Dr Ambedkar Institute of Technology, Bengaluru-56

Department of Electronics and Instrumentation Engineering

Third and Fourth Semester

Scheme and Syllabus - CBCS – 2021 -2022 Regulation

Academic Year 2022-23

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)(As per NEP2020)
B.E. Electronics and Instrumentation Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2021-22

III Semester

Sl. No.	Course Category	Course Code	Course Title	Teaching Department (TD)/ Paper setting Board(PSB)	Teaching Hrs/ Week					Examination				Credits
					L	T	P	S	Total	Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	
1	BSC	21MAT301	Mathematics Course	Mathematics						03	50	50	100	3
2	IPCC	21EIT302	Analog Electronic Circuits	EIE	3	0	2	0	05	03	50	50	100	4
3	IPCC	21EIT303	Digital System Design using Verilog	EIE	3	0	2	0	05	03	50	50	100	4
4	PCC	21EIT304	Sensors and Industrial Instrumentation	EIE	3	0	0	0	03	03	50	50	100	3
5	PCC	21EIL305	Transducers & Virtual Instrumentation LAB	EIE	0	0	2	0	02	03	50	50	100	1
6	UHV	21EII306	Social Connect and Responsibility	Any Department	0	0	1	0	01	01	50	50	100	1
7	HSSC	21HST307	Samskrutika/ Balake Kannada		1	0	0	1	02	01	50	50	100	1
		OR												
		21HST308	Constitution of India & Professional Ethics(CIP)											
8	AEC	21XXT309X	Ability Enhancement Course – III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	01	50	50	100	1
					1	0	0	0						
					If offered as Lab. Course				02	02				
					0	0	2	0						

9	HSSC	21HSN310	Professional skills	HSS	1	0	1	0		02	50	---	PP/NP	0
										Total	**400**	**400**	**800**	**18**
10	Scheduled activities for III to VIII semesters	21HSNS803	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education(PE)(Sports and Athletics), and Yoga with the concerned coordinator of the course during the first week of III semester.The activities shall be carried out between III semesters to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Success full completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities.								
		21HSN803	Physical Education(PE) (Sports and Athletics)	PE										
		21HSN803	Yoga	Yoga										
Course prescribed to lateral entry Diploma holders admitted to III semester B.E. programs														
11	21MAN311		Additional Mathematics–I	Maths	02	02	--	--		--	50	---	PP/NP	

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT**–Internship, **HSSC:** Humanity and Social Science Courses,
AEC–Ability Enhancement Courses .**UHV:** Universal Human Value Course.
L–Lecture, **T–**Tutorial, P-Practical/Drawing, **S–**Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.
TD-Teaching Department, **PSB**: Paper Setting department.

21HST307/407 Samskrutika Kannada is for students who speak read and write Kannada/Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L:T:P) can be considered as (3:0:2)or(2:2:2).The theory part of the IPCC shall be evaluated both by CIE and

SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be Included in these question paper.

21XXI413 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory **21XXI413** Inter/Intra Institutional Internship of **03 weeks** during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up /complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students 'internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses(NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks,he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as **NP/PP** in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as un satisfactory.

(B)Placement Training: These courses are prescribed for I and VI semesters respectively to the students of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an **NP (not pass)** grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

National Service Scheme/Physical Education(Sport and Athletics)/Yoga:

(1) Securing 40% or more in CIE, 35% or more marks in SEE and 40% or more in the sum total of CIE+ SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35%marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall Be mandatory for the award of degree.

Ability Enhancement Course–III			
21EIT3091	Instrumentation & Measurement Techniques	**21EIL3093**	Digital Design Lab using Verilog
21EIT3092	Network Analysis	**21EIL3094**	AEC Lab using Pspice / MultiSIM

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B.E. Electronics and Instrumentation Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2021-22

IV Semester

Sl. No.	Course Category	Course Code	Course Title	Teaching Department (TD)/ Paper setting Board(PSB)	Teaching Hrs/ Week					Examination				Credits
					L	T	P	S	Total	Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	
1	BSC	21MAT401	Mathematics Course (Content of the Mathematics course may be decided in consultation with concerned BOS)	Mathematics						03	50	50	100	3
2	IPCC	21EIT402	Micro controller & Applications	EIE	3	0	2	0	05	03	50	50	100	4
3	IPCC	21EIT403	Fundamentals of Signals and DSP	EIE	3	0	2	0	05	03	50	50	100	4
4	PCC	21EIT404	Control Systems	EIE	3	0	0	0	03	03	50	50	100	3
5	PCC	21EIL405	Control System & Simulation LAB	EIE	0	0	2	0	02	03	50	50	100	1
6	AEC	21EIT406	Biology for Engineers	CHE, PHY	2	0	0	0	02	02	50	50	100	2
7	HSSC	21HST407	Samskrutika Kannada/ Balake Kannada		1	0	0	0	02	01	50	50	100	1
		OR												
		21HST408	Constitution of India, Professional Ethics(CIP)											
8	AEC	21XXT409X	Ability Enhancement Course – IV	TD: Concerned department PSB:	If offered as Theory Course					01	50	50	100	1
					1	0	0							

				Concerned Board	If offered as Lab. Course					02				
					0	0	2							
9	HSSC	21HSN410	Professional skills	HSS	1	0	1	0		02	50	--	PP/NP	0
10	UHV	21XXT412	Universal Human Values	Any Department						01	50	50	100	1
11	INT	21XXI413	Inter/Intra Institutional Internship	Evaluation by the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.					3	100	- -	100	02
								Total			**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester B.E programs

11	21MAN411	Additional Mathematics–I	Maths	02	02	--	--	--	100	PP/NP	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC–Ability Enhancement Courses **HSSC:** Humanity and Social Science Courses, UHV- Universal Human Value Courses.
L–Lecture, T–Tutorial, P-Practical/Drawing, S–Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21HST307/407 Samskrutika Kannada is for students who speak ,read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L:T:P)can be considered as(3:0:2)or(2:2:2).The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Non–credit mandatory course(NCMC):

(A)Additional Mathematics –II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech.., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics-II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics-II shall be indicated as Unsatisfactory.

