Detailed Syllabus
Lecture-wise Breakup

Course Code	17M11EC118	**Semester Odd (specify Odd/Even**	**Semester** 1st **Session** 2020-2021 **Month from July to December**
Course Name	ADVANCED DIGITAL SIGNAL PROCESSING		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Vineet Khandelwal
	Teacher(s) (Alphabetically)	NIL

COURSE OUTCOMES At the end of the semester, students will be able to		**COGNITIVE LEVELS**
CO1	Recall the principles of various transform techniques like Z, Chirp Z, Hilbert, Discrete Fourier transform and Fast Fourier Transform.	Applying Level (C3)
CO.2	Demonstrate the ability to apply different methods to design and analyze digital FIR (Finite Impulse Response) and IIR (Infinite Impulse Response) filters with its structural realization.	Analyzing Level(C4)
CO.3	Analyze Multirate signal processing and examine its application.	Analyzing Level(C4)
CO.4	Comprehend different methods for designing adaptive filters and examine its application	Analyzing Level(C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Review of Digital Signal Processing**	Review of discrete–time sequences and systems, Linear Shift Invariant (LSI) systems. Causality and Stability Criterion, FIR & IIR representations, Z-Transform, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms using decimation in time and decimation in frequency techniques, Chirp Z- Transform, Hilbert Transform and applications	6
2.	**Design of IIR and FIR Filters**	Digital filter specifications, selection of filter type, and filter order, FIR filter design; using windowing Techniques, Fourier Series and frequency sampling method, Design of IIR Filters Using Butterworth, Chebyshev and Elliptic Approximations, Frequency Transformation Techniques; approximation of derivatives, Impulse invariant method, Bilinear transformation, Structures for IIR Systems – Direct Form I & II, Cascade, Parallel, Lattice & Lattice-Ladder Structures, Structures For FIR Systems – Direct , Cascade, Parallel, Lattice & Lattice ladder Structures.	12
3.	**Multirate Digital Signal Processing**	Decimation & Interpolation, Sampling rate conversion, Identities, polyphase decomposition, General polyphase framework for Decimator and Interpolator, Multistage	14

		decimator and Interpolator, Efficient transversal structure for Decimator and Interpolator, FIR and IIR structure for Decimator, Filter design for FIR decimator and Interpolator, Application of Multirate Signal processing.	
4.	**Adaptive Filters**	Introduction, Application of adaptive filters, correlation structure, FIR Weiner Filter, Adaptive Direct-form FIR filters Adaptive Lattice-Ladder filters, Introduction to linear prediction, linear prediction and autoregressive modeling.	10
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	J.G. Proakis & D.G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 4th Edition, PHI, 2012
2.	Aurelio Uncini, "Fundamentals of Adaptive Signal Processing", Springr Nature, Jan 2015.
3.	Tulay Adah and Simon Haykins, "Adaptive Signal Processing: Next Generation Solutions", Wiley India, 2012.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	17M21EC115	**Semester** Even	**Semester** II **Session** 2020-21 **Month from** January to June
Subject Name	Analogue Integrated Circuit Design		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr.Saurabh Chaturvedi
	Teacher(s) (Alphabetically)	Dr.Saurabh Chaturvedi

COURSE OUTCOMES - At the end of the course, students will be able to		**COGNITIVE LEVELS**
C115.1	Relate and recall the MOS device physics	Remembering Level (C1)
C115.2	Understand the concepts of single-stage amplifiers, differential amplifiers and current mirrors	Understanding Level (C2)
C115.3	-Apply the phenomenon of noise and its effects on analogue circuits -Apply various feedback topologies in analogue circuits	Applying Level (C3)
C115.4	Analyze the multistage CMOS amplifiers (op amps) and voltage references	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures**
1.	Basic MOS device physics	MOSFET structures and symbols, MOSFET I-V characteristics, Second-order effects, Device models	6
2.	Single-stage amplifiers	Basic concepts, Small-signal model, Common-source stage, Source follower, Common-gate stage, Cascode stage, Frequency response of amplifiers	6
3.	Differential amplifiers	Single-ended and differential operations, Basic differential pair, Common-mode response	5
4.	Current mirrors	Basic current mirrors, Cascode current mirrors, Active current mirrors	5
5.	Noise in analogue circuits	Noise characteristics and spectrum, Types of noise, Representation of noise in circuits, Noise bandwidth	6
6.	Feedback	Properties of feedback circuits, Feedback topologies, Effect of loading	5
7.	Operational amplifiers	Performance parameters, One-stage op amps, Two-stage op amps, Gain boosting, Slew rate	5
8.	Bandgap references	General considerations, Supply-independent biasing, Temperature-independent references, PTAT current generation, Constant-G_m biasing	4

