RSET

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

COURSE HAND-OUT

B.TECH. - SEMESTER V

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (EC), RSET

VISION

TO EVOLVE INTO A CENTRE OF EXCELLENCE IN ELECTRONICS AND COMMUNICATION ENGINEERING, MOULDING PROFESSIONALS HAVING INQUISITIVE, INNOVATIVE AND CREATIVE MINDS WITH SOUND PRACTICAL SKILLS WHO CAN STRIVE FOR THE BETTERMENT OF MANKIND

MISSION

TO IMPART STATE-OF-THE-ART KNOWLEDGE TO STUDENTS IN ELECTRONICS AND COMMUNICATION ENGINEERING AND TO INCULCATE IN THEM A HIGH DEGREE OF SOCIAL CONSCIOUSNESS AND A SENSE OF HUMAN VALUES, THEREBY ENABLING THEM TO FACE CHALLENGES WITH COURAGE AND CONVICTION

B.TECH PROGRAMME

Program Outcomes (POs)

Engineering students will be able to

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and Electronics and Communication Engineering to the solution of complex Engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
3. **Design/development of solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
6. **The Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex Engineering activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life -long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

Engineering students will be able to:

1. Demonstrate their skills in designing, implementing and testing analogue and digital electronic circuits, including microprocessor systems, for signal processing, communication, networking, VLSI and embedded systems applications;

2. Apply their knowledge and skills to conduct experiments and develop applications using electronic design automation (EDA) tools;

3. Demonstrate a sense of professional ethics, recognize the importance of continued learning, and be able to carry out their professional and entrepreneurial responsibilities in electronics engineering field giving due consideration to environment protection and sustainability.

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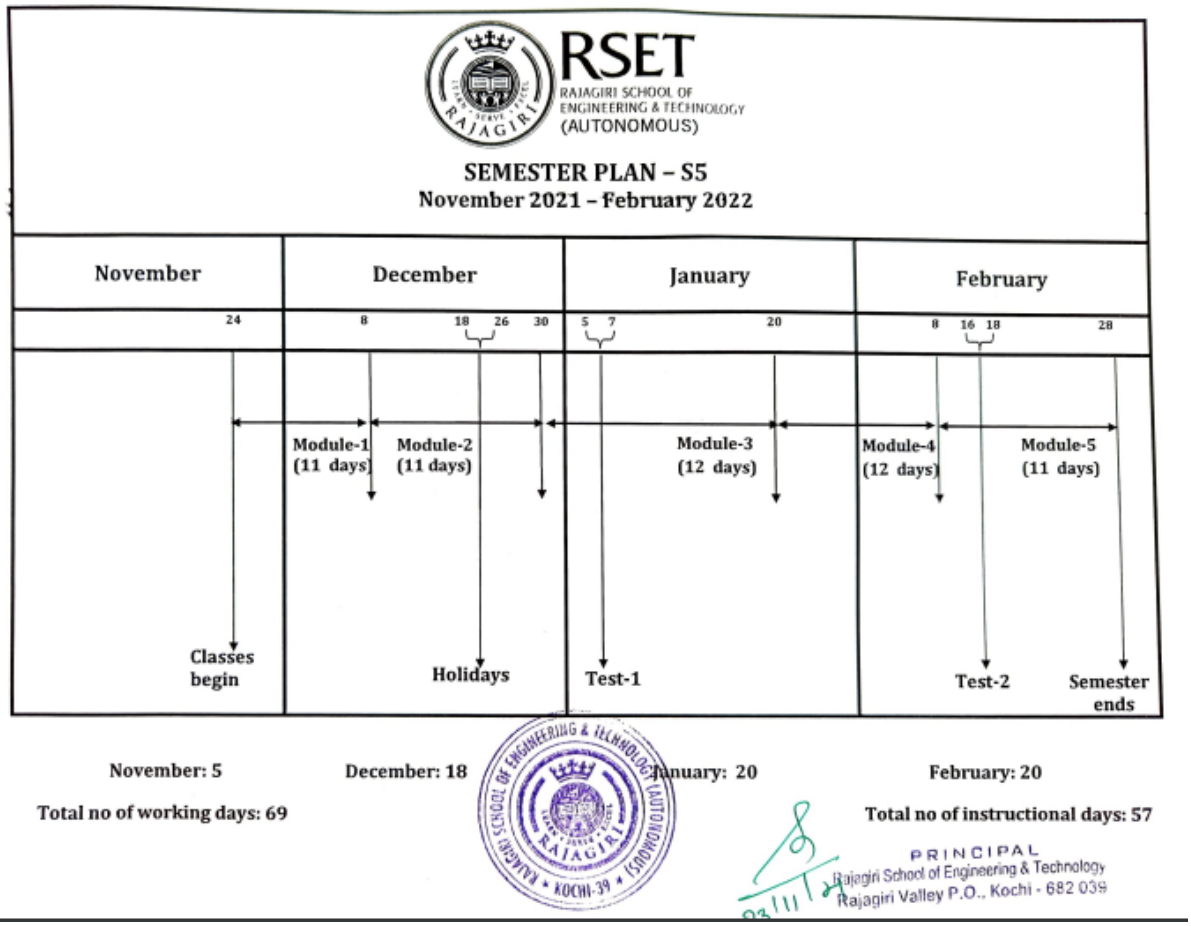
SEMESTER PLAN



SCHEME: B.TECH 5th SEMESTER

(Electronics & Communication Engineering)
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
REVISED SCHEME FOR B TECH SYLLABUS REVISION 2019

SLOT	Code	Subject	Hours/Week			Marks		End-Sem duration - hours	Credits
			L	T	P	Inter-nal	End-Sem		
A	ECT 301	LINEAR INTEGRATED CIRCUITS	3	1	0	50	100	3	4
B	ECT 303	DIGITAL SIGNAL PROCESSING	3	1	0	50	100	3	4
C	ECT 305	ANALOG AND DIGITAL COMMUNICATION	3	1	0	50	100	3	4
D	ECT 307	CONTROL SYSTEM	3	1	0	50	100	4	3
E	HUT300	INDUSTRIAL ECONOMICS AND FOREIGN TRADE	3	0	0	50	100	3	3
	HUT310	MANAGEMENT FOR ENGINEERS	3	0	0	50	100	3	3
F	MCN301	DISASTER MANAGEMENT	2	0	0	50	100	2	1
S	ECL 331	ANALOG INTEGRATED CIRCUITS AND SIMULATION LAB	0	0	3	50	100	2	1
T	ECL 333	DIGITAL SIGNAL PROCESSING LAB	0	0	3	50	100	2	1