(B)Placement Training: These courses are prescribed for I and VI semesters respectively to the students of all B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an **NP(not pass)** grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

Internship of 04 weeks during the intervening period of IV and V semesters; 21XXI413 **Innovation/Entrepreneurship/Societal based Internship.**

(1) All the students shall have to undergo a mandatory internship of **04 weeks** during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up /complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprises (MSME), Innovation centers, or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offer a chance to gain hands-on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavors. Start-ups and small companies are a preferred place to learn the business tack ticks or future entrepreneurs a searning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internships can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship:** Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoys. The rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

Ability Enhancement Course – IV			
21EIT4091	Programming in MATLAB	**21EIT4093**	Signal Conditioning Circuits Lab using Pspice / MultiSIM
21EIT4092	Safety Instrumentation	**21EIT4094**	Sensors and Actuators

Course Title	**Analog Electronic Circuits**						
Course Code	**21EIT302**						
Category	Integrated Professional Core Course **(IPCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	02	00	05	52	04
CIE Marks: 50	**SEE Marks: 50**		**Total Max. marks=100**		**Duration of SEE: 03 Hours**		

COURSE OBJECTIVE:

1. To study and understand the transistor characteristics, biasing methods, ac models of transistor.
2. To study and understand the parameters, Circuit Theorems basic circuits of op-amps.
3. To analyse the frequency response of transistors and Op-amps.
4. To design different amplifier, Oscillators, waveform generation circuits using op-amps
5. To use modeling/simulation parameters with standard equivalent circuit models to predict correctly the expected performance of various general-purpose electronic circuits.

Unit No	Syllabus	No of Teaching hours
1	**MOS Field-Effect Transistors**: Device Structure and Physical operation, Current Voltage Characteristics, MOSFET circuits at DC.	**08**
2	**MOSFET Amplifier**: The MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, Small-Signal Operation and Models, Frequency Response of the CS Amplifier	**08**
3	**Operational Amplifier Fundamentals**: Basic Op-Amp circuit, Op-Amp parameters, Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations Op-Amps as DC Amplifiers, Biasing Op-Amps, Voltage Follower, Direct coupled, Non-inverting Amplifiers, Inverting amplifiers, summer, differentiator, integrator, comparators, Differential amplifier.	**08**
4	**Frequency response of OP-AMP:** Circuit stability, Frequency and phase response, Band width, Slew rate effects, circuit stability precautions. **OP-AMP Applications I:** Instrumentation amplifier, V/I & I/V converters, Voltage sources, current sources and current sinks, first and second order active filters, Clippers, Clampers, Peak detector.	**08**
5	**Specialized IC Applications:** D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OPAMPs, 555 as manostable, Astable multivibrater Phase locked loops - operating principles, monolithic phase looked loops, 565 PLL Applications, VCO.	**08**

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

COURSE OUTCOMES:

CO1: Illustrate working principle of different electronic circuit and their application in real life

CO2: Analyze the equivalent model and performance of transistors and op-amp as an amplifiers.

CO3: Apply the working principal of op-amps to build simple circuits.

CO4: Design and implementing the analog electronic circuits using op-amp and analog IC's for various applications.

CO5: Use modeling/simulation parameters with standard equivalent circuit models to predict correctly the expected performance of various general-purpose electronic circuits.

Text Books:

1. **Microelectronics circuits**, Sedra & Smith, 7th Edition, 20014, Publisher: Oxford University Press, *ISBN*-13: 978-0195338836
2. **Op-amps and Linear Integrated Circuits'** Ramakant A. Gayakward, 4th Edition, Pearson Education, 20015.

Reference Books

1. **"Electronic Devices and Circuit Theory",** Robert L. Boylestad and Louis Nashelsky, PHI/Pearson Education. 12th Edition 2021.
2. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain**, 4th** edition, Reprint 2017
3. "Op-amps & Linear Integrated Circuits Concepts & Applications "Fiore, Cengage, 2018.
4. Electronic Devices and circuits by David A Bell, 5th Edition 2008, OXFORD

EBOOKS/ONLINE RESOURCES

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108105158

Practical Component

Sl.No	Experiments
1	Design and testing the frequency response of CS FET
2	Design and Testing for the performance of FET RC Phase shift Oscillators for range of f_0 ≥100KHz.
3	Design a switching circuit using MOSFET
4	Design a two stage amplifiers using FET : - Plot of frequency Vs gain, Estimation of Q factor, bandwidth of an amplifier and verify using Use any software tool.
5	Design the following circuits using Op-amp (μA741) for the given specification a. Inverting amplifier,

	b. non- inverting amplifier c. Schmitt trigger circuit
6	Design the following circuits using Op-amp (μA741) for the given specification a. Adder b. Subtractor c. Comparator
7	Design and implement 4 bit R-2R DAC using discrete components
8	Implement 3 bit Flash ADC using ICs
9	Design a low-pass and High pass filters (Butterworth I & II order) for different cutoff frequency
10	Design the Wein bridge oscillator using Op-Amp
11	Design an Instrumentation amplifier for different gains using Op-amp and verify using Use any software tool.
12	Design of Astable and Monostable multivibrator using 555 timer
13	Demonstration of open ended project using the concept of Experiments 1- 12

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	Po10	Po11	Po12	Pso1	Pso2	Pso3
Co1	3	2	2		1				1			1	2	1	
Co2	2	2	2		1				1			1	2	1	
Co3	3	1	2		1				1			1	2	1	
Co4	1	2	2		1				1			1	2	1	
Co5	1	2	2		1				1			1	2	1	
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**Digital System Design using Verilog**						
Course Code	**21EIT303**						
Category	Integrated Professional Core Course **(IPCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	02	00	05	52	04
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

