APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech, 2024

Minor Degree in

Electronics and Communication Engineering

Offered By: Electronics and Communication Engineering

CURRICULUM

Minor (Electronics & Communication Engineering)											
Sl. No:	Semester	Course Code	Course Title (Course Name)	Credit Structure			SS	Total Marks		Credits	Hrs./ Week
				L	T	P		CIA	ESE		
1	3	MNECT309	Electronic Circuits and Linear ICs	3	1	0	5	40	60	4	4
2	4	MNECT409	Fundamentals of Microcontrollers and applications	3	0	2[&]	5.5	40	60	4	5
3	5	MNECT509	Principles of Communication System	3	1	0	5	40	60	4	4
4	6	MNECT609	Discrete Signals and Signal Processing	3	0	0	4.5	40	60	3	3
Total							**20/ 21**			**15**	**15/ 17**

[*]*Students must register for theory courses listed in the 3rd and 4th semesters of the Minor curriculum.* [#]*Students who fail a theory course listed in the Minor curriculum are permitted to register for an alternate MOOC course specified in the Minor curriculum.*

[&]*The courses offered in the third and fourth semesters can be structured as either theory-based courses* ***or*** *a combination of theory and lab-based courses.*

SYLLABUS

SEMESTER 3

SEMESTER 3

ELECTRONIC CIRCUITS AND LINEAR ICs

Course Code	**MNECT309**	**CIE Marks**	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXEST104 Introduction to Electrical & Electronics Engineering/ GZEST204 Basic Electrical & Electronics Engineering	Course Type	**Theory**

Course Objectives:

1. To introduce the working principles of fundamental electronic circuits.
2. To provide an understanding of op-amp and other linear ICs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Wave shaping circuits:** Principle and working of RC differentiating and integrating circuits, Diode Clipping circuits - Positive, negative and biased clipper. Diode Clamping circuits - Positive, negative and biased clamper.	**11**
2	**Amplifiers:** Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers, The four basic feedback topologies (Block diagram level only) MOSFET - Types, Structure, Operation and Characteristics of Enhancement type. MOSFET Amplifier - Circuit diagram and working of common source MOSFET amplifier.	**11**
3	**Operational Amplifiers (Op-Amps):** The 741 Op-Amp, Block diagram, Ideal Characteristics of op-amps (gain, bandwidth, slew rate, CMRR, offset voltage, offset current). Applications of op-amps - Inverting amplifier, non-inverting amplifier (Derive gain of both), Adder/summing amplifier, comparator, Schmitt	**11**

	trigger, Instrumentation amplifier. Op-amp based Oscillators : Phase Shift and Wien-bridge Oscillators	
4	**Regulated power supplies:** Review of simple Zener voltage regulator, 3 pin regulators - 78XX and 79XX, Circuit/block diagram and working of SMPS. **Data Converters:** Digital to Analog converters, Specifications, Weighted Resistor type DAC, R-2R Ladder type DAC. Analog to Digital Converters: Specifications, Flash type ADC, Successive Approximation Type ADC, Dual slope ADC.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Realize simple wave shaping circuits using diodes, resistors and capacitors	**K2**
CO2	Describe the working of amplifier circuits	**K2**
CO3	Design operational amplifier circuits for various applications	**K3**
CO4	Explain the working and applications of voltage regulator ICs and data converters	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuit Theory	Robert Boylestad and L Nashelsky	Pearson	11/e, 2015
2	Microelectronic Circuits	Sedra A. S. and K. C. Smith	Oxford University Press	6/e, 2013
3	Linear Integrated Circuits	Salivahanan S. and V. S. K. Bhaaskaran	Tata McGraw Hill	2008
4	Linear Integrated Circuits	Roy D. C. and S. B. Jain	New Age International	3/e, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuits	David A Bell	Oxford University Press	2008
2	Electronic Circuits, Analysis and Design	Neamen D	TMH	3/e, 2007
3	Op-Amps and Linear Integrated Circuits	Gayakwad R. A	Prentice Hall	4/e, 2010
4	Design with Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	Tata McGraw Hill	3/e, 2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108101091
2	https://nptel.ac.in/courses/117103063
3	https://nptel.ac.in/courses/108103378
4	https://nptel.ac.in/courses/108108111