301

LINEAR INTEGRATED CIRCUITS

COURSE INFORMATION SHEET

PROGRAMME: Electronics and Communication Engineering	DEGREE: B.Tech
COURSE:LINEAR INTEGRATED CIRCUITS	SEMESTER: 5 CREDITS: 4
COURSE CODE: ECT301 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: ANALOG INTEGRATED CIRCUITS	CONTACT HOURS: 4 hours /Week.
CORRESPONDING LAB COURSE CODE (IF ANY): ECT331	LAB COURSE NAME: ANALOG INTEGRATED CIRCUITS AND SIMULATION LAB

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Module 1:** **Operational amplifiers(Op Amps):** The 741 Op Amp, Block diagram, Ideal op-amp parameters,typical parameter values for 741, Equivalent circuit, Open loop configurations, Voltage transfer curve, Frequency response curve. **Differential Amplifiers:** Differential amplifier configurations using BJT, DC Analysis- transfercharacteristics; AC analysis- differential and common mode gains, CMRR, input and output resistance, Voltage gain. Constant current bias, constant current source; Concept of current mirror-the two transistor current mirror, Wilson and Widlar current mirrors.	9
II	**Op-amp with negative feedback**: General concept of Voltage Series, Voltage Shunt, current series and current shunt negative feedback, Op Amp circuits with voltage series and voltage shunt feedback, Virtual ground Concept; analysis of practical inverting and non-inverting amplifiers forclosed loop gain, Input Resistance and Output Resistance. **Op-amp applications:** Summer, Voltage Follower-loading effects, Differential andInstrumentation Amplifiers, Voltage to current and Current to voltage converters, Integrator, Differentiator, Precision rectifiers, Comparators, Schmitt Triggers, Log and antilogamplifiers.	11

III	**Op-amp Oscillators and Multivibrators:** Phase Shift and Wien-bridge Oscillators, Triangular andSawtooth waveform generators, Astable and monostable multivibrators. **Active filters**: Comparison with passive filters, First and second order low pass, High pass, Bandpass and band reject active filters, state variable filters.	10
IV	**Timer and VCO:** Timer IC 555- Functional diagram, Astable and monostable operations;. Basicconcepts of Voltage Controlled Oscillator and application of VCO IC LM566, **Phase Locked Loop –** Operation, Closed loop analysis, Lock and capture range, Basic buildingblocks, PLL IC 565, Applications of PLL.	9
V	**Voltage Regulators:** Fixed and Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection. **Data Converters:** Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, Flash type and Successive approximation type.	9
	TOTAL HOURS	48

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1.	Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
2.	Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
3.	Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGrawHill, 2008.
3.	David A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2ndedition, 2010
4.	Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010.
5.	R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, 6th Edition, PHI,2001
6.	C.G. Clayton, Operational Amplifiers, Butterworth & Company Publ. Ltd./ Elsevier, 1971
7.	Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
8.	Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT202	ANALOG CIRCUITS	Amplifier	4

COURSE OBJECTIVES:

1	To equip the students with a sound understanding of fundamental concepts of operational amplifiers
2	To know the diversity of operations that op amp can perform in a wide range of applications
3	To introduce a few special functions integrated circuits
4	To impart basic concepts and types of data converters

COURSE OUTCOMES:

No.	DESCRIPTION	BLOOM'S TAXONOMY LEVEL
CO1	Students will be able to **understand** Op Amp fundamentals and differential amplifier configurations	Understand (2)
CO2	Students will be able to **analyze** and **design** operational amplifier circuits for various applications	Analyze (4)
CO3	Students will be able to **analyze** and **design** Oscillators and active filters using opamps	Analyze (4) & Apply(6)
CO4	Students can **understand** the principle of working and applications of timer, VCO and PLL ICs.	Understand (2)
CO5	Students will be able to outline working of Voltage regulators & data convertors.	Understand (2)

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	3	1	2								1
CO 2	3	3	2	2	2							1
CO 3	3	3	2	2	2							1
CO 4	3	3	1	2	2							1
CO 5	3	3	2	2	2							1

CO-PSO MAPPING:

Programme-specific Outcomes (PSOs)		
1	**2**	**3**
2	1	
2	1	
2	1	
2	1	
2	1	
2	1	

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PO1	3	Analog circuits can be designed and modified to provide solutions to real-life problems
CO1-PO2	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO1-PO3	1	Analog circuits can be designed and modified to provide solutions to real-life problems
CO1-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems
CO1-PO12	1	With prior knowledge of op-amp fundamentals, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO2-PO1	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO2-PO2	3	Analog circuits can be designed and modified to provide solutions to real-life problems
CO2-PO3	2	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO2-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.

CO2-PO5	2	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO2-PO12	1	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO3-PO1	3	Analog circuits can be designed and modified to provide solutions to real-life problems
CO3-PO2	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO3-PO3	2	Analog circuits can be designed and modified to provide solutions to real-life problems
CO3-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO3-PO5	2	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO3-PO12	1	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO4-PO1	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO4-PO2	3	Analog circuits can be designed and modified to provide solutions to real-life problems
CO4-PO3	1	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO4-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO4-PO5	2	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO4-PO12	1	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO5-PO1	3	Analog circuits can be designed and modified to provide solutions to real-life problems

CO5-PO2	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO5-PO3	2	Analog circuits can be designed and modified to provide solutions to real-life problems
CO5-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO5-PO5	2	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO5-PO12	1	The advancement in technology from discrete circuits to ICs

JUSTIFICATION FOR CO-PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PSO1	2	Design & demonstration of analog circuits involves circuit implementation, testing & troubleshooting
CO1-PSO2	1	With prior knowledge of EDA tools, students can use their knowledge to simulate, experiment & develop newer applications
CO2-PSO1	2	Design & demonstration of analog circuits involves circuit implementation, testing & troubleshooting
CO2-PSO2	1	With prior knowledge of EDA tools, students can use their knowledge to simulate, experiment & develop newer applications
CO3-PSO1	2	Design & demonstration of analog circuits involves circuit implementation, testing & troubleshooting
CO3-PSO2	1	With prior knowledge of EDA tools, students can use their knowledge to simulate, experiment & develop newer applications
CO4-PSO1	2	Design & demonstration of analog circuits involves circuit implementation, testing & troubleshooting
CO4-PSO2	1	With prior knowledge of EDA tools, students can use their knowledge to simulate, experiment & develop newer applications

