evaluating
CO2	**Analyze** and build logical/ mathematical/ mechanical model of the project.	IV	Analyzing
CO3	**Design** / simulate the model/ project work	I	Designing
CO4	Implement the project using resources available in project LAB	V	Creating
CO5	**Develop** comprehensive report on project work as per prescribed format	III	Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO 9	PO1 0	PO1 1	PO12
CO1		3				2						1
CO2	2											
CO3			3				2					
CO4					3							
CO5									2	3		

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), and one End Semester Examination (ESE) having 50% and 50% weights respectively.

Assessment	Marks
ISE	50

ISE are based seminar/Group Discussions, interactions with project guides, and rubrics etc.

Title of the Course: Computer Architecture and Operating System Course Code: UELN0601	L	T	P	Credit
	4	-	-	4

Course Pre-Requisite:

Number system basics, Fundamentals of Digital Design, Boolean Logic Simplification and Combinational Logic Design, MSI devices, Sequential Logic Design, Semiconductor Memories, Design using HDL, Computer fundamentals, Microprocessor, Programming skills,

Course Description:

This course covers the fundamentals of Computer organization, Processor design requirement and General purpose Operating system features like multiprogramming, process management, and memory management.

Course Objectives:

1. To design and implement various blocks of Arithmetic Logic Unit.
2. To design and implement control unit and processor.
3. To give a complete overview of O.S.
4. To study the process management and issues.
5. To illustrate Classical IPC problems and solutions.
6. To compare the various memory management schemes

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's level	Bloom's Descriptor
CO1	Design and implement various blocks of Arithmetic Logic Unit	VI	Creating
CO2	Design and implement control unit and processor.	VI	Creating
CO3	Summarize overview of operating system.	II	Understanding
CO4	Explain the process management and issues.	II	Understanding
CO5	Illustrate Classical IPC problems and solutions.	II	Understanding
CO6	Compare the various memory management schemes	IV	Analysing

CO-PO Mapping:

CO	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
CO1			2											
CO2			2											
CO3	2													
CO4	2													
CO5	2													
CO6	2													

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:---Arithmetic Unit Design. Fixed point arithmetic: Byte and word, Adders, Subtracters And Multipliers: Booth's algorithm, Robertson's algorithms, combinational array multiplier. 32/64 bit floating point arithmetic :(IEEE 754 format), introduction to pipeline processing.	**8Hrs.**
Unit 2:---Processor Design Introduction, Hard wired control, , GCD processor Design, Design of Control unit for accumulator based CPU, DMA controller, Two's compliment Multiplier control unit design, , Micro programmed control ,Micro Instruction format	**6Hrs.**
Unit 3:--Fundamentals Of OS And System Software Overview of all system software Operating system- I/O Manager- Assembler- Compiler- Linker- Loader, OS services and components, multitasking, multiprogramming, time sharing, buffering, spooling	**4Hrs.**
Unit 4:---Process And Thread Management Concept of process and threads, process states, process management, context switching, interaction between processes and OS, multithreading.	**6Hrs.**
Unit 5:---Concurrency Control Concurrency and race conditions, mutual exclusion requirements, s/w and h/w solutions, semaphores, monitors, classical IPC problem and solutions, Deadlocks - characterization , detection, recovery, avoidance and prevention	**7Hrs.**
Unit 6:---Memory Management Memory partitioning , swapping, paging, segmentation, virtual memory - Concepts, Overlays, Demand paging, Performance of demand paging , page replacement algorithm, Allocation algorithms	**6Hrs.**
Textbooks: 1. J.P. Hayes "Computer Architecture and Organization" McGraw Hill publication. 2. Silberschatz & Galvin,**" Operating System Concepts",** VIII Wiley 2014.	
References: 1. William Stallings ,**"Operating System: Internals & Design Principles'**, Prentice Hall of India. 2. Milman Milenkovic," **Operating systems, concept &design"**	
Unit wise Measurable students Learning Outcomes: **Unit 1: Student should be able to Design and implement various blocks of ALU** **Unit 2: Student should be able to Design and implement control unit and processor.** **Unit 3: Student should be able to Summarize overview of operating system.** **Unit 4: Student should be able to Explain the process management and issues.** **Unit 5: Student should be able to Illustrate Classical IPC problems and solutions.** **Unit 6: Student should be able to Compare the various memory management schemes.**	

Title of the Course: Digital Signal Processing Course Code:UELN0602	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: signals and systems, sampling theory, Fourier analysis etc.

Course Description: The signal for processing is mathematically modelled as a function or a sequence of numbers that represent the state or behaviour of a physical system. The examples of the signals range from speech, audio, image and video in multimedia systems, electrocardiograms in medical systems (ECG/EKG), to electronic radar waveforms in military. Signal processing is concerned with the representation, transformation, and manipulation of signals and the information they contain. For example, we may wish to remove the noise in speech to make it clear, or to enhance an image to make it more natural. Signal processing is one of the fundamental theories and techniques to construct modern information systems. During the last half century, lots of theories and methods have been proposed and widely studied in digital signal processing. In this semester, we only study the fundamentals of discrete-time signals and systems. The course content includes the concept and the classification of discrete-time signal, representations of signals in time, frequency, z- and discrete frequency domains, representations and analyses of systems, and filter designs.

Course Objectives:

In this course, we will mainly study the following topics: signal representation in time domain, Fourier transform, sampling theorem, linear time-invariant system, discrete convolution, z-transform, discrete Fourier transform, and discrete filter design.