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNECT309

Course Name: ELECTRONIC CIRCUITS AND LINEAR ICs

Max. Marks: 60 | Duration: 2 Hours 30 Minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Explain the working of RC differentiator circuit and sketch the output waveform.	CO1	(3)
2		Discuss the operation of a double clipper.	CO1	(3)
3		What is the effect of cascading in gain and bandwidth of amplifier?	CO2	(3)
4		Contrast voltage series and voltage shunt feedback.	CO2	(3)
5		List the characteristics of an ideal op-amp.	CO3	(3)
6		Explain the working of an op-amp comparator.	CO3	(3)
7		Draw the circuit of a simple zener voltage regulator.	CO4	(3)
8		List any three specifications of DAC.	CO4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1

9	a)	Explain the operation of a slicer.	CO1	5
	b)	Discuss the working of a negative clamper clamping at 0V.	CO1	4
10	a)	Draw an RC integrator circuit and explain the working.	CO1	5
	b)	Explain the working of a positive clamper clamping at -3V.	CO1	4

Module 2

11	a)	Draw the structure of an enhancement type NMOS and explain its operation.	CO2	5
	b)	Discuss current series feedback with the help of a neat diagram.	CO2	4
12	a)	Discuss the working of a MOSFET amplifier.	CO2	5
	b)	Explain the characteristics of a P-channel MOSFET.	CO2	4

Module 3

13	a)	Explain the working of a Schmitt trigger using op-amp, with the help of a circuit diagram, relevant equations and waveforms.	CO3	5
	b)	Draw the block diagram of op-amp and explain the purpose of each block.	CO3	4

14	a)	Explain the working of an instrumentation amplifier.	CO3	5
	b)	Discuss the significance of Slew rate and CMRR in an op-amp	CO3	4
Module 4				
15	a)	Explain the working of weighted resistor type DAC, with the help of a neat diagram.	CO4	5
	b)	Discuss the working of flash ADC.	CO4	4
16	a)	Explain the operation of an SMPS, with the help of a diagram.	CO4	5
	b)	Discuss the working of R-2R ladder type DAC.	CO4	4
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SEMESTER 4

SEMESTER 4

FUNDAMENTALS OF MICROCONTROLLERS AND APPLICATIONS

Course Code	**MNECT409**	**CIE Marks**	40
Teaching Hours/Week (L:T:P)	3:0:2	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	**Theory + Lab**

Course Objectives:

1. To introduce basics of Aurduino
2. To get a hands on experience on Aurduino and its interfacing

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Arduino Basics: Arduino Uno R3 components, Microcontrollers in other Arduinos, Programming Interfaces, Input/Output: GPIO, ADCs, and Communication Busses, Bootloaders and Firmware. (Ch 1 [1]) Digital Inputs, Outputs and PWM: Digital Outputs, Controlling an LED on a breadboard with digitalWrite(), Controlling an RGB LED, Pulse-Width Modulation with analogWrite(), Reading Digital Inputs, Pull-Down Resistors, Using Internal Pull-Up, Contact Bounce Elimination (Ch 2 [1], Ch 5, 6, 7 [2]) Interfacing Analog Sensors: Analog and Digital Signals, Converting an Analog Signal to Digital, ADC Resolution and Quantization, Reading Analog Sensors using analogRead(), Using Analog Inputs to Control Analog Outputs. (Ch 3 [1], Ch 5, 6, 7 [2])	**11**
2	Using Transistors and Driving DC Motors: Driving DC Motors with Transistor, Protection Diodes, Controlling Motor Speed with PWM, H-Bridge to Control DC Motor Direction, Roving Robot, Powering	**11**