CO5-PSO1	2	Design & demonstration of analog circuits involves circuit implementation, testing & troubleshooting
CO5-PSO2	1	With prior knowledge of EDA tools, students can use their knowledge to simulate, experiment & develop newer applications

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Programmable Gain Amplifiers	Tutorial

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	TINA TI simulation tool

WEB SOURCE REFERENCES:

1	/www.coursera.org/learn/electronics
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/
3	http://www.nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/Analog%20circuits/index.htm

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	✓ WEB RESOURCES	
☐ LCD/SMART BOARDS	✓ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐-ASSIGNMENTS	☐ ~~STUD. SEMINARS~~	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION

✓ STUD. LAB PRACTICES	✓ STUD. VIVA	✓ MINI/MAJOR PROJECTS	☐ ~~CERTIFICATIONS~~
☐ ~~ADD-ON COURSES~~	☐ ~~OTHERS~~		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY
☐ ~~ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS~~	☐ ~~OTHERS~~

Prepared by
S.Santhi Jabarani
Dr.Jisa David
Dr. Jobin K.Antony

Approved by
Dr. Rithu James
(HOD)

COURSE PLAN

DAY	Planned
1	Syllabus Discussion, Assignment Details, Class Test, Importance of Attendance
2	Differential amplifiers: Differential amplifier configurations using BJT, (Discuss Theory only -Diagrams working)
3	Balanced and unbalanced output differential amplifiers, Voltage Gain, CMRR(Discuss Theory only-Diagrams-working)
4	Operational amplifiers: Introduction, Block diagram, 1
5	Non-ideal op-amp parameters, Ideal op-amp parameters,
6	open loop op-amp configurations
7	Op-amp with negative feedback: Introduction, feedback configurations,
8	voltage series feedback - non inverting amplifier
9	voltage shunt feedback - Inverting amplifier, properties of Practical op-amp
10	summing, scaling and averaging amplifiers
11	Differential amplifiers
12	instrumentation amplifier.
13	integrator
14	differentiator
15	Op-amp applications: Voltage to current converter
16	current to voltage converter,
17	precision rectifiers
18	log and antilog amplifier,
19	Comparators, zero crossing detector,
20	Schmitt trigger
21	Phase shift oscillator
22	Wien bridge oscillators

23	Astable
24	Monostable
25	triangular and saw tooth wave generators
26	triangular and saw tooth wave generators
27	Active filters
28	First order LPF its frequency response , Design
29	First order HPF, First order BPF, its frequency response , Design
30	Second order Butterworth LPF its frequency response , Design
31	Second order Butterworth HPF its frequency response , Design
32	Second order Butterworth BPF, BSF its frequency response , Design
33	Notch filter State variable filter, Design
34	State variable filter
35	Specialized IC's and its applications: Timer IC 555 (astable operation),
36	Timer IC 555 (monostable)
37	Voltage controlled oscillator,-LM 566 their application
38	PLL, operating principles, PLL IC 565, Applications
39	D to A converter , specifications , weighted resistor type
40	R-2R Ladder type,A to D Converters, Specifications, Flash type,Successive Approximation type
41	Differential amplifier - Current sources, Concept of current mirror circuits,Wilson current mirror circuits
42	Large and small signal operations, - BJT
43	Input resistance, voltage gain, CMRR, non ideal characteristics of differential amplifier
44	Three terminal voltage regulators 78XX and 79XX series
45	IC723 , low voltage and high voltage regulator,Current boosting, current Limiting short circuit protection,fold back protection

SAMPLE QUESTION

MODULE 1

1. Explain the operation of a basic differential pair to:
   a. Small-signal differential input
   b. Large-signal differential input
   c. Small-signal common-mode input
   d. Large-signal differential input
2. Derive using small-signal hybrid pi model of BJT, the input resistance, output resistance, voltage gain and current gain of the differential amplifier in:
   a. Differential mode of operation
   b. Common-mode of operation
3. What is CMRR? Find the expression of CMRR of a double-ended differential amplifier, using small-signal model of the BJT?
4. List the non-ideal characteristics of a diff amp. Explain their origin and derive epressions for each.
5. Explain the frequency response of differential amplifiers in differential and common mode of operation.
6. What is the difference between a current source and a current mirror? Elaborate.
7. Why are current mirrors used in differential amplifiers? What is the benefit of using them?
8. Derive the expression for output current and output resistance of Wilson current mirror. Contrast it with a simple current mirror.
9. Draw and explain the block diagram of an opamp.
10. List the ideal characteristics of an opamp.
11. Draw equivalent circuits of ideal and practical opamps.
12. Draw the voltage-transfer curve of an opamp and explain.
13. Explain the ac characteristics of an opamp.

MODULE II

1. Draw the different negative feedback topologies.
2. Draw opamp circuits in different negative feedback topologies.
3. Compare and contrast between voltage-series and voltage-shunt configurations.
4. List the properties of practical opamps.
5. Draw and explain the following circuits:
   a. Inverting amplifier
   b. Non-inverting amplifier
   c. Summing amplifier
   d. Scaling amplifier
   e. Averaging amplifier
   f. Instrumentation amplifier
   g. V-to-I converters
   h. I-to-V converters
   i. Integrator
   j. Differentiator
   k. Precision half-wave rectifier
   l. Precision full-wave rectifier
   m. Log amplifier

MODULE III

1. Explain the operation of astable multivibrator using opamp.
2. Draw and explain the following op-amp based circuits:
   a. Phase-shift oscillator
   b. Wien bridge oscillator
3. Explain the operation of monostable multivibrator using opamp.
4. How can a triangular wave be generated using an opamp? How can it be converted to a sawtooth wave?
5. What is an active filter? What are its advantages over passive filters?
6. Explain the difference between first order and second-order filters.
7. Design the following Butterworth filters for unity gain and cut-off frequency of 1 kHz:
   a. Low pass filter- first-order & second-order
   b. High pass filter – first-order & second-order
8. Design a Bandpass filter for unity gain and 1 kHz bandwidth for low Q and high Q, for a Butterworth response.
9. Design a Bandstop filter for unity gain and 1 kHz stop bandwidth for low Q and high Q, for a Butterworth response.