After completing the course, the students should be able to understand

1.How to analyze a given signal or system using tools such as Fourier transform and z-transform
2.What kind of characteristics should we analyze to know the property of a signal or system
3. How to process signals to make them more useful
4. How to design a signal processor (digital filter) for a given problem.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Demonstrate DFT and Wavelet Transform	**II**	**Applying**
CO2	Design and implement IIR and FIR filters using simulation tools	**V**	**Designing**
CO3	Explain architecture of DSP processors	**II**	**Understanding**
CO4	Explain realization of multi-rate filters	**II**	**Understanding**

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- Discrete Fourier Transform & FFT Algorithms: Overview of DFT , Fast Fourier transform algorithms – Radix -2 DIT , DIF , Filtering of long duration sequences using overlap-Add and Overlap-save algorithm.	076**Hrs.**
Unit 2:--- wavelet Transform : Fourier Transform and its limitations , short time Fourier transform, continuous wavelet Transform , Discretization of the continuous wavelet Transform, Multi resolution Approximations ; wavelet and Scaling function coefficients, Orthogonality of compactly supported wavelets , Biorthogonal decomposition , harr wavelets , the daubechies wavelets construction , denoising using wavelets , perfect reconstruction filter bank design using walelets.	07 **Hrs.**
Unit 3:--- FIR Filter Design : Characteristic of FIR filter , properties of FIR filter , type of FIR filter Fourier series method, frequency sampling , Fourier series & windowing method.	07 **Hrs.**
Unit 4:--- IIR Filter Design: Analog filters approximations Butterworth filters, Chebyshev filters mapping of s-plare to 2- plare ,filter stability, characteristics of discreate time IIR filter , Design of IIR using Impulse Invariance Method , Bilinear Z- Transform method, Placement of poles & zeros , Freqency Transformation.	06 **Hrs.**
Unit 5:---Realization of filter : FIR and IIR filter realization in cascade form and parallel form, effect of finite word length on redirection of filter. Introduction to DSP processor 67XX: Introduction, TMS320C67XX Architecture, Functional Units, pipelining, Registers, Addressing modes.	9 **Hrs.**
Unit 6:--- Multi-rate digital signal processing : Need of Multirate digital signal processing , decimation by factor D, two stage decimater, interpolation by factor I , two stage Interpolator , sampling rate conversion by initial factor I by D, application of multirate signal processing.	05 **Hrs.**

Textbooks:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.

References:

1. Emmanuel C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

Unit wise Measurable students Learning Outcomes:

1. Comprehend the principles of wavelet transform, DFT and FFT.
2. Apply the fundamentals of DSP to **analyze** the performance of FIR and IIR filter design
3. Compare and contrast difference between FIR and IIR filter design.
4. Design the decimation and interpolation of circuits for DSP

Title of the Course: Data Structures & Algorithms	L	T	P	Credit
Course Code: UELN0603	3	-	-	3

Course Pre-Requisite: Student should have knowledge of Basics in C/C++ Programming, Data types in C/C++.

Course Description: This course gives a introduction to data types, algorithms to access different data types, complexity involved in different data type algorithms, different flavours of data types.

Course Objectives:

1. To provide the student with a solid foundation in Engineering. Fundamentals & programming required to solve basic Engineering Problems.
2. To introduce the concepts of array, record & pointers.
3. To understand the importance of linked lists and its applications.
4. To train the students so that they will be prepared to work on multidisciplinary problems.
5. To introduce the concepts of non linear data structures & searching techniques.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	**Explain** the concepts of basic data structure operations	II	Understanding'
CO2	**Apply** the Algorithms to Add, delete, sort, and search for data structures like Array, linked list, Stack and Queue.	III	Applying
CO3	**Evaluate** the performance of algorithms for managing the data structure.	V	Evaluating
CO4	**Illustrate** the concept of trees, graphs and searching techniques.	II	Understanding

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2													
CO2	3													
CO3				2										
CO4	2													

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- Introduction & Overview Arrays, Records Introduction to theory of data structures & its data types, Algorithms: complexity, time space trade-off with example. Introduction, linear arrays, representation of linear array in memory, traversing linear arrays, inserting & deleting, Sorting: bubble sort, searching: linear search, binary search, Multidimensional arrays,	**6 Hrs.**
Unit 2:---Pointers Pointers: pointer arrays, Records: Record structures, representation of records in memory, parallel arrays, matrices, sparse matrices.	6 **Hrs.**
Unit 3:--- Linked Lists Introduction, linked lists & its representation, Traversing & searching a linked list, memory allocation, Garbage collection, insertion & deletion of nodes of linked list, header linked list, two-way lists, programming problems.	**8 Hrs.**
Unit 4:--- Stacks & Queues: Introduction to stacks, stack as an Abstract Data type , representation through Arrays & linked lists ,Applications of stacks , stacks & recursion, Queue as an abstract data type representation, circular, double ended, priority, Quicksort ,application of queues.	**6 Hrs.**
Unit 5:--- Trees Binary Tree: introduction, types, definition, properties, representations, operations, binary tree traversal, reconstruction, counting number of binary trees, applications. Advanced trees: AVL trees or height balanced trees, representation operation, Threaded binary trees, Expression trees. Multiway trees: trees, multiway search trees, B+ trees, Heaps, construction of a Heap.	8 **Hrs.**
Unit 6:--- Graphs Introduction, Graph theory terminology, sequential representation of graphs: Adjacency Matrix, Path matrix, Warshall's Algorithm, shortest paths, linked representation. Operations, Traversing, Posets, Topological sorting, Hashing, Hash functions, collision, chaining	**6 Hrs.**
Textbooks: 1.Seymour Lipschautz –'Data structures' - Shaum's outlines -Tata McGraw Hill 2.ISRD group –'Data structure using C '–- Tata McGraw Hill Reference Books	
References: 1.Langsam, Augenstein, Tenenbaun –'Data structure using C & C++ ' - PHI 2.Mark Allen Weiss- 'Data structure & algorithm analysis in C'- 2nd edition –Pearson Education (LPE) 3.M.T. Goodrich, R. Tamassia, D. Mount- Data Structures & Algorithms in C++- Wiley Publication 4.A.N. Kamthane-" Introduction to Data structures in C"- Pearson Education (LPE) 5.Data structure – A programming Approach with C- D.S Kushawaha, A.K.Misra-PHI Publi. 6. Data structures – A pseudocode Approach with C- R.F.Gilberg,b.a.forouzan-Cengage Learning.	
Unit wise Measurable students Learning Outcomes: 1. Student would be able to explain what is the structure of data type and complexity involved in it. 2. Student would be able to explain the structure of array, records and pointers and memory allocation of these structures. 3. Student would be able to explain the structure of linked list its advantages and would able to write algorithms for it. 4. Student would be able to explain the structure of Stacks and Queues its applications and would able to write algorithms for it. 5. Student would be able to explain the structure of Trees its applications and would able to write algorithms for it. 6. Student would be able to explain the structure of Graphs its applications and would able to write algorithms for it. 7. Student would be able to explain the concept of hashing and different techniques involved in it.	