1. Make the students to understand the principles of Boolean algebra and simplification using K-maps and Quine- McCluskey techniques.
2. Analyze and design the digital systems like Adders, Subtractor, Decoders, Multiplexers, Encoders, and Comparators etc.
3. Understand the operation of flip-flops, counters, registers, and register transfers and to design and analyze the operation of sequential circuits using various flip-flops
4. Understand the concepts of HDL-Verilog dataflow, behavioral and structural description
5. Design and develop the verilog code for both combinational and Sequential circuits using procedure, task and function

Unit No	**Syllabus**	**No of Teaching hours**
1	**Principles of combinational logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey minimization technique **Introduction to Verilog:** Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Behavioral description, Implement logic gates, half adder and full adder using Verilog data flow description.	08 Hours
2	**Combinational Functions:** Arithmetic Operations: Adders and subtractor cascading full adders, Look ahead carry, Binary Comparators -2bit and 4 bit, Verilog Description of for above circuits. Multiplexers, Demultiplexers & its Applications **Verilog Behavioral description:** Structure, variable assignment statement, sequential statements, loop statements, Verilog behavioral description of Multiplexers (2:1,4:1,8:1) and De-multiplexers (1:2,1:4,1:8)	08 Hours
3	**Analysis and design of combinational logic:** Decoders: Binary – Gray vice versa, BCD – Excess 3, BCD – Decimal, BCD – Seven segment, Seven segment display. Encoders: Realization of Priority Encoders, **Verilog behavioral description of Encoders (**8 to 3 with priority and without priority), Decoders (2 to 4).	08 Hours
4	**Sequential Logic Circuits:** Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip- flop Master slave FF, Registers and Shift Registers: PISO, PIPO, SISO, SIPO, Right shift and left shift, Universal Shift register. **Verilog behavioural description** of latches (D-latch, SR latch) and flip-flops (D, T, JK, SR flip-flops).	08Hours

5	**Counters, design and their applications:** Counters, Binary ripple counters, Synchronous binary counters, Modulo N counters, Synchronous and Asynchronous counters. **Verilog behavioural description** of Synchronous and Asynchronous counters, sequential counters.	08 Hours

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course outcomes:

CO1: Simplify Boolean functions using k-map and Quine-Mc.Cuskey minimization technique

CO2: Design combinational circuits, write Verilog code for combinational circuits (MUX, De-MUX, adder, subtractor and comparator circuits)

CO3: Design and analyze code converters, encoders and decoders and write Verilog code for the same.

CO4: Analyze and design sequential circuits and write Verilog code for the same.

CO5: Analyze and design synchronous and asynchronous circuits and write Verilog code for the same.

TEXT BOOKS:

1. "Digital Logic Applications and Design", John M Yarbrough, Thomson Learning, 2001.(units 1,2,3,4,5-logic design)
2. "HDL Programming VHDL and Verilog"- Nazeih M.Botros, 2009 reprint, Dreamtech press(units 1,2,3,4,5-verilog description)

REFERENCE BOOKS:

1. Fundamentals of logic Design", Charles H Roth, Jr Cengage learning

2. "VHDL: Programming Examples"-Douglas perry-Tata McGraw-Hill 4th edition 2004

3. "Fundamentals of HDL" by Cyril P R Pearson/Sanguin 2010

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108105132
2. https://nptel.ac.in/courses/117105080
3. https://nptel.ac.in/courses/108103179

Practical Component:

Note: (1) Use discrete components to test and verify the logic gates.
(2) Use FPGA/CPLD kits for down loading the Verilog code and test the output.

Sl.No	Experiments
1	Simplification, realization of Boolean expressions using logic gates/Universal gates
2	To design and implement a. Adder/Subtractor – Full/half using logic gates.

	b. 4-bit Parallel Adder/ subtractor using IC 7483.
3	To realize using IC 7483 a. BCD to Excess-3 code conversion and vice versa b. Binary to Gray code conversion and vice versa
4	To study a. Multiplexer IC74153 and application b. Priority encoder and 3:8 Decoder using IC74138 c. Two bit comparator using gates
5	To verify the truth table of following flip-flops using IC (a) T type (b) JK Master slave (c) D type
6	To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193)
7	Adder/Subtractor – Full/half using Verilog data flow description
8	Code converters using Verilog Behavioral description a. Gray to binary and vice versa b. Binary to excess3 and vice versa
9	Combinational designs using Verilog Behavioral description a. 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder b. 1:8 Demux and verify using test bench c. 2-bit Comparator using behavioral description
10	Flip-flops using Verilog Behavioral description a) JK type b) SR type c) T type and d) D type
11	Binary any-sequence UP/Down 4-bit counter using Verilog behavioral description
12	Interface experiments: (a) Stepper motor (b) Waveform generation using DAC

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	P10	Po11	Po12	Pso1	Pso2	Pso3
Co1	3	2	2		1				1			1	2	1	
Co2	2	2	2		1				1			1	2	1	
Co3	3	1	2		1				1			1	2	1	
Co4	1	2	2		1				1			1	2	1	
Co5	1	2	2		1				1			1	2	1	
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**Sensors and Industrial Instrumentation**						
Course Code	**21EIT304**						
Category	Professional Core Course **(PCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	00	00	03	40	03
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

In this course students will be able to:

1. Explain the fundamentals of transducers and sensors
2. Demonstrate the operation of different sensors
3. Apply the principles of different type of sensors and transducers for various measurements.
4. Develop a signal conditioning circuits for resistive sensors.
5. Illustrate the importance, characteristics and advantages of suitable sensors and transducers for various applications.