MODULE IV

1. Explain how can 555 timer be configured as an astable multivibrator and monostable multivibrator using the internal block diagram of 555 timer IC.
2. List the applications of 555 timer IC.
3. What is a VCO? Elaborate.
4. Provide the block diagram of PLL and explain its operation.
5. What is capture range and lock range of a PLL? Give the expressions for both for 565 PLL IC.
6. How can a PLL be used in the following applications?
   a. AM detection
   b. FM detection
   c. Frequency multiplication
   d. Frequency division
   e. Frequency synthesis

MODULE V

1. Write notes on the specifications of:
   a. ADC and b. DAC
2. Explain the operation of the following circuits:
   a. Weighted resistor type DAC
   b. R-2R Ladder type DAC
   c. Flash-type ADC
   d. Counter-ramp type ADC
   e. Single-slope type ADC
   f. Dual-slope-type ADC
   g. Successive approximation type ADC
3. What is the benefit of using monolithic IC voltage regulators over others?

ECT 303

DIGITAL SIGNAL PROCESSING

COURSE INFORMATION SHEET

PROGRAMME: UG PROGRAMME IN ELECTRONICS & COMMUNICATION ENGINEERING	**DEGREE: B. TECH.**
COURSE: DIGITAL SIGNAL PROCESSING	**SEMESTER: 5** **CREDITS: 4**
COURSE CODE: ECT303 REGULATION : 2019	**COURSE TYPE: CORE**
COURSE AREA/DOMAIN: SIGNAL PROCESSING	**CONTACT HOURS: 3 + 1 (Tutorial) hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): ECL333	**LAB COURSE NAME: DIGITAL SIGNAL PROCESSING LABORATORY**

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Basic Elements of a DSP system, Typical DSP applications, Finite-length discrete transforms, Orthogonal transforms – The Discrete Fourier Transform: DFT as a linear transformation (Matrix relations), Relationship of the DFT to other transforms, IDFT, Properties of DFT and examples. Circular convolution, Linear Filtering methods based on the DFT, linear convolution using circular convolution, Filtering of long data sequences, overlap save and overlap add methods, Frequency Analysis of Signals using the DFT (concept only required)**	**9**
II	**Efficient Computation of DFT: Fast Fourier Transform Algorithms-Radix-2 Decimation in Time and Decimation in Frequency FFT Algorithms, IDFT computation using Radix-2 FFT Algorithms, Application of FFT Algorithms, Efficient computation of DFT of Two Real Sequences and a 2N-Point Real Sequence**	**8**
III	**Design of FIR Filters - Symmetric and Anti-symmetric FIR Filters, Design of linear phase FIR filters using Window methods, (rectangular, Hamming and Hanning) and frequency sampling method, Comparison of design**	**12**

	methods for Linear Phase FIR Filters. Design of IIR Digital Filters from Analog Filters (Butterworth), IIR Filter Design by Impulse Invariance, and Bilinear Transformation, Frequency Transformations in the Analog and Digital Domain.	
IV	**Structures for the realization of Discrete Time Systems - Block diagram and signal flow graph representations of filters, FIR Filter Structures: Linear structures, Direct Form, CascadeForm, IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form, Computational Complexity of Digital filter structures. Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation), Anti- aliasing and anti-imaging filter.**	**11**
V	**Computer architecture for signal processing: Harvard Architecture, pipelining, MAC, Introduction to TMS320C67xx digital signal processor, Functional Block Diagram. Finite word length effects in DSP systems: Introduction (analysis not required), fixed-point and floating-point DSP arithmetic, ADC quantization noise, Finite word length effects in IIRdigital filters: coefficient quantization errors. Finite word length effects in FFT algorithms: Round off errors**	**9**
TOTAL HOURS		**49**

TEXT BOOKS:

Sl.No.	BOOK TITLE/AUTHORS/PUBLICATION
1.	**Proakis J. G. and Manolakis D. G., Digital Signal Processing, 4/e, Pearson Education, 2007**
2.	**Alan V Oppenheim, Ronald W. Schafer ,Discrete-Time Signal Processing, 3rd Edition , Pearson 2010**
3.	**Mitra S. K., Digital Signal Processing: A Computer Based Approach, 4/e McGraw Hill (India) 2014.**

RFERENCE BOOKS:

Sl.No.	BOOK TITLE/AUTHORS/PUBLICATION

4.	**Ifeachor E.C. and Jervis B. W., Digital Signal Processing: A Practical Approach, 2/e Pearson Education, 2009.**
5.	**Lyons, Richard G., Understanding Digital Signal Processing, 3/e. Pearson Education India, 2004.**
6.	**Salivahanan S, Digital Signal Processing,4e, Mc Graw –Hill Education New Delhi, 2019.**
7.	**Chassaing, Rulph., DSP applications using C and the TMS320C6x DSK. Vol. 13. John Wiley & Sons, 2003.**
8.	**Vinay.K.Ingle, John.G.Proakis, Digital Signal Processing: Bookware Companion Series,Thomson,2004.**
9.	**Chen, C.T., "Digital Signal Processing: Spectral Computation & Filter Design", Oxford Univ. Press, 2001.**
10.	**Monson H Hayes, "Schaums outline: Digital Signal Processing", McGraw HillProfessional, 1999**

COURSE PRE-REQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEM
ECT204	**SIGNALS AND SYSTEMS**	**Analysis of continuous time and discrete time signals and systems**	**4**

COURSE OBJECTIVES:

This course aims to provide an understanding of the principles, algorithms and applications of DSP.