Title of the Course: Open Elective -I Microcontroller Architectures and programming Code: UOEL0625	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite:

Binary and hexadecimal Number systems and arithmetic, Basics of C programming

Course Description:

This course is designed to understand basic concepts in microcontroller architecture and programming. The first two unit give exposure to basics of digital systems and micro computing unit architecture. The study of MSC51 architecture and programming is offered. The last chapter gives exposure to programming ready to use hardware and software platform like Arduino and integrated development environment for programming enabling faster deployment of application for industries.

Course Objectives:

1. To understand the concepts of digital systems
2. To develop concept micro computing architectures
3. To understand programming embedded system using assembly language embedded C
4. To understand Programming environment of Arduino and understand real life applications using ready to use hardware platform resources available

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Illustrate digital systems concept	2	Understanding
CO2	Compare architectures of micro computing units	2	Understanding
CO3	Programming in assembly language Embedded C to meet system requirements	3	Applying
CO4	Develop applications on Arduino platform	3	Applying

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1													
CO2	2													
CO3		2			3									
CO4		1			3								3	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- Digital systems: Logic gates, simplification of Boolean equations, Combinational logic for ALU design, MUX and DEMUX, Encoders and decoders, Memory elements: RS, D, T, JK flip-flops, clock sources, triggering of flip-flops, Flip-flop timing diagram case studies, analysis of Moore and Millay machines	7 **Hrs.**
Unit 2:-- Building blocks of Architectures: Concept of Memory, ROM, RAM, EPROM, EPROM, DRAM, organization of computing system: Processor, Registers, ALU, memory subsystem, Von-Newman and Harvard architecture, Pipeline architecture, RISC and SISC architecture, F-D-E cycle of CPU, concept of Stack memory and FIFO operation of stack memory	6 **Hrs.**

Unit 3:- Architecture of MSC51 8051 block diagram, Memory organization, SFR, introduction to: IO ports, Timer counters, MCS 51 Interrupts, serial communication port of MSC51	7 **Hrs.**
Unit 4:- Instruction set and assembly language programming of 8051 Illustration of Addressing modes of MSC51 using suitable data transfer instructions, Arithmetic and logical instruction, instructions, Program flow control instructions, concept of subroutine, nested call, call instructions	6 **Hrs.**
Unit 5: Embedded C programming (8 bit): Key words memory models, memory types, data types, bit data type, pointers, functions, interrupt functions, reentrant functions, study of simple programming case studies (Minimum 2)	7 **Hrs.**
Unit 6:- Unit 6: Platform based programming: software architecture, IDE study, drivers, libraries, Serial monitor, Interfacing switches, LEDs and sensors, serial communication using Arduino	7 Hrs
Text books 1. Digital Design Morris Mano, Michael D. Ciletti, 5th edition, Pearson. 2. The 8051 microcontroller- Architecture, programming and applications, K J Ayala, 3. C programming for Arduino Julien Bayle PACKT Publishing	
Reference book 1. Digital systems Principles and applications Ronald J Tocci, Pearson 2. The 8051 microcontroller and embedded system using assembly and C, M A Mazidi, Pearson 3. Exploring Arduino®: Tools and Techniques for Engineering Wizardry, Jeremy Blum, Wiley.	
Unit wise Measurable students Learning Outcomes: 1. Students should be able understand concepts of digital systems basics 2.Students should be able compare and contrast different architectures of central processing Unit 3. Students should be able to develop assembly language programs using MCS 51 4. Students should be able develop C code developed for specific architecture under consideration 6. Students should be able develop applications using Arduino programming environment and ready to use hardware platforms	

Title of the Course: Industrial Automation	L	T	P	Credit
Course Code: UOEL0626	3	-	-	3

Course Pre-Requisite: Basic Knowledge of Sensors and instrumentation

Course Objectives:

Objectives of this course are:

1.Understand the fundamentals and importance of industrial automation systems

2.Learn to develop a PLC program for an automatic control system and its applications

3.Understand the mechanism, architecture, working principles and applications of DCS and SCADA

Course Learning Outcomes:

1. Students will be able to understand fundamentals and need of Industrial automation
2. Students will understand the basic concepts of Programmable Logic control.
3. Students will understand the ladder, functional block programming and various timers.
4. Students will be able to understand distributed Control System and SCADA basics.

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Understand the basic industrial automation	II	Understanding
CO2	Develop a PLC program for an automatic control system of a medium degree of complexity.	VII	Creating
CO3	Understand the mechanism and applications of SCADA.	II	Understanding

CO-PO Mapping:

CO	a	b	c	d	e	f	g	h	i	j	K
CO1											
CO2											
CO3											
CO4											
CO4											
CO5											
CO6											

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE and 30-40 % Weightage of first three units.