	Geared Motor with 7805 Regulator, Robot Hardware and Software (Ch 4 [1], Ch 8 [2]) Driving Stepper and Servo Motors: Driving Servo Motors, Controlling a Servo, Driving Stepper Motors, Bipolar Stepper Motors Working (Ch 5 [1], Ch 8 [2])	
3	Serial Communication: Serial Data Communication between Serial Monitor and Arduino, Software Serial (Ch 7 [1], Ch 4 [2]) I2C: I2C Hardware Design, Communication Scheme and ID Numbers, Hardware Requirements and Pull-Up Resistors, Communicating with an I2C Temperature Probe. (Ch 10 [1], Ch 13 [2]) SPI: SPI Hardware Configuration, Communication Scheme, Comparing SPI to I2C and UART, Communicating with an SPI Accelerometer (Ch 11 [1], Ch 13 [2])	**11**
4	Sounds: Making Sound Using tone() and Speaker, Making Sound Sequences (Ch 6 [1], Ch 9 [2]) Interrupts: Hardware Interrupts, Trade-offs Between Polling and Interrupting, Arduino Hardware Interrupt Capabilities, Hardware-Debounced Button Interrupt Circuit, Hardware interrupt example code, Timer Interrupts, Timer interrupt example (Ch 13 [1]	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	5	10	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate interfacing digital and analog sensors with Arduino, including the use of PWM, ADCs, and communication protocols, for real-time data acquisition and control.	**K2**
CO2	Analyze and implement motor control techniques using transistors, protection diodes, PWM, and H-Bridge circuits to control DC motor speed and direction in embedded applications.	**K3**
CO3	Explain and implement serial communication protocols including UART, I2C, and SPI to enable reliable data exchange between Arduino and peripheral devices.	**K2**
CO4	Explain the concept of hardware and timer interrupts, and implement interrupt-driven programming in Arduino.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Exploring Arduino	Jeremy Blum	Wiley	2e 2020
2	Arduino Cookbook	Michael Margolis et. al	O'Reilly	3e 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Arduino: A Technical Reference	J. M. Hughes	O'Reilly	1e 2016

1. Continuous Assessment (5 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (3 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

Final Marks Averaging: *The final marks for preparation and conduct of experiments are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Internal Lab Examination (10 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (3 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task
2. **Result (5 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (2 Marks)**
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 8 Experiments)

Experiment No.	Experiment
1	Blinking an LED
2	LED fade-in fade-out using PWM. Observe PWM on scope
3	Toggling an LED controlled by Push button - with and without bounce elimination (Study push-button behaviour on DSO Single-Seq mode)
4	Cycling through colors with RGB LED
5	Reading pot. value with analogRead() and printing on serial monitor
6	Interfacing DC motor with H-bridge. Control speed and direction of motor with a pot.
7	Interfacing matrix keypad (5.5 [2])
8	Interfacing HC-SR04 Ultrasonic Sensor to measure distance (6.5 [2])
9	Interfacing microphone, smoothing the values and displaying on serial plotter (6.8 [2])
10	Interfacing temperature sensor (6.9 [2])
11	Interfacing RFID tags (6.10 [2])
12	Interfacing rotary encoder (6.11 [2])
13	Interfacing IMU (6.15, 6.17 [2])
14	Interfacing GPS module (6.14 [2])
15	Controlling a servo angle with a pot.
16	Interfacing a NEMA17 stepper motor interface
17	Sending a digit (single characters 0 to 9) that blinks the onboard LED at a rate proportional to the received digit (
18	Playing a tone with the frequency set by a variable resistor (9.1 [2])
19	Interfacing LCD display (11.1 [2])
20	Any other experiment from [1] or [2]