COURSE OUTCOMES: After the completion of the course the student will be able to

Sl. No.	DESCRIPTION
1	**State and prove the fundamental properties and relations relevant to DFT and solve basic problems involving DFT based filtering methods**
2	**Compute DFT and IDFT using DIT and DIF radix-2 FFT algorithms**
3	**Design linear phase FIR filters and IIR filters for a given specification**

4	**Illustrate the various FIR and IIR filter structures for the realization of the given system function**
5	**Explain the basic multi-rate DSP operations decimation and interpolation in both time and frequency domains using supported mathematical equations**
6	**Explain the architecture of DSP processor (TMS320C67xx) and the finite word length effects**

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2		2							2	3	3	1
2	3	3	3		3							2	3	3	1
3	3	3	3		3							2	3	3	1
4	3	3	2		3							2	3	3	1
5	2	2	2		2							2	3	3	1
6	2	2	-		-							2	3		1
ECT 303	2.67	2.67	2		2.17							2	3	2.5	1

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT 303.1-PO1	3	DFT calculations

ECT 303.1-PO2	**3**	**Convolution of real time signals are performed using segmented methods.**
ECT 303.1-PO3	**3**	**Design of systems with minimum hardware**
ECT 303.1-PO5	**2**	**Simulation using MATLAB**
ECT 303.1-PO12	**2**	**Study of applications of DFT**
ECT 303.2-PO1	**3**	**FFT calculations**
ECT 303.2-PO2	**3**	**DIT and DIF FFT calculations**
ECT 303.2-PO3	**3**	**Design of systems with minimum hardware**
ECT 303.2-PO5	**3**	**Simulation using MATLAB**
ECT 303.2-PO12	**2**	**Study of applications of FFT**
ECT 303.3-PO1	**3**	**Filter equations and derivations**
ECT 303.3-PO2	**3**	**Deriving filter specifications**
ECT 303.3-PO3	**3**	**Filter design for practical signal processing applications**
ECT 303.3-PO5	**3**	**MATLAB simulation**
ECT 303.3-PO12	**2**	**Design of filters with improved specifications**
ECT 303.4-PO1	**3**	**Realization of structures**

ECT 303.4-PO2	**3**	**Realization of filters**
ECT 303.4-PO3	**2**	**Realization using minimum multipliers**
ECT 303.4-PO5	**3**	**MATLAB simulation**
ECT 303.4-PO12	**2**	**Realization of advanced filters**
ECT 303.5-PO1	**2**	**With supported mathematical equations**
ECT 303.5-PO2	**2**	**Use of decimation and interpolation in filter design**
ECT 303.5-PO3	**2**	**Use of multirate signal processing in advanced applications**
ECT 303.5-PO5	**2**	**MATLAB simulation**
ECT 303.5-PO12	**2**	**Use of multirate signal processing in advanced applications**
ECT 303.6-PO1	**2**	**Fixed and floating point arithmetic**
ECT 303.6-PO2	**2**	**Use of DSP processors in different applications**
ECT 303.6-PO12	**2**	**Advanced DSP processors**

JUSTIFICATION FOR CO-PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT 303.1-PSO1	**3**	**Implementation of DFT & IDFT**

ECT 303.1-PSO2	**3**	**Simulation using Matlab/ Python**
ECT 303.1-PSO3	**1**	**Assignments and Seminar**
ECT 303.2-PSO1	**3**	**Implementation & Design of DFT using FFT methods**
ECT 303.2-PSO2	**3**	**FFT implementation using Matlab / Python**
ECT 303.2-PSO3	**1**	**Assignments and Seminar**
ECT 303.3-PSO1	**3**	**Implementation & Design of filters**
ECT 303.3-PSO2	**3**	**Filter implementation using Matlab/ Python**
ECT 303.3-PSO3	**1**	**Assignments and Seminar**
ECT 303.4-PSO1	**3**	**Implementation of filter structures.**
ECT 303.4-PSO2	**3**	**Simulation using Matlab /Python**
ECT 303.4-PSO3	**1**	**Assignments and Seminar**
ECT 303.5-PSO1	**3**	**Implementation of multirate DSP**
ECT 303.5-PSO2	**3**	**Simulation using Matlab/ Python**
ECT 303.5-PSO3	**1**	**Assignments and Seminar**
ECT 303.6-PSO1	**3**	**Design of filters with low finite word length effects.**

ECT 303.6-PSO3	**1**	**Assignments and Seminar**

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSED ACTIONS
1	**Adaptive Filter Design**	**Students are asked to refer to online materials regarding adaptive filters.**

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS:

Sl. No.	DESCRIPTION
1	**MATLAB introduction**
2	**Advanced applications**

DESIGN AND ANALYSIS TOPICS:

Sl. No.	DESCRIPTION
1	**Filter Design and Analysis**
2	**Window Design and Analysis**

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	**http:// www.nptel.iitm.ac.in/**
2	**http:// www.slideshare.net**

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ **CHALK & TALK**	☐ **STUD. ASSIGNMENT**	☐ **WEB RESOURCES**	
☐ **LCD/SMART BOARDS**	☐ **STUD. SEMINARS**	☐ **ADD-ON COURSES**	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS**	☐ **STUD. SEMINARS**	☐ **TESTS/MODEL EXAMS**	☐ **UNIV. EXAMINATION**
☐ **STUD. LAB PRACTICES**	☐ **STUD. VIVA**	☐ **MINI/MAJOR PROJECTS**	☐ **CERTIFICATIONS**
☐ **ADD-ON COURSES**	☐ **OTHERS**		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)**	☐ **STUDENT FEEDBACK ON FACULTY (TWICE)**
☐ **ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS**	☐ **OTHERS**

Prepared by **Approved by:**

Mr. Naveen N **HOD-ECE**
Ms. Neethu Radha Gopan
Dr. Sabna N

COURSE PLAN

UNIT	DETAILS	HOURS
I	**Basic Elements of a DSP system, Typical DSP applications, Finite-length discrete transforms, Orthogonal transforms – The Discrete Fourier Transform: DFT as a linear transformation (Matrix relations), Relationship of the DFT to other transforms, IDFT, Properties of DFT and examples. Circular convolution, Linear Filtering methods based on the DFT, linear convolution using circular convolution, Filtering of long data sequences, overlap save and overlap add methods, Frequency Analysis of Signals using the DFT (concept only required)**	**9**
II	**Efficient Computation of DFT: Fast Fourier Transform Algorithms-Radix-2 Decimation in Time and Decimation in Frequency FFT Algorithms, IDFT computation using Radix-2 FFT Algorithms, Application of FFT Algorithms, Efficient computation of DFT of Two Real Sequences and a 2N-Point Real Sequence**	**8**
III	**Design of FIR Filters - Symmetric and Anti-symmetric FIR Filters, Design of linear phase FIR filters using Window methods, (rectangular, Hamming and Hanning) and frequency sampling method, Comparison of design methods for Linear Phase FIR Filters. Design of IIR Digital Filters from Analog Filters (Butterworth), IIR Filter Design by Impulse Invariance, and Bilinear Transformation, Frequency Transformations in the Analog and Digital Domain.**	**12**
IV	**Structures for the realization of Discrete Time Systems - Block diagram and signal flow graph representations of filters, FIR Filter Structures: Linear structures, Direct Form, CascadeForm, IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form, Computational Complexity of Digital filter structures. Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation), Anti- aliasing and anti-imaging filter.**	**11**