Course Contents:

Unit 1:--- Introduction to Automation Automation: Fundamentals of Industrial Automation, Need and role of Automation, Evolution of Automation, and Elements of process control loop, Current Trends. Programmable Logic Controller: Controllers, Hardware, Internal Architecture. Input−output devices Mechanical switches, Proximity switches, Photoelectric sensors and switches, Encoders, Output devices Relay Directional control valves, Motors, Stepper motors, Examples of applications.	**7 Hrs.**
Unit 2:--- : **Ladder and functional block programming** Ladder diagrams, Logic functions, Latching, Multiple outputs, Function blocks, Program examples, Instruction lists, Sequential function charts, Structured text, Internal relays, Ladder programs, One-shot operation, Set and reset, Jump and call: Jump, Subroutines	**8 Hrs.**

Unit 3:--- Timers Types of timers, Programming timers, Off-delay timers, Pulse timers, Programming examples, Counters, Timers with counters, Sequencer, Data handling	**6 Hrs.**
Unit 4:--- Distributed Control system System Architecture Introduction Analog Control Direct Digital Control Distributed Control System Functional Components DCS Control Network Operator Console Core Architectural Components System Configuration Computers-Algorithms, Languages, Programmes computers-Hierarchical Control . Supervisory computer tasks and DCS configuration, DCS- System integration with PLCs and Computers	**7 Hrs.**
Unit 5:--- Supervisory Control and Data Acquisition (SCADA) Introduction, brief history of SCADA, elements of SCADA. Features of SCADA, Fundamental principles of modern SCADA systems, The SCADA software, and SCADA protocols Functions of RTU Comparison of the terms SCADA, DCS, PLC and smart Instrument.	05 **Hrs.**
Textbooks: 1.Programmable Logic Controller W Bolton 5th Edition ISBN: 978-1-85617-751-1, Elsevier Publication 2009 2.'Instrument Engineers' Handbook, Process Control Bela G. Liptak 4th Edition 3. Practical SCADA for industry David Bailey Edwin Wright ISBN:0750658053, Elsevier Publication 2003	
References: 1.Understanding Distributed Processor Systems for Control. Samuel M. Herb ISA Publication, 1999 2.Computer control of processes - M.Chidambaram, Narosa publishing, Reprint 2010 3.Programmable Logic Controller Frank D. Petruzella Third Edition TaTa McGraw-Hill Edition, 2010 4.Computer Based Industrial control- Krishna Kant, Prentice Hall of India. 6th Edition, 2004 5.Distributed computer control for industrial automation popovic and bhatkar Publication by Marcel Dekker, Inc. New York, NY, USA ©1990	

Title of the Course: Professional Elective II Digital Image Processing Course Code: UELN0621	L	T	P	Credits
	3	--	-	3

Course Pre-Requisite:
Random Variables, Set Theory, Signals and Systems.

Course Description:
This course gives the students the fundamentals of digital image processing, linear filtering, linear transforms, image enhancement in both spatial and frequency domain; image reconstruction; inverse problems in imaging; edge detection; feature extraction; compression; wavelet based imaging and mathematical morphology

Course Objectives:
1. To provide the student with fundamentals of digital image processing.
2. To build various Image enhancement, restoration and compression techniques
3. To develop various Image segmentation methods, Wavelet based and morphological Image Processing.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Explain the basic elements and applications of image processing.	II	Understanding
CO2	Analyze image sampling and quantization requirements and its implications.	IV	Analysing
CO3	Design and implement two-dimensional spatial and frequency filters for image enhancement.	VI	Creating
CO4	Develop Wavelet based applications.	III	Apply

CO-PO Mapping:

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

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three units)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three units) covered after MSE.

Course Contents:	
Unit 1: DIGITAL IMAGE FUNDAMENTALS Image sensing and acquisition. Basic concept of image sampling and quantization Representations of digital image. Spatial and gray level resolution. Zooming and shrinking of image. Basic relationship between pixels, Image registration techniques.	6 Hrs.
Unit 2: IMAGE ENHANCEMENT (SPATIAL and Frequency DOMAIN) Basic gray level transformations: image negation, log transformations, Power law transformations, Piece wise linear transformations. Histogram processing, Histogram equalization, Histogram matching. Image enhancement using arithmetic and logical operations. Filtering in frequency domain: obtaining frequency domain filters from spatial filters. Generating filters directly in the frequency domain, Low pass (smoothing) and High pass (sharpening) filters in Frequency domain.	7 Hrs.
Unit 3: IMAGE SEGMENTATION Detection of discontinuities, Edge linking and boundary detection. Threshold, Region oriented segmentation. Morphological Image Processing. Dilation and Erosion: Dilation, Structuring Element Decomposition, the Strel function, Erosion. Combining Dilation and Erosion: Opening and closing the hit and miss transformation.	8 Hrs.
Unit 4: IMAGE COMPRESSION Redundancies and their removal methods. Fidelity criteria. Image compression models, Source encoder and decoder, Error free compression, Lossy Compression, JPEG 2000 Standard.	6 Hrs.
Unit 5: COLOR IMAGE PROCESSING. Color fundamentals, color models, RGB color model, CMY color model, HSI color model. Pseudo color image processing: intensity slicing. Gray level to color transformation.	7 Hrs.
Unit 6: Wavelets and Multi resolution Processing Image Pyramids, Subband Coding, Types of Wavelet transforms. Multi resolution Expansions: Series Expansions .Scaling Functions. Wavelet Functions, Wavelet Transforms in One Dimension: The Wavelet Series Expansions .The Discrete wavelet Transform. The Continuous Wavelet Transform.	7 Hrs.
Text Books: 1.Rafael C. Gonzalez and Richard E. Woods, "Digital image processing", (Pearson Education publication) 2." Digital image processing" by A. K. Jain	
Reference Books: S. Sridhar, "Digital Image Processing", (Oxford) 2) Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", (PHI)	
Unit wise Measurable Learning Outcomes: 1. Explain the basic elements and applications of image processing 2. Analyze image sampling and quantization requirements. 3. Design and implement two-dimensional spatial and frequency filters for image enhancement 4. Explain the image segmentation and image compression problem 5. Illustrate image compression. 6. Illustrate color image processing. 7. Develop Wavelet based applications	

Title of the Course: Professional Elective II Embedded System Programming Course Code:UELN0622	L	T	P	Credit
	3	-	-	3

Course Pre-Requisites:

Study of 8 bit microcontroller architecture and assembly language programming, Basics of C programming, Programming resources of microcontroller like Timer, ADC, DAC, PWM, Serial buses etc.