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNECT409

Course Name: FUNDAMENTALS OF MICROCONTROLLERS AND APPLICATIONS

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		What is the function of the bootloader in Arduino ?		(3)
2		Design the value of resistance required to connect an LED to the digital output pin of an Arduino		(3)
3		Draw the PWM signal needed to rotate a servo motor to 45°		(3)
4		Draw the circuit for interfacing a DC motor to Arduino? What is the need for the protection diode?		(3)
5		Mention two uses of the Arduino serial port.		(3)
6		Draw the SPI hardware configuration and explain the function of the communication lines.		(3)
7		Mention one application of timer interrupt.		(3)
8		What is the use of tone() function? What are its parameters?		(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1

9	a)	Write code for a temperature alert system where the color of an RGB LED will indicate whether the temperature is too low, normal or too high		4
	b)	What is the difference between map() and constrain() functions? Mention typical use of these functions.		5
10	a)	Explain the principle behind the analogwrite() function. Write code to vary the brightness of an LED using analogwrite()		4
	b)	With a circuit diagram and code, explain how a push button connected to a digital output pin can be used to turn on/off an LED connected to a digital output pin.		5

Module 2

11	a)	Write code to control the speed of a DC motor with the Arduino. Comment your code for easy understanding.		4
	b)	Explain the working a 4-steps per rotation bipolar stepper motor with diagrams		5
12	a)	Explain the working of an H-bridge circuit. Explain the features of L293D IC		4

	b)	Write code to play a tone with the frequency set by a variable resistor connected to analog input. Comment your code for improving readability		5
Module 3				
13	a)	Explain any four functions in the Serial library.		4
	b)	Explain the I2C bus protocol with a diagram.		5
14	a)	Write code that will turn on/off the onboard LED when '1'/'0' is sent from serial monitor.		4
	b)	With a diagram, explain the working principle of a MEMS accelerometer.		5
Module 4				
15	a)	Compare the benefits and drawbacks of interrupts and polling		4
	b)	Write code that will sound a buzzer when an analog sensor reading exceeds a threshold.		5
16	a)	Write an example application that uses the interrupt capability of Arduino. Comment your code for readability		4
	b)	Write code for playing a tone whose frequency is set by a potentiometer		5
*****				

SEMESTER 5

SEMESTER 5

PRINCIPLES OF COMMUNICATION SYSTEM

Course Code	MNECT509	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of the structure and functioning of modern communication systems

2. To equip students with the conceptual knowledge of diverse communication technologies—including radio, optical, wireless, and satellite systems—and to foster the ability to analyze their evolution, operational principles, and applications in real-world scenarios.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Communication Fundamentals** Introduction to Electronic Communication - Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, The Electromagnetic Spectrum, Bandwidth. (Text 1, Chapter 1 - Sections 1-1 to 1-6). Electronic Fundamentals for Communications - Gain, Attenuation, Decibels. (Text 1, Chapter 2 - Section 2-1). Digital Communication Techniques - Digital Transmission of Data, Parallel and Serial Transmission, Data Conversion, Pulse Modulation. (Text 1, Chapter 7 - Sections 7-1 to 7-4)	11