V	**Computer architecture for signal processing: Harvard Architecture, pipelining, MAC, Introduction to TMS320C67xx digital signal processor, Functional Block Diagram. Finite word length effects in DSP systems: Introduction (analysis not required), fixed-point and floating-point DSP arithmetic, ADC**	**9**

SAMPLE QUESTION

Module-1

1. Compare overlap-add method and overlap-save method.
2. State and prove any three properties of DFT.
3. Derive the relationship between impulse response and frequency response of a discrete time system.
4. What is BIBO stability? What are the conditions for BIBO system?
5. Explain the frequency analysis of signals using DFT?

Module-2

1. Compute the DFT of the sequence $x(n) = \sin(n\pi/4)$, where N=8 using DIT FFT algorithm.
2. Compute the DFT of the sequence $x(n) = \sin(n\pi/4)$, where N=8 using DIF FFT algorithm.
3. Compute the DFT of the sequence x(n) = (8,0,0,0,0,0,0,0) using FFT algorithm.
4. Show that DIT algorithm is the transpose of DIF algorithm.
5. Show that using a single DFT calculation how can we obtain the DFT of two sequences.

Module-3

1. Plot the location of zeros for linear phase FIR filters for different cases.
2. Write the transfer function and sketch the frequency response of an N-point rectangular window.
3. State clearly the principle of designing FIR filter using windows.
4. Compare FIR and IIR filters.

Semester V, Course Hand-Out

Department of EC, RSET 20

5. What are the conditions for a digital filter to be causal and stable?
6. What are the advantages of window method of designing FIR filters?

Module-4

1. Design an ideal high pass filter with a desired frequency response.
2. Using rectangular window design a LPF with a pass band of unity, cut off frequency 1000 Hz and working at a sampling frequency of 5 kHz. The length of impulse response is 7.

Module-5

1. Obtain the direct and cascade form realization of $H(z) = 1 + 5/2z^{-1} + 2z^{-2} + 2z^{-3}$
2. An FIR filter is given by difference equation $y(n) = 2x(n) + 4/5x(n-1) + 3/2x(n-2) + 2/3x(n)$ Determine the lattice structure.
3. Realise the following FIR filter in direct form, cascade form and lattice structure.

a. $H(z) = 1 + 2z^{-1} + 1/2z^{-2} - 1/2z^{-3} - 1/2z^{-4}$

4. Compare fixed point and floating point numbers.52. What are the different types of quantization errors?
5. Draw the quantization noise model for a second order system $H[z] = 1/(1-0.9z^{-1} +0.2z^{-2})$ and find the steady state output noise variance for a) cascade realization b) direct form realization.Use b = 3 bits.

ECT 305

ANALOG AND DIGITAL COMMUNICATION

COURSE INFORMATION SHEET

PROGRAMME: **ELECTRONICS AND COMMUNICATION ENGINEERING**	DEGREE: **B.TECH** UNIVERSITY: **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**
COURSE: **ANALOG AND DIGITAL COMMUNICATION**	SEMESTER: **S5** CREDITS: **4**
COURSE CODE: **ECT305** REGULATION: **2019**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **BASIC SCIENCE & ENGINEERING**	CONTACT HOURS: **3(L)+1(T) hours/week**
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
1.1	Block diagram of communication system, analog and digital systems , need for modulation	2
1.2	Amplitude modulation, model and spectrum and index of modulation	2
1.3	DSB-SC and SSB modulation. SSB transmitter and receiver	2
1.4	Frequency and phase modulation. Model of FM, spectrum of FM signal	2
2.1	Review of random variables, CDF and PDF, examples	2
2.2	Entropy of RV, Differential entropy of Gaussian RV, Expectation, conditional expectation, mutual information	4
2.3	Stochastic processes, Stationarity, WSS and SSS. Autocorrelation and power spectral density. Response of LTI systems to WSS	3
3.1	Source coding theorems I and II	1
3.2	PCM,Transmitter and receiver, companding Practical A and mu law companders	4
3.3	DPCM, Linear predictor, Wiener Hopf equation	3
3.4	Delta modulator	1
4.1	G-S procedure	3
4.2	ISI, Nyquist criterion, RS and SRC, PR signalling and duobinary coding	3
4.3	Equalization, design of zero forcing equalizer	3
4.4	Vector model of AWGN channel, Correlation receiver, matched filter	4
4.5	MAP receiver, ML receiver, probability of error	1
4.6	Channel capacity, capacity of Gaussian channel, Its significance in design of digital communication schemes	2
5.1	Need of digital modulation in modern communication	1

5.2	Baseband QPSK system, signal constellation. Effect of AWGN, probability of error (with derivation). BER-SNR curve, QPSK transmitter and receiver.	4
5.3	QAM system	1

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Communication Systems, Simon Haykin, Wiley.
T2	Digital Communications: Fundamentals and Applications, Sklar, Pearson.
T3	Digital Telephony, John C. Bellamy, Wiley
R1	Principles of Digital Communication,R. Gallager, Oxford University Press
R2	Digital Communication, John G Proakis, Wiley.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT 204	Signals and Systems	Basics of signals, Fourier Transform, sampling	4
MAT 204	Probability, Random Process and Numerical Methods	Random variables, random processes, stationarity	4

COURSE OBJECTIVES:

1	To introduce various analog and digital communication systems
2	This familiarize the students with the application of concepts of random processes with respect to communication systems
3	To study various channel effects

COURSE OUTCOMES:

SL. NO.	DESCRIPTION	Blooms' Taxonomy Level
C0.1	Explain the existent analog communication systems.	Understand (level 2)
C0.2	Apply the concepts of random processes to LTI systems.	Apply (level 3)
C0.3	Apply waveform coding techniques in digital transmission.	Apply (level 3)

C0.4	Apply GS procedure to develop digital receivers.	Apply (level 3)
C0.5	Apply equalizer design to counteract ISI.	Apply (level 3)
C0.6	Apply digital modulation techniques in signal transmission.	Apply (level 3)