Total Number of Lectures	**42**
Evaluation Criteria **Components** **Maximum Marks** T1 20 T2 20 End Semester Examination 35 TA 25(Attendance, Performance. Assignment/Quiz) **Total** **100**	

Recommended Reading Material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	B. Razavi, *Design of analog CMOS integrated circuits*, 2nd ed., McGraw-Hill Education, 2017.
2.	P. E. Allen and D. R. Holberg, *CMOS analog circuit design*, 3rd ed., Oxford UniversityPress, 2015.
3.	P. R. Gray, P. J. Hurst, S. H. Lewis, and R. G. Meyer,*Analysis and design of analog integrated circuits*, 5th ed., John Wiley & Sons, 2014.

Detailed Syllabus
Lecture-wise Breakup

Course Code	20M51EC121	**Semester** Odd **(specify Odd/Even)**	**Semester** I **Session** 2020-2021 **Month from** July to December
Course Name	Introduction to IOT System Design		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Gaurav Verma
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Outline the various IOT communication models & terminologies with networking and protocol considerations.	Understanding Level (C2)
CO2	Identify various IOT hardware platforms and their utilization with various sensors and actuators.	Applying Level (C3)
CO3	Examine various cloud platforms & Apps for monitoring, control and analysis using web development and IOT boards.	Analyzing Level (C4)
CO4	Experiment the basic concepts of python programming and make use of them in image processing, data analytics and Raspberry Pi for developing IOT applications.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	IOT Comm. Models and Terminologies	Introduction to IOT (People Connecting to Things, Things Connecting to Things, Definition of IOT, History of IOT), IOT Components (Sensors & Actuators, Things, Communications, Networks, The Internet, Protocol Stack), IOT Communication Models, IOT Applications, IOT Companies, Baseline Technologies (Machine to Machine (M2M) Communication, Web of Things (WOT)), Address Crunch in IOT, IOT Terminologies (IOT Node, LAN, MAN & WAN, IOT Gateway & Proxy), IOT Network Configuration (Gateway Prefix Allotment, Impact of Mobility on Addressing, Concept of Tunneling, Multi-homing), IPv4 Versus IPv6.	6
2.	IOT Networking Protocols	Introduction to IOT Networking, Networking Standards and Technologies (Network Access & Physical Layer, Internet Layer, Transport Layer, The application layer), IOT Networking Protocols, Network Access and Physical layer IoT Network Technologies ((LPWAN (Low Power Wide Area Network), Cellular, Bluetooth Low Energy (BLE), RFID, NFC, Zigbee, Wifi, Ethernet), Internet layer IoT network technologies (IPv6, 6LoWPAN, and RPL), Application layer IoT network technologies (HTTP, HTTPS, MQTT, AMQP, and XMPP), IoT networking considerations and challenges, IoT Platforms Capabilities.	8

3.	IoT supported Hardware platforms (Arduino&NodeMcu)	Introduction to Arduino (Different Arduino boards, Arduino Uno board description and its pin configuration, Arduino IDE and program uploading, different functions related to GPIOs and special functions (PWM and Serial communication), Interrupts, Introduction to NodeMcu (board description & pin configuration), Integration of NodeMcu in Arduino IDE,Interfacing with Arduino/NodeMcu using processing language (LED, Switch, Seven Segment, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), use of simulator and compiler, Configuring NodeMcu as Wifi Module (ESP8266).	8
4.	Web Development and Interaction with Apps &Cloud Platform	Basics of HTML programming (elements, attributes, paragraph, image etc), CSS, Tables and Forms, Creating local server and webserver using NodeMcu, Creating a Web page tocontrol actuatorWifi, Introduction to Thingspeak Cloud Platform (creating account and configure channel for live data feed, Concept of Write and Read APIs), Case Studies: Controlling an actuator connected to NodeMcu using remote web interface via cloud, Visualization of sensor data on the cloud and integrate them onto the webpage, Introduction to IFTTT & Adafruit IO (creating account and configuration), Controlling home appliances using Google Assistant AI application via IFTTT and Adafruit I/O (MQTT protocol).	10
5.	Introduction to Python , Raspberry pi & their Applications	Introduction to python, python IDE, Data types, various programming constructs (loops, if, else etc.), operators, functions, modules, data handling (pandas), file operations, Image operations (PIL-pillow), data plotting in python (Matplotlib), Introduction to Raspberry pi (Raspberry pi different model comparison, Pin Configuration, Set up your Raspberry pi, Raspbian OS, Remote Access using SSH, Interfacing with Raspberry pi using python and use of open source libraries (LED, Switch, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), IOT based Case Studies.	10
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman, Taylor and Francis (CRC Press), 2017.
2.	"Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press), 2014.