2	**Communication Hardware and Systems** Multiplexing and Demultiplexing - Multiplexing Principles, Frequency-Division Multiplexing, Time-Division Multiplexing, Pulse-Code Modulation. (Text 1, Chapter 10 - Sections 10-1 to 10-4) Digital Data Transmission - Digital Codes, Principles of Digital Transmission, Transmission Efficiency, Modem Concepts and Methods, Error Detection and Correction. (Text 1, Chapter 11 - Sections 11-1 to 11-4, 11-7)	**11**
3	**Satellite and Optical communication fundamentals** Satellite Communication - Satellite Communication Systems, Satellite Applications, Global Navigation Satellite Systems. (Text 1, Chapter 17 - Sections 17-2, 17-5, 17-6). Optical communication - Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing. (Text 1, Chapter 19 - Sections 19-1 to 19-5).	**11**
4	**Cellular and Wireless Communication Technologies** Cellular Technologies - Cellular Telephone Systems, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems. (Text 1, Chapter 20 - Sections 20-1, 20-3, 20-4). Wireless Technologies - Wireless LAN, PANs and Bluetooth, ZigBee, Radio-Frequency Identification and Near-Field Communications. (Text 1, Chapter 21 - Sections 21-1, 21-2, 21-6).	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the structure of communication systems and apply basic electronic concepts like gain, decibels etc in communication circuits.	**K2, K3**
CO2	Describe the operation of radio transmitters and receivers, and explain basic multiplexing principles used in communication systems.	**K2**
CO3	Explain the principles and components of optical communication systems and describe modern wireless technologies like WLAN, Bluetooth, and RFID.	**K2**
CO4	Explain satellite communication systems and GNSS principles, and differentiate the evolution and functionalities of 2G, 3G, and 4G cellular technologies.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Communication Systems	Louis E. Frenzel Jr.	McGraw-Hill Education	Fourth Edition 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Communication Systems	Simon Haykin, Michael Moher	Wiley	5th Edition, 2009
2	Modern Digital and Analog Communication Systems	B.P. Lathi, Zhi Ding	Oxford University Press	5th Edition, 2018
3	Principles of Communications	Taub, Schilling, Saha	McGraw Hill Education	4th Edition, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.google.com/search?q=https://www.youtube.com/watch%3Fv%3Dn35-ayDoG14
2	https://www.google.com/search?q=https://www.youtube.com/watch%3Fv%3Dh9vt_yKj658
3	http://digimat.in/nptel/courses/video/117105143/L01.html
4	https://archive.nptel.ac.in/courses/117/105/117105077/

MODEL QUESTION PAPER				
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY **FIFTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR**				
Course Code: MNECT509				
Course Name: Principles of Communication System				
Max. Marks: 60			Duration: 2 hours 30 minutes	
		PART A		
		Answer all questions. Each question carries 3 marks	CO	Marks
1		Three cascaded amplifiers have power gains of 5, 2, and 17. The input power is 40 mW. What is the output power?	CO1	(3)
2		How is digital transmission different from analog transmission?	CO1	(3)
3		What is quantization and how does it affect signal quality?	CO2	(3)
4		What is the basic principle of FDM	CO2	(3)
5		A satellite transponder operates in the C band. Assume a local oscillator frequency of 2 GHz. What is the uplink receiver frequency if the downlink transmitter is on channel 4? The downlink frequency of channel 4 is 3840 MHz.	CO3	(3)
6		How do GPS receivers distinguish between the different satellite signals all transmitted on the same frequencies	CO3	(3)
7		What is the benefit of TDD over FDD?	CO4	(3)
8		Name the three Wi-Fi frequency bands.	CO4	(3)
PART B				
Answer any one full question from each module. Each question carries 9 marks				
Module 1				
9	a)	Why are audio signals not transmitted directly by electromagnetic waves?	CO1	3
	b)	What is the human hearing frequency range.? What is the approximate frequency range of the human voice?	CO1	3