Course Description:

This course is designed to understand concepts in developing algorithms using UML for modern embedded systems. The main focus of the course is writing effective C codes to design embedded system with due consideration to safety, as embedded systems are used in Automotive and Avionic systems. Due consideration should be given to program embedded systems to meet performance metrics. All above mentioned concepts should be practiced on ready to use hardware platform and integrated development environment for programming

Course Objectives:

1. To understand the concepts of UML for optimized program design
2. To understand programming embedded system using embedded C
3. Write C codes to meet MISRA C standard
4. To describe various methods to meet safety and reliability in programming Embedded systems
5. To understand methods to evaluate performance and optimize the system in design
6. To understand Programming environment of Arduino and develop real life applications using ready to use hardware platform resources available

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Illustrate use of UML for program design	2	Understanding
CO2	Practice Embedded C to meet system requirements and to meet MISRA C standard	3	Applying
CO3	Analysing various method to develop codes to meet safety and performance optimization	4	Analysing
CO4	Develop applications on Arduino platform	*3*	*Applying*

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		2	2											
CO2													3	
CO3							2							
CO4					3									3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on Lab assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:- Introduction to software modelling UML diagrams, writing use cases, Class diagrams, Class relationships, Dynamic modelling with UML, Interaction diagram, Sequence diagram, Fork and Join, Branch and merge, Activity diagram, State chart diagram, Dynamic modelling with structured design methods, Data and control flow diagram	6 **Hrs.**
Unit 2:---Basics of Embedded C programming Software and its manifestation, Embedded C program, C building blocks, C program structure,MISRA C guidelines for C programming	4Hrs
Unit 3:- Embedded C Programming Bit wise operator, Pointer variables and memory addresses, Functions, Pointers to functions, Structures, The interrupts,	8Hrs
Unit 4: Platform based programming: software architecture, IDE study, drivers, libraries, Serial monitor, Trigonometric C functions in, Time measure, Interfacing switches, LEDs and sensors, serial communication using Arduino, hardware and timer interrupts, Programming libraries, Memory management	10Hrs
Unit 5:- Performance analysis and optimization Performance measures, Complexity analysis, Comparing algorithms, Analysing code, Analysing algorithms, Analysing data structures, Instructions in details, Response time, Time loading, Memory loading, Evaluating performance, Performance optimization, Optimizing for power consumption	4 Hrs
Unit 6:- Safety, Reliability and robust design Introduction, Failure models, safe and robust design, System functional level consideration, System architectural level consideration, Data and control faults, Power sub systems	4 **Hrs.**
Textbooks: 1. Embedded systems A contemporary design tool, James K Peckol, Wiely 2. C programming for Arduino Julien Bayle PACKT Publishing	
References: 1. C in depth S K Srivastava, Deepali Srivastva, BPB publication 2. Exploring Arduino®: Tools and Techniques for Engineering Wizardry, Jeremy Blum, Wiley	
Unit wise Measurable students Learning Outcomes: **1.** Students should be able understand concepts of UML for algorithms development and programing in embedded C 2.Students should be able write embedded C codes to develop embedded systems 3. Students should be able apply concept of safety while designing C codes using MISRA C 4. Students should be able develop applications using Arduino programming environment and ready to use hardware platforms 5. Students should be able analyse performance of C code developed for specific architecture under consideration and design optimized code	

Title of the Course: Professional Elective-II Biomedical Electronics Course Code:UELN0623	L	T	P	Credit
	3	-	-	3

Course Pre-Requisites:

Basics of Human anatomy, basics of different sensors and their working principle

Course Description:

Course refers to a very broad class of devices and systems. In this course we will primarily study sensing systems, which means that the system front-end will generally be a sensing element. Other than this restriction, we will cover all aspects of typical biomedical instrumentation systems. We will do them in the following order:

1. Basic Sensors and Principles -- including biopotential electrodes
2. Electronic Interfacing: including system noise figure, system bandwidth, pre-amplifiers, post amps, instrumentation amps, A/D and D/A converters, aliasing, triggering and signal averaging
3. Computation: including data capture and signal processing
4. Systems: complete system response using specific examples (electromyogram, pressure sensors and blood pressure measurements, flow sensors and blood flow measurements, and chemical biosensors)

Course Objectives:

1. To study and understand the basic concepts of human physiology
2. To model the human physiological system as per system requirement
3. To study the different sensors and transducers used in the field of biomedical science and it's working principle
4. To design the system that suits the most for the desired biomedical problem/application

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Understand the human physiology	II	Understand
CO2	Build and develop the mathematical modelling of the biological system	III	Applying
CO3	Understand the working principle of different biomedical sensors	II	Understand
CO4	Build the electro-mechanical system for the desired application of problem	III	Applying