Unit No	Syllabus	No of Teaching hours
1	**Introduction:** Generalized functional block diagram of Instrumentation system, Definition of a sensor and transducer, electric transducers, classification of transducers, Selection and choice of Transducers **Static characteristics of measurement system:** Definition, static calibration, true value, types of error- Gross error, systematic error, random error, static error, static correction, scale range and scale span, Reproducibility & drift, repeatability, accuracy & precision, linearity, Hysteresis, threshold, Dead time & dead zone, Resolution & discrimination, problems **Dynamic characteristics:** Definition, Speed of response, measuring lag, fidelity, Dynamic error, dead time, step input response of first order & second order systems.	**08**
2	**Resistive transducers:** Theory of strain gauges, bonded and un-bonded Strain gauges, RTD, Thermistor, **signal conditioning for Resistive sensors**: measurement of resistance, voltage dividers: potentiometers, dynamic measurements, amplifiers for voltage dividers, Wheatstone bridge balance measurements **Inductive sensor:** LVDT **Capacitive sensors:** variable capacitor, differential capacitor. **Piezo-electric sensors**: piezo electric effect, materials, applications.	**08**
3	**Ultrasonic sensor** working principle and its Applications involving ultra-sonic detection. **Laser and Radar sensor** working principle and its Applications, Advantage and disadvantages. **Digital encoding transducers:** classification of encoders, construction, shaft encoder.	**07**
4	**Flow measurement:** turbine meters, electromagnetic flow meters. **Liquid level measurement:** Resistive method, inductive methods, capacitive methods. **Pressure Measurement:** standards and calibration, High pressure measurement, Mcleod Gage, Knudsen gage **Radiation sensors:** radiation pyrometer, infra-red and optical pyrometer, Thermocouple.	**09**
5	**Other sensing methods**: photo-diode, phototransistors, Sensors based on MOSFET transistors, Charge couples and CMOS Image sensors, Fiber optic sensors, ultra-sonic based sensing methods, Biosensors	**08**

	Applications: weather monitoring systems, water monitoring systems, Battery monitoring systems.	

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course Outcome

CO1: Illustrate the characteristics of transducers.
CO2: Demonstrate the operation of Ultrasonic, Laser and Radar sensors
CO3: Demonstrate the operation of encoders, flow meters, pressure measurement, level and radiation sensors.
CO4: Analyze and develop signal conditioning circuits for resistive sensors.
CO5: Analyze the performance of various sensors, transducers for different applications.

Text books:

1. Electrical & Electronic Measurements & Instrumentation, A.K.Sawhney. Dhanphat Rai 19th edition, PHI 2019
2. Measurement systems application and Design, E.O.Doebline, 5th Edition, TMH 2004

Reference Books:

1. B.C.Nakra and K.K. Choudhury, Instrumentation Measurement and Analysis, Tata McGraw-Hill Education, 2nd Edition, 2003
2. Ramon Pallas-Areny and John G Webster Sensors and signal Conditioning John Wiley New York , A Wiley-Interscience Publication, 2nd edition
3. Patranabis, D, Sensors and Transducers, Wheeler Publishing Co., Ltd. New Delhi, 2018.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108105153
2. https://nptel.ac.in/courses/108105064
3. https://nptel.ac.in/courses/108105064
4. https://nptel.ac.in/courses/103105130

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	P10	Po11	Po12	Pso1	Pso2	Pso3
CO1	2	1	0		1							1	3	1	
CO2	2	1	0		1							1	3	1	
CO3	2	1	0		1							1	3	1	
CO4	2	1	2	1	1							1	3	1	
CO5	2	1	2	1	1							1	3	1	

Strength of correlation: Low-1, Medium- 2, High-3

Course Title	**Transducers & Virtual Instrumentation LAB**						
Course Code	**21EITL305**						
Category	Professional Core Course **(PCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

In this course students will be able to:

1. To study characteristics of different sensors and transducer
2. Understand the components of a Virtual Instrument (LabVIEW) and common LabVIEW functions
3. Build a simple data acquisition application using MyDAQ.
4. Develop interest and skill to build a real time Programming Architectures in LabVIEW.

Sl.No	Experiments
1	Study the characteristics of LVDT with signal conditioning circuit
2	Study the characteristics of Strain Gauge/ Load cell using Wheatstone bridge and signal conditioning circuit
3	Study the characteristics of RTD with signal conditioning circuit
4	To explore the following programming tools in LabVIEW a) Basic arithmetic operations b) Sum of n numbers using for loop c) Sorting even numbers using while loop in an array d) Working with Formula Nodes & Expression Nodes Creating a Sub VI
5	Design a VI for programmable Function Generator for the following functionalities. a. Waveform generating options for generating – Sine, Triangle, Saw tooth & Square Waveforms. b. Digital Display for Magnitude & Frequency c. Graphical chart for analog waveform.
6	Design a real time batch processing using LabVIEW.
	Interfacing Experiments
7	Controlling the intensity of LED using DAQ 6008 with LabVIEW
8	To develop a VI to interface USB DAQ 6008 with LabVIEW and perform the analog read and write operations
9	To develop a VI to interface USB DAQ 6008 with LabVIEW and perform the Digital read and write operation
10	Measurement of Real-world signal from LDR using LabVIEW
11	Measure and display the temperature using any sensor in LabVIEW.
12	Real time sequential control of bottle filling system

Course Outcomes:

CO1: Compare the characteristics of different transducers
CO2: Recognize the components of Virtual Instrumentations
CO3: Design the experiments using data acquisition.
CO4: To interface different sensors and transducer with Labview using My DAQ
CO5: Build VI programs to measure real time data and control devices.

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	Po10	Po11	Po12	Pso1	Pso2	Pso 3
Co1	3		1		2							1	2	2	
Co2	1	2	1		2							1	2	2	
Co3	3	2	2		2							1	2	2	
Co4	3	1	2	1	2							1	2	2	
Co5	3	1	2	1	2							1	2	2	
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	Instrumentation & Measurement Techniques						
Course Code	**21EIT3091**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	01	00	00	00	01	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives: The students will be able to

1. Understand the use of various electrical, electronic instruments, principles of operation, analysis, and calibration of instruments.