Subject Code	20M51EC124	**Semester (Even)**	**Semester II Session 2020-2021 Month January to June**
Subject Name	IOT Perspective: Cloud Computing and Machine Learning		
Credits	3	**Contact Hours**	3

Course Outline : The IoT Cloud, Fundamentals of Cloud Computing, Device Management Layer, Data Ingestion Layer, Data Processing Layer, Data Storage Layer, Application Layer, Data Visualization and Reporting Layer, Orchestration Layer, Virtualization, Scaling, A Paradigm Shift from Cloud to Fog Computing, Introduction to Node-RED, Basic nodes and flows, Node-RED programming model, Dashboards and UI techniques, Using FRED (Cloud Node-RED), Revisiting Python, Introduction to Supervised ML and Unsupervised ML, Mathematical Background for ML-Matrix ops Probability Theory(Bayes' Theorem), Statistical knowledge for ML- Mean,Median, Mode, Tools required for development -Anaconda, Jupyter NB, ML libraries Explained: Scipy, Numpy,Matplotlib, ML Glossary- Variable types, k-fold, CV, AUC,F1 score,Overfitting/Underfitting,Generalization,Data split & hyper parameter training, Data wrangling using Pandas, Preprocessing data and featureengineering, Exploratory Data analysis usingVisualisation, Scikit-learn Library for ML, Classification-Regression, Different types of Regression-Linearand Logistic, Decision tree Algorithms, Naive-Bayes' Classification, KNN Classification, Real-world code exercises, Clustering Introduction, k-means clustering, SVM and Artificial Neural Networks.

Detailed Syllabus
Lab-wise Breakup

Course Code	20M55EC113	**Semester** Odd **(specify Odd/Even)**	**Semester** Ist **Session** 2020 -2021 **Month** July 2020 to Dec 2020
Course Name	Microelectronics and IoT Lab-1		
Credits	3	**Contact Hours**	6

Faculty (Names)	**Coordinator(s)**	
	Teacher(s) (Alphabetically)	Dr.Gaurav Verma, Dr.Rachna Singh, Dr.Shruti Kalra, Dr.Ruby Beniwal, Dr.Kirmender Singh,Dr.Shamim Akhter

COURSE OUTCOMES: At the end student will be able to		**COGNITIVE LEVELS**
CO1	Understand the fundamentals of VLSI CAD tools (software) and IOT & embedded specific boards (Hardware).	Understanding Level (C2)
CO2	Apply the concept of programming (processing and python) & interfacing in designing IOT application around various sensors and actuators.	Applying Level (C3)
CO3	Use the IOT system designs around IOT boards involving cloud and web applications.	Analyzing Level (C4)
CO4	Understand the Hardware Descriptive Language (HDL) and design systems using FPGA	Understanding Level (C2)
CO5	Design and analyze CMOS based circuit design	Analyzing Level (C4)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Familiarization with IOT boards (Arduino Board, ESP8266, NodeMcu&their IDE)	To get acquainted with Arduino &NodeMcu board and understand the difference between them. Integrate NodeMcu in Arduino IDE and subsequently, test the programs like i) Blinking of LED ii) PWM waves generation of different duty cycles	CO1
2.	Traffic Light Controller	Design a traffic light controller system that has four LEDs-RED, YELLOW. GREEN and ADVANE GREEN. The sequence in which the LEDs are turned on is as follows: RED for 1 min, YELLOW for 15 sec, GREEN for 1 min, ADVANE GREEN for the last 10 sec of GREEN.Interface a light dependent resistor(LDR) to select manual and automatic mode.	CO2
3.	Real Time Clock/Date Display	Design a digital clock display using LCD and a mode switch. The clock, normally displays the time in hr-min-sec format. It updates the time automatically using the timer interrupt of the microcontroller. On pressing the mode switch, the display changes to date in dd-mm-yy format. . On pressing the button, the display returns to show time.	CO2
4.	Weather Monitoring Station using NodeMcu	Design a weather monitoring station using NodeMcu and DHT11 (Humidity and Temperature Sensor) and visualize the sensor parameters on the Thingspeak cloud platform.	CO3