	c)	A power amplifier with a 40-dB gain has an output power of 100 W. What is the input power?	CO1	3
10	a)	An information signal to be transmitted digitally is a rectangular wave with a period of 71.4 μs. It has been determined that the wave will be adequately passed if the bandwidth includes the fourth harmonic. Calculate (a) the signal frequency, (b) the fourth harmonic, and (c) the minimum sampling frequency (Nyquist rate).	CO1	5
	b)	The voltage range of an A/D converter that uses 14-bit numbers is 26 to 16 V. Find (*a*) the number of discrete levels (binary codes) that are represented, (*b*) the number of voltage increments used to divide the total voltage range, and (*c*) the resolution of digitization expressed as the smallest voltage increment.	CO1	4
Module 2				
11	a)	A special PCM system uses 16 channels of data, one whose purpose is identification (ID) and synchronization. The sampling rate is 3.5 kHz. The word length is 6 bits. Find (*a*) the number of available data channels, (*b*) the number of bits per frame, and (*c*) the serial data rate.	CO2	5
	b)	Explain transmitting end of an FDM system with figure.	CO2	4
12	a)	A block of 256 sequential 12-bit data words is transmitted serially in 0.016 s. Calculate (*a*) the time duration of 1 word, (*b*) the time duration of 1 bit, and (*c*) the speed of transmission in bits per second.	CO2	4
	b)	The bandwidth of a communication channel is 12.5 kHz. The *S*/*N* ratio is 25 dB. Calculate (*a*) the maximum theoretical data rate in bits per second, (*b*) the maximum theoretical channel capacity, and (*c*) the number of coding levels *N* needed to achieve the maximum speed.	CO2	5
Module 3				
13	a)	Explain the working of a satellite transponder with figures.	CO3	4
	b)	Explain how triangulation works to locate a GPS receiver	CO3	5
14	a)	What are the Basic elements of a fiber-optic communication system?	CO3	3

	b)	The numerical aperture of a fiber-optic cable is 0.29. What is the critical angle?	CO3	3
	c)	What special effect occurs when the incident ray strikes the interface between two media at an angle greater than the critical angle, explained in detail?	CO3	3
Module 4				
15	a)	How does handoff (handover) work in a cellular system?	CO4	4
	b)	Explain how MIMO technology improves 4G performance.	CO4	5
16	a)	Explain how a wireless access point works in a WLAN setup.	CO4	4
	b)	How does RFID work in identifying objects wirelessly? What is the difference between active and passive RFID tags?	CO4	5
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SEMESTER 6

SEMESTER 6

DISCRETE SIGNALS AND SIGNAL PROCESSING

Course Code	MNECT609	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To enable students to apply sampling and quantization techniques for converting analog signals into their discrete-time equivalents and perform basic signal manipulations.
2. To facilitate the application of concepts related to discrete-time systems, including convolution and difference equations, for analyzing system behavior.
3. To develop the ability to apply Fourier-based techniques such as DTFT, DFT, and FFT for frequency domain analysis of discrete-time signals.
4. To provide practical skills in applying image processing techniques, including spatial domain operations and basic image compression methods.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Analog to Digital Conversion** - Analog and digital signals, sampling of continuous-time signals, sampling theorem and aliasing, anti-aliasing filters, quantization—uniform and non-uniform, quantization error and signal-to-noise ratio, advantages of digital over analog signal processing, **Discrete-Time Signals and Properties** - Elementary discrete-time signals such as unit impulse, unit step, exponential and sinusoidal sequences, signal operations including time shifting, reversal, and scaling.	9

2	**Classification of discrete-time systems**—static/dynamic, causal/non-causal, linear/nonlinear, time-invariant/time-variant, stable/unstable systems, **Linear Time-Invariant (LTI) Systems** - impulse response and LTI systems, properties of LTI systems, linear convolution and its properties, graphical and tabular methods of convolution, system interconnections—cascade and parallel, representation of systems using difference equations and block diagrams, recursive and non-recursive system analysis.	**9**
3	**Discrete-Time Fourier Transform (DTFT)—**definition, magnitude and phase spectra, properties of DTFT, frequency response of systems, Parseval's theorem, **Discrete Fourier Transform (DFT)**—definition, properties, interpretation of DFT, circular and linear convolution using DFT, **Fast Fourier Transform (FFT)**—Radix-2 Decimation-In-Time (DIT) and Decimation-In-Frequency (DIF) algorithms, butterfly diagram and bit reversal, applications of frequency analysis in signal processing.	**9**
4	**Application - Digital image fundamentals**—pixel representation, resolution, and intensity, grayscale and color image formats, image acquisition and digitization, image operations in spatial domain—addition, subtraction, contrast stretching, negative transformation, thresholding, histogram equalization, spatial filtering—smoothing filters such as mean and Gaussian, sharpening filters such as Laplacian and high-boost, basic edge detection methods—Sobel and Prewitt, introduction to image compression—need, lossless vs lossy compression, basics of Run Length Encoding (RLE) and JPEG (conceptual).	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply sampling and quantization techniques to convert analog signals into discrete-time signals, and perform basic signal operations.	K3
CO2	Apply the principles of discrete-time systems to analyze system behavior using convolution and difference equations.	K3
CO3	Apply DTFT, DFT, and FFT techniques to analyze discrete-time signals in the frequency domain.	K3
CO4	Apply spatial domain techniques and basic compression methods for processing and enhancing digital images.	K3