2. Apply DC/AC bridges for unknown parameters measurement.

3. Analyse and evaluate the performance of various electrical and electronic Instruments

4. Develop mathematical models, analyse and design various instrument systems.

Unit No	**Syllabus**	**No of Teaching hours**
1	Measurement System: instrumentation – definition, classification and characteristics of transducer- static and dynamic- errors in measurements- calibration, primary and secondary standards..	02 Hours
2	Measurement of Resistance, Inductance and capacitance: Wheatstone bridge- sensitivity analysis, kelvin's double bridge, Maxwells bridge, schering Bridge, source and detectors, problems., hay's bridge , Anderson's bridge	02 Hours
3	Digital Instruments: Digital Voltmeters – Introduction, DVM's based on V – T, V – F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multi-meters, Digital frequency meters.	03 Hours
4	Waveform Generators: Square wave and pulse generators, Triangular wave-shape generator, Signal and function generators	03Hours
5	Cathode Ray Oscilloscope & Signal Analyzers General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes.	03Hours

Text Books

1. Electrical and Electronic Measurements and Instrumentation, A.K.Sawhney, Dhanpat

Rai & sons, 18th Edition, ISBN:81-7700-016-0

2. Electronic Instrumentation, H S Kalsi, TMH, 2nd Edition, 2010, ISBN: 978-00-707-

2066

Reference books:

1. Electronic Instrumentation and Measurements, David A Bell, PHI/Pearson Education, 2nd Edition, 2012, ISBN: 978-81-203-2360.

2. The condensed Handbook of Measurement and Control, N E Battikha, ISA copy right2018

Course Title	Network Analysis						
Course Code	**21EIT3092**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	01	00	00	00	01	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course objectives:

1. Understand the basic network theorems.
2. Apply the network theorem to solve for network parameters.
3. Understand the transient behavior of the electrical network.
4. Study the Laplace transformation application for electrical circuits.

Unit No	**Syllabus**	**No of Teaching hours**
1	Basic Concepts: Practical sources, Source transformations, Network reduction using Star – Delta transformation. Two port network parameters: Definition of z, y and h parameters, relationship between them.	03 Hours
2	Network Theorems – 1: Loop and Node Analysis, Superposition, and Millman's theorems. Numerical with independent sources.	02 Hours
3	Network Theorems - II: Thevinin's and Norton's theorems; Maximum Power transfer theorem. Numerical with independent sources.	02 Hours
4	Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their Representation, evaluation of initial conditions in RLC circuits for DC excitations, relevant derivations and numerical.	03Hours
5	Series RLC circuit, Resonance, frequency-response of series circuits, Q –factor, Bandwidth, relevant numerical. Laplace Transformation & Applications: Solution of networks, step, ramp and impulse responses. Laplace Transformation of RLC circuit.	03Hours

Course outcome:

1. Knowledge on different network theorem .
2. Apply the network theorem to Electrical circuits and solve for circuit parameters.
3. Analyze the transient behavior of the electrical network.
4. Evaluate the circuit using Laplace transformation

TEXT BOOKS:

1. Network Analysis and Synthesis, Ravish R Singh, 2nd Edition, McGrawHill,2019.

REFERENCE BOOKS:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and DurbinTMH 6 th Edition, 2002

Course Title	Digital Design Lab using Verilog						
Course Code	**21EIL3093**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Learning Objectives: This course will enable students to:

- Familiarize with the CAD tool to write HDL programs.
- Understand simulation and synthesis of digital design.
- Program FPGAs/CPLDs to synthesize the digital designs.
- Interface hardware to programmable ICs through I/O ports.
- Choose either Verilog or VHDL for a given Abstraction level.

Sl no.	Program
1.	To convert a Boolean expression into logic gate circuit and simulate it in different dataflow/structural description
2.	Verilog Code for Shift register
3.	Verilog Code for ALU
4.	Verilog Code for Instruction Memory
5.	Verilog code for 16-bit single-cycle MIPS processor
6.	Plate License Recognition in Verilog HDL
7.	How to load a text file into FPGA using Verilog HDL
8.	Verilog code for Traffic Light Controller
9.	Verilog code for PWM Generator
10.	Verilog code for counter
11.	Design a finite state machine in Verilog to detect the given sequence of bits.
12.	Write Verilog code using FSM to simulate elevator operation

CO1 : Understand the basics of Hardware Description Languages, Program structure and basic language elements of Verilog

CO2 : Understand types of modelling, modules, functions of Verilog and simulate and synthesize related Programs.

CO3 : Design, Simulate and Synthesize various Verilog descriptions for Combinational circuits.

CO4 : Design, Simulate and Synthesize various Verilog descriptions for Sequential circuits.

Course Title	AEC Lab using Pspice / MultiSIM						
Course Code	**21EIL3094**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course objectives:

1. To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
2. To give the knowledge and practical exposure on simple applications of analog electronic circuits

Sl. No	**Experiments**
1	Experiments to realize diode clipping (single, double ended) circuits.
2	Experiments to realize diode clamping (positive, negative) circuits.
3	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).
4	Design and Testing for the performance of BJT/FET Wein Bridge Oscillators
5	Design and testing of RC coupled Single stage BJT amplifier
6	Design and testing the frequency response of CS FET/ MOSFET
7	Design and Testing for the performance of BJT/FET RC Phase shift Oscillators
8	Design and Testing for the performance of FET Hartley & Colpitts Oscillators for range of $f_0 \geq 100$KHz.
9	Testing of a transformer less Class – B push pull power amplifier and Determination of its conversion efficiency.
10	Design and testing of voltage series amplifier
11	Design and testing of current amplifier
12	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determine line/load regulation characteristics.

Course Title	**Microcontroller & Applications**						
Course Code	**21EIT402**						
Category	Integrated Professional Core Course **(IPCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	02	00	05	52	04
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

This course introduces the student to

1. To understand the basic concepts of microcontroller and embedded systems.
2. To understand the architecture of MSP430F55xx microcontroller, Addressing modes, instruction format and Register set
3. To understand the parallel ports, interfacing of various modules like switch, led, display, stepper motor DC motor, and sensors.
4. To understand the peripherals modules like timer, pwm, ADC and DMA
5. To understand the serial communication modules of MSP430

Unit No	Syllabus	No of Teaching hours
1	**Introduction:** Microprocessor, Microcontrollers and Embedded systems, MSP430F55xx series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller;	08 Hours
2	MSP430F55xx assembly programming, Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.	08 Hours
3	Parallel Ports, Lighting LEDs, Flashing LEDs, Read Input from a Switch, Toggle the LED state by pressing the push button, 7-segment Display Interfacing, LCD interfacing. Stepper motor, DC motor Interfacing, IR Sensor, LDR Sensor Interfacing.	08 Hours
4	Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.	08Hours
5	Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.	08Hours

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course Outcome

CO1: Understand the architecture of, instruction format, Instruction set, and Addressing modes of MSP430 microcontroller.