5.	Controlling NodeMcu Remotely using Webpage	Interface a DC Motor with NodeMcu and control it using a HTML webpage deployed at remote machine viaThingspeak cloud platform.	CO3
6.	Controlling home appliances using Google Assistant	Introduction to IFTTT & Adafruit IO (creating account and configuration), Controlling home appliances (interface relay) using Google Assistant AI application via IFTTT and Adafruit I/O (MQTT protocol).	CO3
7.	Familiarization with IOT board (Raspberry Pi)	To get acquainted with Raspberry Pi board and on board modules. Installation of Raspbian OS and remote access using SSH.	CO1
8.	Waste Management System	Design a waste management system having an IR sensor and a LCD (use Adafruit library). The sensor is mounted on a dustbin and sends its status (Full/Empty) on LCD and on Thingspeak cloud platform.	CO3
9.	Camera Module Interface	Interface the camera module with Raspberry Pi and send clicked images on to the Gmail account.	CO2
10.	Introduction to HDL Tool	Introduction to Vivado/ModelSim	CO1
11.	Behavioral modeling	Write the HDL description of an 8-bit ALU. The ALU should perform basic arithmetic and logical functions (excluding divide and multiply).	CO4
12.	Structural Modeling	Write the HDL description of 4x1 Multiplexer using positional and named association and IP modeling.	CO4
13.	Dataflow Modeling	Write the HDL description of n-bit ripple carry adder using generate block and parameter statement.	CO4
14.	Switch Level Modeling	Write the HDL description of 2 input NAND and NOR gate using switch level model.	CO4
15.	UDP	Write the HDL description of full adder using the concept of user defined primitives.	CO4
16.	Memory Design	Write the HDL description of 4x32 register bank	CO4
17.	Counter	Write the HDL description of 6-bit ripple counter (structural model) using T-flip flop (behavioral model)	CO4
18.	FSM Modeling and functional verification	Write the HDL description of 8-bit multiplier by repeated addition with the help of Mealy and Moore FSM. Also functionally verify them using test bench	CO4
19.	FPGA Implementation	Hands on experience on FPGA: verify full adder and d-latch on Zed board.	CO4
20.	Introduction to SPICE Tool	Introduction to Tanner tools: T-Spice, S-Edit	CO**1**
21.	Analysis of MOS transistors	Analyze the I-V characteristics of MOS transistors and perform parameter extractions	CO5
22.	DC analysis of MOS inverter	To analyze the voltage transfer characteristics (VTC) of MOS based inverters and compute critical points	CO5
23.	Transient Analysis of MOS inverter	To analyze and calculate the propagation delay, rise time and fall time of a CMOS inverter	CO5
24.	Transient analysis of NAND/NOT Gate	Simulate Two-input NAND/ NOR gate and compute worst case delay	CO5
25.	Transient analysis of	Simulation of a logic circuit with the given Boolean expression.	CO5

	complex gate		
26.	Concept of sub-circuit based design	Realize two-input XOR gate and 2x1 multiplexer using CMOS transmission gates as sub-circuit.	CO5
27.	Introduction to Layout	Layout design of CMOS Inverter	CO5
28.	Complex Layout Design	Layout design of CMOS based NAND/NOR gate	CO5
Evaluation Criteria Components Maximum Marks	**Viva1** 20 Viva2 20 Day to Day 60 **Total 100**		

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press), 2017
2.	"Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press), 2014
3.	N. H. E. Weste and D. M. Harris, “CMOS VLSI design: A circuits and systems perspective,” 3rd edition, Addison-Wesley, 2005.