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Signal Processing: Principles, Algorithms, and Applications	John G. Proakis, Dimitris G. Manolakis	Pearson Education	4th Edition, 2007
2	Signals and Systems	Alan V. Oppenheim, Alan S. Willsky, with S. Hamid Nawab	Pearson Education	2nd Edition, 2013
3	Digital Signal Processing: A Computer-Based Approach	Sanjit K. Mitra	McGraw Hill Education	4th Edition, 2011
4	Discrete-Time Signal Processing	Alan V. Oppenheim, Ronald W. Schafer	Pearson Education	3rd Edition, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Understanding Digital Signal Processing	Richard G. Lyons	Pearson Education	3rd Edition, 2010
2	Digital Image Processing	Rafael C. Gonzalez, Richard E. Woods	Pearson Education	4th Edition, 2018
3	Schaum's Outline of Digital Signal Processing	Monson H. Hayes	McGraw Hill Education	2nd Edition, 2011
4	Signal Processing and Linear Systems	B. P. Lathi, Roger Green	Oxford University Press	2nd Edition, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105134/
2	https://archive.nptel.ac.in/courses/108/106/108106151/
3	https://onlinecourses.nptel.ac.in/noc21_ee02/preview
4	https://archive.nptel.ac.in/courses/108/101/108101174/

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNECT609

Course Name: DISCRETE SIGNALS AND SIGNAL PROCESSING

Max. Marks: 60		Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		A continuous-time sinusoidal signal $x(t) = \sin(2\pi.600t)$ is sampled at a rate of 800 Hz. (a) Determine whether aliasing will occur. (b) If aliasing occurs, find the aliased frequency.	CO1	(3)
2		Given the signal $x[n] = 3\delta[n+1] + 2\delta[n] - \delta[n-2]$. Determine whether the signal is even, odd, or neither. Justify your answer with appropriate calculations or a sketch.	CO1	(3)
3		Given a system with impulse response $h[n] = \{1,2,1\}$ and input $x[n] = \{1,-1\}$ compute the output $y[n]$ using linear convolution.	CO2	(3)
4		Determine whether the system defined by $y[n] = x[n] \cdot x[n-1]$ is linear. Justify your answer with an example.	CO2	(3)
5		Compute the DTFT of the discrete-time signal $x[n] = \delta[n] + \delta[n-1]$. Express the result in terms of magnitude and phase spectra.	CO3	(3)
6		Given a 4-point DFT of a sequence $x[n] = \{1,0,0,0\}$, compute all four DFT values and interpret the frequency content.	CO3	(3)
7		Given a threshold value of 128, binarize the following grayscale pixel array: [80,135,120,200,100].	CO4	(3)
8		Given a grayscale image with pixel values [50,100,150,200], apply a contrast stretching operation that maps 50 to 0 and 200 to 255. What are the new pixel values?	CO4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1

9	a)	Given a discrete-time signal $x[n] = \{1,2,3,4\}$ perform the following operations and draw all the resulting signals clearly. (i) Time reversal: $x[-n]$ (ii) Time shift: $x[n-2]$	CO1	3