CO2: Able to write assembly program and understand the IO pins, GPIO control, interrupt and interrupt programming

CO3: Able to interface the I/O devices to MSP 430 microcontroller and write the C-program for working the peripherals

CO4: Able to understand the peripherals modules like ADC, Timer, PWM, comparator and write program for the modules

CO5: Able to understand the serial communication peripherals module and write program for the module.

Text Books:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication.
2. John H Davies, MSP430 Microcontroller Basics, Newnes Publications, Elsevier,2008.

References:

1. Chris Nagy, Embedded Systems Design using TI MSP430 Series, Newnes Publications, Elsevier, 2003.
2. User Guide from Texas Instruments

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106105193
2. https://nptel.ac.in/courses/108105102

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	P10	Po11	Po12	Pso1	Pso2	Pso3
Co1	3	2	2		1				1			1	2	1	
Co2	2	2	2		1				1			1	2	1	
Co3	3	1	2		1				1			1	2	1	
Co4	1	2	2		1				1			1	2	1	
Co5	1	2	2		1				1			1	2	1	
Strength of correlation: Low-1, Medium- 2, High-3															

Practical Component

Sl.No	Experiments
1	Data Transfer - Block move, Exchange data in an array.
2	Sorting, Finding largest element in an array.
3	Assembly language program to add n 1-byte numbers and store 16 bit sum.
4	Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube –(16 bits Arithmetic operations – bit addressable).
5	Code conversion: HEX - Decimal and Decimal - HEX.
6	Assembly language program to convert BCD to ASCII using logical instructions and Arithmetic instructions and verify whether same answer is obtained.
7	Programs using CALL and RETURN instructions
Interfacing Experiments	
1	Interface LED and Switches, implement 4 : 1 multiplexer circuits
2	Interface 7-segment Display, LCD Display
3	Internal ADC and Temperature control interface to MSP430.
4	Stepper and DC motor control interface to MSP430.
5	Use internal Timer to generate the required timing
6	Use internal PWM module to vary the Speed of DC motor
7	Use internal USCI to communicate the data Asynchronously

Course Title	**Fundamentals of Signals and DSP**						
Course Code	**21EIT403**						
Category	Integrated Professional Core Course **(IPCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	02	00	05	52	04
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

1. To understand the concepts of various operations to be performed on signals.
2. Represent the Linear time invariant systems using the time-domain concepts.
3. Introduce students to the applications of Z –transformation for the analysis of systems represented in discrete domain.
4. To determine DFT using FFT
5. To learn the design of Digital IIR and FIR filters using different techniques
6. Apply digital signal processing techniques for various applications

Unit No	**Syllabus**	**No of Teaching hours**
1	**Introduction**: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems. **Time domain representation of LTI System**: Impulse response, convolution sum and Convolution Integral.	07 Hours
2	**LTI system Properties in terms of impulse response**: System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response. **Z Transform**: Introduction, properties of ROC, properties of Z transforms inversion of Z – transforms, problems.	08 Hours
3	**Introduction to DFT:** Efficient computation of DFT Properties of DFT, FFT algorithms, Radix 2 and Radix-4 FFT algorithms , Decimation in Time, Decimation in Frequency algorithms , Use of FFT algorithms in Linear Filtering and correlation.	08 Hours
4	**FIR Filters:** Properties, Design of FIR filters – Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters by Rectangular Hamming & Hanning windows. FIR Filter design using Frequency sampling technique. **IIR Filters:** Specification and design techniques, Impulse Invariant and Bilinear Transformation techniques. Design of digital Butterworth low pass filters using Analog filter design techniques, Transform of Low pass to High pass, Band pass and Band rejection filters.	09 Hours
5	**Applications**: Dual tone Multi frequency signal detection, Spectral analysis using DFT, Musical Sound Processing, and Digital FM Stereo generation, sampling rate conversion.	08 Hours

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course Outcome:

CO1: To classify the types of signals and systems and determine its properties.
CO2: To analyze Linear time invariant systems using the time-domain concepts.
CO3: To apply Z –transformation for the analysis of systems represented in discrete domain.
CO4: Analyze the digital signals using various digital transforms DFT, FFT
CO5: Design and implement digital IIR & FIR filters for the given specifications.
CO6: Apply the digital signal processing concepts in different applications.

Text Books:

1. "Signals and Systems", Simon Haykin and Barry Van Veen John Wiley & Sons, 2nd 2007
2. Digital Signal Processing Principles, Algorithms and Applications, John G Proakis and Manolakis, Pearson, Fourth Edition, 2014.
3. Digital Signal Processing- S K MITRA, Mc Graw-Hill. Publication 4th Edition, 2013

Reference Books:

1. "Signals and Systems" Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, Pearson Education Asia / PHI, 4th edition, Indian Reprint 2007
2. Digital Signal Processing with Matlab Examples volume1, Jose Maria Giron-Sierra, © Springer Science+Business Media Singapore 2017
3. Digital Signal Processing Fundamentals and Applications, Li Tan Purdue, Jean Jiang Second edition, Elsevier publication, 2013.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/117102060
2. https://nptel.ac.in/courses/108104100

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	P10	Po11	Po12	Pso1	Pso2	Pso3
CO1	1	1	2	1						1		1	1	3	
CO2	1	2	2	3	3				1	1		1	1	3	
CO3	2	2	2	2	3				1	2		2	1	3	
CO4	1	2	3	2	3				1	2		2	1	3	
CO5	1	2	3	2	3				1	2		2	1	3	
CO6	2	2	1	1	1	2			1	2	1	2	1	3	