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1					1								
CO2		3	3		2								1	1
CO3	2													
CO4				2		1			1		2		1	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:---Basic cell physiology; human bones, Systemic physiology: Neuromuscular system; Blood and lymph; Circulatory system; Respiratory and Cardiovascular system, Gastro-intestinal system; Kidney and excretory system; Sensory systems- visual, auditory, vestibular; Endocrine- pituitary, adrenal, pancreas, Clinical and technological implications	8-- Hrs.
Unit 2:--- Electro-Mathematical modelling of biological system and computational problems in the context of biology and medicine with emphasis on deterministic models. Review of limits, derivatives, and graphing of functions, Function maxima and minima. Integration. Linear ordinary differential equations. Second order partial differential equations. Transform techniques. Difference approximations, discrete models, and numerical solutions, error analysis. Introduction to algorithmic for biology and medicine.	6-- Hrs.
Unit 3:--- Introduction to biosensors and classification. Different transduction mechanisms in sensors. Types of recognition layers. Examples and functioning of different types of biosensors including, but not restricted to, optical, mechanical (e.g. micro cantilever, piezo, SAW, etc), electrochemical, FET, thermal, etc. Analytical modelling of biosensors.	6-- Hrs.
Unit 4:--- **Medical measurands**; Sensor characteristics and design for measurement of medical parameters like ECG, arterial flow, blood pressure, heart sounds; Bio potential amplifiers, charge amplifiers and other interfaces; Signal conditioning and display. Medical imaging considerations; X-rays, X-ray tube design, film and detector design; CT - scanners: generations and basic algorithms. Elements of electrical safety; Built-in safety features for medical instruments.	8-- Hrs.
Unit 5:---Instrumentation for clinical laboratory: Measurement of pH value of blood, ESR measurements, Hb measurement, oxygen and carbon dioxide concentration in blood, GSR measurement, polarographic measurements, computer applications.	6-- Hrs.
Unit 6:--- System Development for the Biomedical Application	6-- Hrs.

Text books :

1. Arthur C. Guyton: Textbook of Medical Physiology, 8th ed, Prism Books (Pvt) Ltd & W.B. Saunders Company, 1991.
2. W.F.Ganong, Review of Medical Physiology, 13th ed., Prentice-Hall, 17th edition, 1995
3. J. D. Murray, Mathematical biology: an introduction, 3rd ed., New York, Springer 2002.
4. R. W. Shonkwiler, Mathematical Biology: An Introduction with Maple and Matlab, Springer 2009.
5. E. Kreyszig. Advanced Engineering Mathematics, 9th Ed., Wiley, 2006

Reference books:

1.Handbook of biosensors and biochips: Marks, Robert S....et al.: John Wiley, 2007
2. Engineering biosensors, kinetics and design applications by AjitSadana..San Diego, Academic Press, 2002
3. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
4. Biosensors: theory and applications by Donald G. Buerk. Lancaster: Technomic Pub., 1993.

Unit wise Measurable students Learning Outcomes:

1 Understanding of Basics of human anatomy
2 Introduction mathematical approach to biomedical problems
3 Introduction to biosensors
4 Introduction to biomedical sensor
5 Instrumentation for clinical laboratory
6 System Development for the Biomedical Application

Title of the Course: Aptitude Enhancement with Vedic Maths	L	T	P	Credit
Course Code:UELN0661	2	-	-	-

Course Pre-Requisite: Basic Mathematics, Arithmetic calculations

Course Description:

This course encompasses the study of Vedic maths and focuses on preparation of aptitude for competitive exams and entrance tests.

Course Objectives:

1. To understand techniques of Vedic Maths.
2. To solve Arithmetic and Logical reasoning problems quickly
3. To understand the techniques to solve Data Interpretation problems
4. To create verbal and comprehensional ability

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Apply techniques of Vedic Maths for mathematical and logical reasoning	II	Understanding
CO2	Apply techniques to solve arithmetic and logical reasoning	IV	Applying
CO3	Apply techniques to solve Data Interpretation problems	IV	Applying
CO4	Analyze and comprehend passages effectively	III	Analyzing

CO-PO Mapping:

CO-PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	2	1												
CO2			2										2	
CO3			2										2	
CO4			2							2			2	

Assessments :

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content (Objective Test)

Course Contents:

Unit I : Vedic Maths Multiplication (Nikhilam, Anurupyen, Eknyunen purven, Urdhwatiryagbhyam, Antyayodarshakepi, Ekadhiken purven, Yawadunam), Division (Nikhilam, Urdhwatiryagbhyam), Speed maths inspired by Vedic Maths	7 **Hrs.**
Unit 2 : **Mathematical Reasoning and Aptitude** Types of reasoning, Number series, Letter series, Codes and Relationships, Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.).	5**Hrs.**
Unit 3 : Logical Reasoning Understanding the structure of arguments, Evaluating and distinguishing deductive and inductive reasoning, Analogies, Venn diagram: Simple and multiple Uses for establishing validity of arguments, Indian Logic: Means of knowledge, Pramanas: Perception, Inference, Comparison, Verbal testimony, Implication, Non-apprehension, inference, invariable relation, fallacies of inference).	**5Hrs.**
Unit 4:- Data Interpretation Sources, acquisition and classification of Data, Quantitative and Qualitative Data, Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of Data, Data Interpretation, Data and Governance.	4**Hrs.**

Unit 5: Verbal Ability and comprehension Jumbled Paragraphs, Summary/Inference of short paragraph, Reasoning type comprehension, Vocabulary based comprehension, Thought based, fact verification, opposite meaning type comprehension.	5**Hrs.**

Textbooks:

1. How to Prepare for Quantitative Aptitude (English, McGraw Hill Education, Arun Sharma)

References:

- Verbal Ability and Reading Comprehension**,** Pearson Publications by Nishit K Sinha
- How to prepare for Data Interpretation, Pearson Publications by Arun Sharma
- Quantitative Aptitude by R.S. Aggarwal

Unit wise Measurable students Learning Outcomes:

1. The student will be able to explain basics of Vedic Maths.
2. The student will be able to apply techniques to solve logical reasoning problems.
3. The student will be able to explore techniques to solve data interpretation problems.
4. The student will be able to analyze and comprehend passages effectively.

Title of the LAB: Mini project	L	T	P	Credit
Course Code: UELN0641	-	-	2	1

LAB Pre-Requisite:
Microcontroller hardware design, program design, IDE programming, Basics of electronics system design, Matlab/ C programming etc.