		(iii) Amplitude scaling: $2x[n]$		
	b)	An analog signal is sampled and quantized to produce the following 3-bit encoded levels: 010, 011, 100, 101. (i) Convert these binary values to their corresponding quantized voltage levels assuming uniform quantization in the range $[-4V, +4V]$. (ii) Determine the quantization step size and discuss the quantization error if the actual signal sample was 2.6V for the code 100.	CO1	6
10	a)	A discrete-time signal is defined as $x[n] = (-1)^n u[n]$ where $u[n]$ is the unit step function. **1.** Generate and tabulate the values of $x[n]$ for $n = -3$ *to* $n = 5$. **2.** Plot the signal and apply a time shift of $+2$ (i.e., $x[n+2]$). **3.** Comment on the changes observed in the signal due to the time shift.	CO1	3
	b)	An analog signal ranging from −5V to +5V is sampled and quantized using an 8-bit uniform quantizer. 3. Calculate the quantization step size. 4. Determine the quantization level that corresponds to an input voltage of +2.3V. 5. Compute the maximum possible quantization error. 6. Estimate the Signal-to-Quantization Noise Ratio (SQNR) in decibels (dB).	CO1	6
Module 2				
11	a)	Given the block diagram of a system composed of two subsystems: one performing delay $x[n-1]$ and another performing summation $x[n] + x[n-1]$, derive the equivalent system function and write its difference equation.	CO2	5
	b)	Two LTI systems with impulse responses $h_1[n] = \{1, 0, -1\}$ and $h_2[n] = \{1, 2\}$ are connected in cascade. Find the overall impulse response of the combined system.	CO2	4
12	a)	Given the recursive system defined by $y[n] = -0.5y[n-1] + x[n]$ with $y[-1] = 2$ and input $x[n] = \delta[n]$, compute the first four values of the output $y[n]$ for $n = 0$ to 3.	CO2	5
	b)	Determine whether the system defined by $y[n] = x[-n]$ is linear, time-	CO2	4

		invariant, and causal. Justify each property with appropriate reasoning or examples.		
Module 3				
13	a)	Two sequences are given: $x[n] = \{1,2,1,2\}, h[n] = \{1,-1,1,-1\}$. Compute the linear convolution using DFT and IDFT.	CO3	6
	b)	Explain how bit reversal is applied in an 8-point FFT computation. Then, show the bit-reversed order for indices 0 to 7.	CO3	3
14	a)	Apply the Radix-2 DIT FFT algorithm to compute the 8-point FFT of the sequence $x[n] = \{1,0,0,0,1,0,0,0\}$, Show the butterfly diagram, output after each stage and final output.	CO3	5
	b)	For a system with impulse response $h[n] = \{1,-1\}$, compute and sketch the frequency response $H(e^{j\omega}$. Discuss the magnitude and phase response.	CO3	4
Module 4				
15	a)	A binary image row is represented as: $[1,1,1,0,0,1,1,0,0,0]$ Apply Run Length Encoding (RLE) to compress the image data. Also compute the compression ratio.	CO4	5
	b)	For a 3×3 image patch with pixel values $\begin{bmatrix}100 & 120 & 130\\110 & 115 & 125\\105 & 108 & 118\end{bmatrix}$ apply a 3×3 mean filter and compute the filtered center pixel value.	CO4	4
16	a)	For a 3×3 image patch $\begin{bmatrix}10 & 20 & 30\\40 & 50 & 60\\70 & 80 & 90\end{bmatrix}$ apply the Sobel operator in the horizontal direction and compute the edge response at the center pixel.	CO4	6
	b)	An 8-bit grayscale image has pixel values ranging from 0 to 255. Consider the following 3×3 image patch: $\begin{bmatrix}120 & 125 & 130\\110 & 115 & 120\\100 & 105 & 110\end{bmatrix}$	CO4	3

		1. Compute the average intensity of the entire patch. **2.** Apply a sharpening filter using Laplacian mask and compute the filtered value at the center pixel (115) $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$		
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