Strength of correlation: Low-1, Medium- 2, High-3

Practical component: Experiments are conducted using MATLAB/ SCI Lab and implement using Processor

Sl. No	Experiments
1	Write a program to verify the sampling theorem and aliasing effects with various sampling frequencies
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Generation of discrete-time sequences.
4	Determine the linear convolution of two given point sequences using FFT algorithm.
5	Determine the correlation using FFT algorithm.
6	Determine the spectrum of the given sequence using FFT
7	Design and test FIR filter using Windowing method (Hamming window and Kaiser window) for the given order and cut-off frequency
8	Design and test FIR filter using frequency sampling method
9	Design and test Butterworth 2nd order low pass & high pass filter
10	Design and test Chebyshev 2nd order low pass& high pass filter.
11	Generation and detection of DTMF signal using MATLAB
12	Implementation of Real-time echo generation
13	Demonstration of open ended project using the concept of above mentioned Experiments.

Course Title	**Control Systems**						
Course Code	**21EIT404**						
Category	Professional Core Course **(PCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	00	00	03	40	03
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objective:

1. To introduce the concept of feedback control system.

2. To impart knowledge in mathematical modeling of physical systems.

3. To impart knowledge in characteristics and performance of feedback control system.

4. To teach a variety of classical methods and techniques for analysis and design of control systems.

5. To understand and analyze the stability of control systems in time domain using Roth-Hurwitz method and root locus technique.

6. To understand and analyze the stability of control systems in frequency domain using Nyquist and Bode Plots

Unit No	**Syllabus**	**No of Teaching hours**
1	**System Modelling:** Introduction, Review of Systems, Mathematical Models, Differential equation of Physical Systems, Mechanical Translational systems and Rotational systems, Electrical systems, Analogous systems, Block Diagrams and Signal Flow Graphs.	08 Hours
2	**Time Response of feedback control systems:** Standard test signals, Unit step response of First and second order systems, under damped second order system I & II, steady state errors, Static error constants.	08 Hours
3	**Stability analysis:** Concepts of stability, Necessary conditions for Stability, Routh- Hurwirtz stability criterion, Routh- Hurwirtz stability criterion- special cases **The Root Locus Method:** Introduction, The root locus concepts, Construction of root locus I and root locus II.	08 Hours
4	**Frequency Domain Analysis:** Introduction to Bode plots, numerical problems on Bode plots, Stability Margins, Nyquist's Stability Criterion.	08Hours
5	**Compensation Techniques:** Lead, lag, lead lag network and compensator design using Root locus techniques.	08Hours

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course Outcome:

CO1: Generate mathematical models of linear time invariant control system by applying differential equations, transfer function, block diagram and signal flow diagram techniques.
CO2: Transform from electrical to mechanical and vice versa by applying suitable analogy
CO3: Analyze and characterize the behavior of a control system in terms of time domain and frequency domain performance parameters.
CO4: Compute and assess the system stability by applying Routh Hurwitz and root locus techniques
CO5: Assess the stability of the system in the frequency domain by applying Nyquist stability criterion and bode Plots
CO6: Design lead, lag and lead lag compensators for the given specifications by drawing root locus and bode plots

TEXT BOOK:

1. J. Nagarath and M.Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th edition – 2007
2. "Modern Control Engineering **",** K. Ogata, Pearson Education Asia/ PHI, 5th Edition, 2010.

REFERENCE BOOKS:

1. "Automatic Control Systems", Benjamin C. Kuo and FaridGolnaagi, Wiley Studnt 8th Edition, 2009
2."Feedback and Control System", Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.
3. "Design and Analysis of Control Systems**"** Arthur G.O. Mutambara CRC Publication 2nd Indian Reprint 2015
4. Control Systems Engineering Norman S. Nise, California State Polytechnic University, 7th Edition, Pomona, Wiley Publications

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/107106081

MAPPING of COs with POs

	Po1	Po2	Po3	Po4	Po5	Po6	Po7	Po8	Po9	P10	Po11	Po12	Pso1	Pso2	Pso3
CO1	2	2	2	2	2			1	1	1	1	1	2	1	3
CO2	1	2	2	3	2			1	1	1	1	1	2	1	3
CO3	2	2	2	3	2			1	1	1	1	1	2	1	3
CO4	1	2	2	3	2			1	1	1	1	1	2	1	3
CO5	1	2	2	3	2			1	1	1	1	1	2	1	3
CO6	2	2	2	3	2			1	1	1	1	1	2	1	3
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**Control System & Simulation LAB**						
Course Code	**21EITL405**						
Category	Professional Core Course **(PCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

The objective of the lab is to design a system and calculate the transfer function, analyzing the stability of the system (both open and closed loop, with positive and negative feedback) with time domain approach and frequency response analysis, using MATLAB/ Modelica

Sl.No	Experiments
1	Study the operation of Sample and Hold circuits using discrete components and IC.
2	Transfer Function of DC Motor
3	Time Domain Analysis of Second Order System using discrete components
4	Verify the function of programmable gain amplifier using analog multiplexer.
5	Design relay driving circuits using photo devices (LDR & Optocouplers).
6	To study the unipolar and Bipolar analog Multiplexer
7	Frequency Response Analysis of Lead Compensating network
8	Frequency Response Analysis of Lag Compensating Network
9	Mathematical Modeling of Physical Systems
10	Root Locus Plot Using Matlab
11	Bode Plot And Nyquist Plot
12	Study the PID controller and its effects on the feedback loop response

Upon the completion of Control Systems practical course, the student will be able to attain the following:

1. Model a mechanical (masses, dampers and springs) and electrical system (inductors, resistors, capacitors) in the form of a transfer function.