LAB Description:
This lab prepares students to develop thinking process to solve problems of industry, Medical field, Automotive and avionic industry, Social problem, security issues, AI based solutions etc.by application of science and engineering in innovative manner. The group of students not more than 3 should identify problems, perform requirement analysis. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of mini-project. As per requirements the group should develop specifications of final outcome of the project. The students should think critically and undertake design of the project with skills available with them to meet the requirements and specifications. The group is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the synopsis within first week of the semester. The student is expected to exert on design, development and testing of the proposed work as per the schedule. The working model of the project should be demonstrated for internal submission and oral examination.
This LAB will help to develop sensitivity of students towards industry problems, think critically to find innovative solutions to simplify human life.
Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester. The project should complete in 12 weeks including field trails if any.
At the end of project the guide should advise students to protect IP either in the form of Patent or registration of design or publish paper on work completed or participate in project competition

The probable areas of the project work (but not only restricted to): Machine automation**,** biomedical engineering, prosthesis, accident prevention, efficiency/cost/ time improvements, , smart city, smart transportation, Automotive Electronics, energy utility, energy harvesting, AI based solutions, cyber security, Biometrics etc.

Course Objectives:
1. Evaluate industry needs.
2. Identify suitable problem that can be solved using Electronics engineering knowledge Viz system design, Modelling, MATLAB and C programming. FPGA/ CPLD based solutions.
3. Design and implement the solution using hardware / software or both
4. Testing of the implementation
5. Write project report as per standard format

Course Learning Outcomes:

CO	After the completion of the course the student will able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Identify industry/ societal problem that can be implantable using first principles of science, engineering and skills like, C Programming, Modelling	**III**	Applying
CO2	Analyze and build logical/ mathematical/ mechanical model of the project.	**IV**	Analysing
CO3	Design / simulate the model/ project work	**VI**	Creating
CO4	Implement the project using resources available in project LAB	**VI**	Creating
CO5	Write comprehensive report on project work as per prescribed format	**VI**	Creating

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of Evaluation: In semester evaluation (ISE), and End Semester Evaluation (ESE) having 25 and 50 marks respectively.

Assessment	Marks
ISE	25
ESE (OE)	50

ISE is based on seminar/Group Discussions, interactions with project guides, and rubrics etc.

ESE: Assessment is based on 100% LAB work based on rubrics and field trials if applicable.

Title of the Course: Computer Architecture and Operating System LAB Course Code:UELN0631	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: VHDL Programming, C Programming and LINUX shell Commands

Course Description:

This course covers hands on experience of Processor level design of components on kits and programming on PC in VHDL and downloading on FPGA and testing.

Using various OS services Shell scripting, use of System calls and demonstration of OS features for memory management and IPC problems.

Course Objectives:

1. To implement Processor level component using FPGA and analyze the performance
2. To motivate students use LINUX Shell commands and write scripts.
3. To develop the methodology for OS programming using system calls
4. To write C programmes using gcc compiler for LINUX Programming.

Course Learning Outcomes:

CO	After the completion of the course the student will able to	Bloom's	
		Level	Descriptor
CO1	Implement Processor level component using FPGA and analyze the performance	VI	Creating
CO2	Make use of LINUX Shell commands and write scripts	III	Applying
CO3	Develop the methodology for OS programming using system calls	III	Applying
CO4	Develop C programmes using gcc compiler for LINUX Programming	III	Applying

CO-PO Mapping:

CO	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
CO1		2	3										2	2
CO2					2									
CO3			3											
CO4			3											

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	Marks
ISE	50

ISE is based on practical performed/ Quiz/Lab Assignments / Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Minimum of 4 experiments to be conducted on Programming using VHDL based on subject Computer Architecture and Operating System (UELN0601) Unit I and II

Minimum 6 Experiment on LINUX OS based on subject Computer Architecture and Operating System(UELN0601)unit III to VI

Using shell command, Scripting and using system calls for fork (), Message passing, IPC and Process Synchronization.

Title of the Course: Model Based Design LAB	L	T	P	Credit
Course Code:UELN0632	-	-	4	2

Course Pre-Requisite: Electronics Instrumentation, Control system basics, Programming basics

Course Description: This course is designed to understand concepts in Development methodologies in MBD using methods like Waterfall, V model, iterative and incremental, Spiral.
The industry standard simulation tools like Matlab and Simulink will be used to model basic systems like motor, generators PID controllers etc. The Automotive subsystems will be discussed and simulated. Few models previously designed will be tested on real time targets like Arduino

Course Objectives:

1. To understand the concepts of Model based systems design
2. To understand Matlab/ Scilab programming Applications
3. To understand, design and model various automotive control systems using Simulink/ Scilab
4. To develop test strategy for model evaluation
5. To understand automotive systems and develop models for the same

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Illustrate Development methodologies in MBD	II	Understanding
CO2	Develop models of system in design	III	Applying
CO3	Evaluate performance of models	V	Evaluating
CO4	Testing of automotive systems model developed	IV	Analysing

CO-PO Mapping:

CO	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
CO1			3											
CO2	3												3	3
CO3				3										3
CO4							2							3

The faculty should publish sufficient number of Design problems based on syllabus contents. The students should implement the designed problems throughout the semester.

Teacher Assessment:.
ISE is based on Lab assignment/declared test/quiz/seminar/Group Discussions etc.
ESE: Assessment based on Lab assignments demonstration oral examination

Assessment	Marks
ISE	25
ESE (OE)	50

Course Contents:

Unit 1:- Introduction to model based design: Work flow of model based design (MBD), Need of MBD, Core concepts of MBD, Development methodologies in MBD: Waterfall, V model, iterative and incremental, Spiral	-
Unit 2:--- Introduction to MATLAB, Simulink and SIMSCAPE tool boxes. An overview of Matlab, Numeric, cell and structure array, Functions and files, Programming with matlab Creating and simulating model, Modelling programming construct, modelling discrete system, Modelling continues system, Solver selection, developing model hierarchy, modelling conditionally executing algorithms, combining models into diagrams, creating library .	-