CO-PO AND CO-PSO MAPPING

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	-	-	-	-	-	-	-	-	-	-			
CO2	3	3	2	3	3	-	-	-	-	-	-	-			
CO3	3	3	2	3	3	2	-	-	-	-	-	2			
CO4	3	3	2	3	3	2	-	-	-	-	-	2			
CO5	3	3	2	3	3	2	-	-	-	-	-	2			
CO6	3	3	2	3	3	2	-	-	-	-	-	2			

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	**LOW/ MEDIUM/ HIGH**	**JUSTIFICATION**
CO1-PO1	H	The knowledge of mathematics, science, Engineering fundamentals, and Electronics and Communication Engineering are essential to study the various analog communication systems
CO1-PO2	H	Students analyse and evaluate the various analog communication systems
CO2-PO1	H	Basic knowledge of probability and signals and systems help the students to apply the concepts of random processes to analyse complex LTI systems
CO2-PO2	H	Students analyse the relationship between the autocorrelation and power spectral density at the input and output of an LTI system when a wide sense stationary random process is given as input
CO2-PO3	M	Students can apply the knowledge of random processes to design and analyse systems
CO2-PO4	H	Students can use the knowledge of random processes to investigate complex problems in communication

CO2-PO5	H	Students can use the knowledge of fundamentals of probability and random processes to understand and use modern tools for prediction and modeling of complex communication engineering problems
CO3-PO1	H	Students apply basic knowledge of mathematics and other engineering fundamentals to learn the various waveform coding techniques
CO3-PO2	H	Students analyse and evaluate the various waveform coding techniques in terms of their performance
CO3-PO3	M	Students learn to design the transmitters and receivers for the waveform coding techniques
CO3-PO4	H	The knowledge of basic waveform coding techniques can be used to design and analyse more complex methods
CO3-PO5	H	Students can use modern IT tools like MATLAB to design and investigate the waveform coding techniques
CO3-PO6	M	Implemental socially relevant projects using the basic knowledge of waveform coding techniques
CO3-PO12	M	Students can use the knowledge of basic waveform coding techniques to research more complex coding techniques
CO4-PO1	H	Students use the basic knowledge of signals and mathematical tools to learn GS procedure
CO4-PO2	H	Students use the knowledge of GS procedure to analyse complex communication engineering problems
CO4-PO3	M	Students use GS procedure to design receivers to minimise the error is reception
CO4-PO4	H	Students can use the concept of signal space to analyse complex modulation techniques
CO4-PO5	H	Modern IT tools can be used for design and simulation of receivers foe various modulation techniques using the basic understanding of GS procedure
CO4-PO6	M	Students can use their knowledge of signal space and signal constellation in socially relevant projects
CO4-PO12	M	The basic knowledge of signal space and GS procedure can encourage the students to research more efficients receivers in future
CO5-PO1	H	Basic knowledge of mathematics and signals are required to understand the concept of ISI and how to avoid it in communication systems
CO5-PO2	H	Students analyse the problem of ISI and learn techniques to avoid it in practical communication systems
CO5-PO3	M	Students learn to design equalisers to overcome ISI
CO5-PO4	H	Students design equalisers to overcome the problem of ISI
CO5-PO5	H	Students can use modern IT tools to visualise the problem of ISI and design equalisers to negate it

CO5-PO6	M	The knowledge of ISI and equaliser design can be used to implement socially relevant projects
CO5-PO12	M	Students understand the need to understand the concept of ISI and the design of equalisers and apply this to more complex communication engineering problems in future
CO6-PO1	H	Students use the basic knowledge of mathematics, signals and probability to understand the various digital modulation techniques
CO6-PO2	H	Students analyse various digital modulation techniques to learn the BER achieved
CO6-PO3	M	Students can use the knowledge of SNR-BER relationship to design appropriate transmitters and receivers
CO6-PO4	H	Students can use their knowledge of the basic digital modulation techniques to design more complex modulation methods and analyse their performance
CO6-PO5	H	Modern IT tools can be used to visualise and analyse the performance of the various digital modulation techniques in terms of their BER performance
CO6-PO6	M	The knowledge of basic digital modulation techniques can help the students to involve in communication engineering related projects with social relevance
CO6-PO12	M	Students can use their understanding of basic modulation techniques to understand, analyse and design new modulation techniques to meet the communication requirements of the future

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Design and simulation of digital communication systems/Digital modulation schemes	ASSIGNMENT/ PROJECT	1,2,33,4,5,12 T	1,2

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	MIMO (Multiple Input Multiple Output) and Spatial Beamforming.	Video Lectures/Student Presentations	1,2,3,4,5,12	1,2

WEB SOURCE REFERENCES:

1	https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee06/
2	http://ndl.iitkgp.ac.in/document/S1loNUNiRE91VEk4NzFxWDNoYW05bGN2NmxONEJJMXRnQTAwVzJiUExxYTlkRXBMR0tEeEdWNDNiNWxlY3JMNkxNNFJsR2hIcmFSaUV4a0dZQ0dhQy9PTjBuVFJaOEhWVkpaUUlIcmhaRUk9
3	https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee27/
4	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-36-communication-systems-engineering-spring-2009/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENTS	☑ WEB RESOURCES	☑ ONLINE CLASSES
☑ LCD/SMART BOARDS	☐STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☐STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Ms. Deepthy G.S.
Mr. Jaison Jacob
Dr. Susan Dominic

Approved by

Ms. Rithu James
(HOD, ECE)

COURSE PLAN

UNIT	DETAILS	HOURS
1.1	Block diagram of communication system, analog and digital systems , need for modulation	2
1.2	Amplitude modulation, model and spectrum and index of modulation	2
1.3	DSB-SC and SSB modulation. SSB transmitter and receiver	2
1.4	Frequency and phase modulation. Model of FM, spectrum of FM signal	2
2.1	Review of random variables, CDF and PDF, examples	2
2.2	Entropy of RV, Differential entropy of Gaussian RV, Expectation, conditional expectation, mutual information	4
2.3	Stochastic processes, Stationarity, WSS and SSS. Autocorrelation and power spectral density. Response of LTI systems to WSS	3
3.1	Source coding theorems I and II	1
3.2	PCM,Transmitter and receiver, companding Practical A and mu law companders	4
3.3	DPCM, Linear predictor, Wiener Hopf equation	3
3.4	Delta modulator	1
4.1	G-S procedure	3
4.2	ISI, Nyquist criterion, RS and SRC, PR signalling and duobinary coding	3
4.3	Equalization, design of zero forcing equalizer	3
4.4	Vector model of AWGN channel, Correlation receiver, matched filter	4
4.5	MAP receiver, ML receiver, probability of error	1
4.6	Channel capacity, capacity of Gaussian channel, Its significance in design of digital communication schemes	2
5.1	Need of digital modulation in modern communication	1