2. Analyze the effect of P, PI, PD and PID controllers on a control system

3. Perform time response analysis of a second order control system using MATLAB

4. Analyse and interpret stability of the system through Root Locus, Bode plot and NYQuist plot.

5. Design Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.

MAPPING of COs with POs

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

Course Title	**Programming in MATLAB**						
Course Code	**21EIT4091**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Sl.No	Experiments
1	Programs on basic algebra functions.
2	Programs on basic operations of vector
3	Programs on basic operations of matrix.
4	Program to generate discrete waveforms.
5	Program to perform basic operation on signals.
6	Program to perform convolution of two given sequences
7	Program to perform correlation of two given sequences.
8	Programs to plot different types of graphs
9	Program to perform basic operation on images
10	Program to perform basic filtering operation on signals
11	Program to perform basic filtering operation on images
12	Program to perform simple transformation (DCT) on images

Course Outcome:

1. Understand the different tools in matlab
2. Illustrate the different operators of matlab
3. Apply the different filtering technique to signal and images
4. Analyze the signal and images using matlab

Course Title	Safety Instrumentation						
Course Code	**21EIT4092**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	01	00	00	00	01	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

The main objective of the course is to

1. Design the concept of automation safety

2. Provide basic knowledge on architecture and components of safety systems

3. Provide knowledge on different algorithms and applications in instruments

4. Provide knowledge on different applications in safety instruments

5. To design safety management system for industries

Unit No	**Syllabus**	**No of Teaching hours**
1	Safety Instrumentation and Machinery: Introduction, Introduction to IEC 61511 and the safety lifecycle, SIS configurations for safety and availability targets	02 Hours
2	Selection of sensors and actuators in safety systems Selection of sensors and actuators for safety duties, Selection of safety controllers, System integration and application, software Programming	02 Hours
3	Saftey Mechine Tools: Tools Machinery safety, Guide to Regulations and Standards	03 Hours
4	Hazardous Areas and Intrinsic Safety: Introduction, Zonal :Classification, Area classification, Methods of explosion protection, Flameproof concept Ex d, Intrinsic safety, Increased safety Fire detection, fire alarm and fire fighting systems. Safety sign boards, instruction on portable fire extinguishers. Fault finding and repairs.	03Hours
5	Electrical safety instruments Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant	03Hours

Course outcomes:
1. Understand the basic safety terms.
2. Identify the hazards around the work environment and industries.
3 .Able to demonstrate the portable extinguishers used for different class of fires.
4.Able to write the case studies by sharing experience of the employees working in housekeeping, laboratories like workshops, electrical labs, machine shops, electronics and computer laboratories.

TEXT BOOKS:

1. Electrical Safety, fire safety and safety management by S.Rao, R K Jain and Saluja. Khanna Publishers, ISBN: 978-81-7409-306-6

Course Title	Signal Conditioning Circuits Lab using Pspice / MultiSIM						
Course Code	**21EIT4093**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	00	02	00	02	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Objective: This laboratory course enables students to

1. Understand the working of op-amp. as amplifier, inverter and scale changer .
2. Realize and test amplifier and oscillator circuits for the given specifications also Implement filtering circuits for signal processing application
3. Realize the op-amp circuits for the applications such as DAC, implement mathematical functions

Design of the following Circuits and analyze the characteristics and verify through simulation using the software Multisim /P-SPICE

Exp no	Syllabus
1.	To design and implement Addition , Subtraction ,Differentiator, and Integrator circuits.
2.	To realize Full wave Precision rectifier using op-amp.
3.	To design and implement I. Butterworth Lowpass filter . II. Butterworth Highpass filter.
4.	To design and implement I. RC Phase shift oscillator. II. Wein Bridge oscillator.
5.	To realize I.ZCD II. Schmitt trigger circuits.
6.	Design and implement opamp as Instrumentation amplifier circuit.
6.	To design and implement I. Astable Multivibrator using 555 timer II. Mono-stable Multivibrator using 555 timer
7.	To realize Sample and Hold circuit using discrete components
8.	To realize Programmable Gain Amplifier using Analog Mux
9.	To design and implement 4 bit R-2R DAC using discrete components.

10.	To design and implement 3 bit Flash ADC using IC.
11.	Implement 8-bit DAC using IC DAC 0800 IC.
12.	Implement 8-bit ADC using ADC 0809 IC.

Course outcomes:

At the end of the course students will be able to

1 Analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources, and Op-amp applications as data converters like IC ADC 0800 and IC DAC 0809.

2. Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.

3. Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.

Course Title	Sensors and Actuators						
Course Code	**21EIT4094**						
Category	Ability Enhancement Course – III (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	01	00	00	00	01	13	01
CIE Marks: 50	**SEE Marks: 50**		**CIE Marks: 50**		**SEE Marks: 50**		

Course Objectives:

In this course students will be able to:

1. Explain the fundamentals of sensors

2. Demonstrate the operation of different sensors, actuators, micro sensors, micro actuators

3. Demonstrate the operations of sensors materials and processing techniques.

4. To study the advantages, disadvantages, limitations of suitable sensors and actuators for various applications.

Unit No	**Syllabus**	**No of Teaching hours**
1	SENSORS: Difference between sensor, transmitter and transducer. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.	02 Hours
2	ACTUATORS: Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.	02 Hours
3	Micro Sensors : Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.	03 Hours
4	Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect.	03Hours
5	SENSOR MATERIALS AND PROCESSING TECHNIQUES: Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials. Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining and surface silicon micro machining.	03Hours

Text books:

1. Patranabis.D, “Sensors and Transducers”, Wheeler Publishing Co., Ltd. New Delhi, 2018.

2. Sergej Fatikow and Ulrich Rembold, “ Microsystem Technology and Microbotics”, First edition,

Springer –Verlag NEwyork, Inc, 1997.

Reference Books:

Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, First edition, Kluwer academic publishers, Springer, 1997.

CO1: Describe the fundamentals of different sensors.

CO2: Demonstrate the working operation of different sensors, actuators, micro sensors, micro actuators.

CO3: Determine the operations of sensors materials and its processing techniques.

CO4: Illustrate the advantages, disadvantages, limitations of suitable sensors and actuators for various applications.