Unit 3:- Model-Based Design for a small system - Motor Model, Generator Model, Controller Model, modelling using state flow	-
Unit 4:- Explore the system response using different control methods. Tune the system, Explore system limitations, understand and refine models, Generating and Applying a PID Controller in Simulink	-
Unit 5:- Study of modelling and simulation of the automotive systems	-
Unit 6:-. Real time simulations on a Simple target (like Arduino)	-

Textbooks:

1. Managing Model based design, Roger Aarensrtup, MathwoksInc
2. Introduction to Matlab for Engineers, William J Palm, Mc Graw Hill
3. Using Simulink and Stateflow in Automotive Applications, MathwoksInc

References:

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005.
3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
4. Process control CD Johnson

Unit wise Measurable students Learning Outcomes:

1. Students should be able understand concepts of Model based design.
2.Students should be able to simulate motor generator models use in automotive industry
3. Students should be able to develop models atleast 2 models using state flow
4. Students should be able evaluate performance of models
5. Students should be able test models
6. Students should be able simulate models on real time target hardware platform

Title of the Course: Data Structures and Algorithms LAB	L	T	P	Credit
Course Code: UELN0633	-	-	2	1

Course Pre-Requisite:
Student should have knowledge of Basics in C/C++ Programming, Data types in C/C++.

Course Description: This course gives introduction to data types, algorithms to access different data types, complexity involved in different data type algorithms, different flavours of data types.

Course Objectives:

1. To provide the student with a solid foundation in Engineering. Fundamentals & programming required to solve basic Engineering. Problems.
2. To introduce the concepts of array, record & pointers.
3. To understand the importance of linked lists and its applications.
4. To train the students so that they will be prepared to work on multidisciplinary problems.
5. To introduce the concepts of non linear data structures & searching techniques.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Explain** the concepts of basic data structure operations	II	Understanding
CO2	**Apply** the Algorithms to Add, delete, sort, and search for data structures like Array, linked list, Stack and Queue.	III	Applying
CO3	**Evaluate** the performance of algorithms for managing the data structure.	V	Evaluating
CO4	**Illustrate** the concept of trees, graphs and searching techniques.	II	Understanding

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO
CO1	2													
CO2	3												1	
CO3				2									2	
CO4	2													

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% Weightage respectively.

Assessment	Marks
ISE	50
ESE	50

ISE is based on practicals performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on Practical and oral examination

Course Contents:

Minimum 10 Experiments of Data Structures on Arrays, Linked Lists, Trees and Records.

Textbooks:

1.Seymour Lipschautz –'Data structures' - Schaum's outlines -Tata McGraw Hill
2.ISRD group –'Data structure using C '–- Tata McGraw Hill Reference Books

References:

1.Langsam, Augenstein, Tenenbaun –'Data structure using C & C++ ' - PHI
2.Mark Allen Weiss- 'Data structure & algorithm analysis in C'- 2nd edition –Pearson Education (LPE)
3.M.T. Goodrich, R. Tamassia, D. Mount- Data Structures & Algorithms in C++- Wiley Publication
4.A.N. Kamthane-" Introduction to Data structures in C"- Pearson Education (LPE)
5.Data structure – A programming Approach with C- D.S Kushawaha, A.K.Misra-PHI Publication.

6.Data structures – A pseudocode Approach with C- R.F.Gilberg,b.a.forouzan-Cengage Learning.

Experiment wise Measurable Students Learning Outcomes:

1. Student would be able to explain what is the structure of data type and complexity involved in it.
2. Student would be able to explain the structure of array, records and pointers and memory allocation of these structures.
3. Student would be able to explain the structure of linked list its advantages and would able to write algorithms for it.

Title of the Course: Digital Signal Processing LAB	L	T	P	Credit
Course Code: UELN0634	-	-	2	1

Course Pre-Requisite: Knowledge of Derivative, Integration, Matrices and Laplace transform.

Course Description: The course studies dynamic systems encountered in a variety of instrumentation and Mechatronics systems, the modelling of such systems and the response of these systems to a disturbance. In addition, the control of dynamic systems using feedback and the design of control systems using different design techniques will be studied.

Course Objectives:

Objectives of this course are:

1. To study the fundamental concepts of Signal Processing and Code Composer Studio.
2. To study the concept Fast Fourier Transform
3. To study and Programming with DSP Processors
4. To Design Digital Filters

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Analysis of different Types of Discrete Time Signals	IV	Analyzing
CO2	Determine Fast Fourier Transform	V	Evaluating
CO3	Design of Digital Filters	VI	Creating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3												
CO2		2												
CO3	1	2	2										2	

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE(POE)	50

ISE is based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1:--- Introduction to Code Composer Studio-I.	2**Hrs.**
Experiment No. 2:--- Introduction to Code Composer Studio-II.	2**Hrs.**
Experiment No. 3:--- Introduction: Signal types, DSP objectives, DSP applications.	2**Hrs.**
Experiment No. 4:--- Discrete Fourier Transform, Circular convolution, and filtering via the DFT.	2**Hrs.**
Experiment No. 5:--- Fast Fourier Transform: decimation in time and frequency algorithms.	2**Hrs.**
Experiment No. 6:--- Butterworth, Chebyshev and Elliptic Analog and Digital Filters.	2**Hrs.**
Experiment No. 7:--- FIR filters design methods.	2**Hrs.**
Experiment No. 8:--- Discrete-time filters structures and finite precision effects.	2**Hrs.**

Textbooks:

1. Digital Signal Processing by Alan V. Oppenheim, Ronald W. Schafer, PHI Learning, 2011
2. Digital Signal Processing: Principles Algorithms and Applications, by John G. Proakis Pearson Education India, 2001.

References:

1. Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith Elsevier, 2013.
2. Digital Signal Processing by Ramesh Babu C. Ramesh Babu Durai, Laxmi Publications, 2005

Experiment wise Measurable students Learning Outcomes:

1. The students will be able to analyze different types of Discrete Time Signals.
2. The students will be able to determine FFT of different signals.
3. The students will be able to Design different Filters.

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