5.2	Baseband QPSK system, signal constellation. Effect of AWGN, probability of error (with derivation). BER-SNR curve, QPSK transmitter and receiver, QAM system	5

SAMPLE QUESTIONS

MODULE 1

- Give the time domain equation of an AM signal and plot its spectrum.
- Write the mathematical expression of Narrow band FM and draw its spectrum.
- A 400 Watt carrier is modulated to a depth of 75 percent. Calculate the total power in the modulated wave.
- Compute the bandwidth of the narrow band FM signal with modulating signal frequency of 1kHz and index of modulation 0.3.
- If a sinusoidal is amplitude modulated by the carrier $5\cos 2\pi 300t$ to a depth of 30%, compute the power in the resultant AM signal.
- Draw the block diagram of a communication system and explain.
- Write the time domain equation of an FM signal with a single tone modulating signal and plot its spectrum.
- A 100MHz carrier is frequency modulated by a cosine signal of amplitude 20V and frequency 100kHz. The frequency sensitivity of the modulator is 25kHz/Volt. Calculate the frequency deviation, modulation index and bandwidth of the resulting FM signal.
- Draw the block diagram of the SSB transmitter and explain.
- A SSB transmitter radiates 0.5kW when the modulation percentage is 60 %. How much of carrier power is required if we want to transmit the same message by an AM transmitter?
- Explain how FM is transmitted and received with the help of block diagrams.

MODULE 2

- Find the mean value and variance of a continuous random variable α whose probability density function $f_\alpha(\alpha) = C\,\text{Cos}(\alpha+\pi/4)$ with $\alpha \in [-\pi/4, 0]$ and C being some constant. Note: First find the value of C.
- Let X be the number of tails obtained by tossing a coin 3 times. Obtain the PMF and CDF of X.
- Let X be a random variable with PDF given by $f_X(x) = cx2$ for $|x| \leq 1$ and 0 otherwise. i) Find the constant c ii) Find E[X] and Var(X) iii) Find $P(X \geq 0.5)$.
  Give the relation between autocorrelation and power spectral density of a WSS.
- Explain mutual information. Give its relation with self in formation.
- A WSS process with autocorrelation $R_X(\tau) = e^{-\alpha|\tau}$ is applied to an LTI system with impulse response $h(t) = e^{-\beta|t|}$ with $|\alpha| > 0$, $|\beta| > 0$. Find the output power spectral density.
- Give the conditions for stationarity in the strict sense.
- A zero memory source has a source alphabet S = {s1, s2, s3}, with probabilities P = {1/2, 1/4, 1/4}.
- Find the entropy of the source.
- State Einstein-Wiener-Khintchine relations with equations

MODULE 3

- Draw and explain the block diagrams of PCM transmitter and receiver.
- Explain how DPCM helps in bandwidth reduction as compared to PCM.
- Design a 3-tap linear predictor for speech signals with an autocorrelation vector [0.95 0.85 07.0.6] based on the Wiener-Hopf equation. Compute the minimum mean square error.
- Design a 3 tap linear predictor for speech signals with the autocorrelation vector values [1 0.8 0.604] based on Wiener-Hopf equation. Also determine the least variance of the predictor.

- Compute the A law and mu-law quantised values of a signal that is normalized to 0.8 with A=32 and mu=255.
- A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×106 bits/s. What is the maximum message bandwidth for which the system operates satisfactorily?

MODULE 4

- What is a matched filter? Derive an expression for the impulse response of a matched filter.
- A baseband digital system uses 4-level PAM along with the raised cosine pulse. The system has a frequency response of 3.2 kHz. If the binary data is transmitted at 9600 bps data rate, then what would be the symbol rate and roll-off factor of the transmitted ulse shape for zero ISI?
- What is raised cosine spectrum?
- Give the mathematical model of ISI
- With the help of necessary mathematical expressions explain inter symbol interference (ISI).
- Compute the probability of error for maximum likely hood detection of binary transmission.
- Explain the term matched filter. Plot the BER-SNR curve for a matched filter receiver.
- Design a zero forcing equalizer for the channel that is characterized by the filtertaps {1, 0.7, 0.3}.
- Explain partial response signaling.

MODULE 5

- Derive the bit error probability for QPSK.
- Draw the constellation diagram for QPSK modulation and explain the generation and detection of QPSK signals with the help of block diagrams.
- With the help of diagrams, explain the working of BPSK transmitter and receiver. Derive an expression for probability of error for BPSK.
- Draw the block diagram for QPSK generation and detection with relevant equations. Derive the probability of error for a QPSK system with Gray coding.
- Draw the BER-SNR plot for a QPSK system.
- Draw the BER-SNR plot for a BPSK system.
- Draw the signal constellation of a QPSK system with and without AWGN.
- Draw the signal constellation of a QAM system.
- Explain QAM.

ECT 307

CONTROL SYSTEM

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS AND COMMUNICATION ENGINEERING	DEGREE: B.TECH
COURSE: CONTROL SYSTEMS	SEMESTER: 5 CREDITS: 4
COURSE CODE: ECT307 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: CONTROL SYSTEMS	CONTACT HOURS: 4hours /Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NA

SYLLABUS:

UNIT	DETAILS	HOURS
I	Basic Components of a Control System, Applications, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system. Effects of Feedback on Overall Gain, Stability, External, disturbance or Noise. Types of Feedback Control Systems, Linear versus Nonlinear Control Systems, Time-Invariant versus Time-Varying Systems. Mathematical modelling of control systems - Electrical Systems and Mechanical systems. Block diagram representation and reduction methods. Signal flow graph and Mason's rule formula.	10
II	Standard test signals. Time response specifications. Time response of first and second order systems to unit step input, ramp inputs, time domain specifications. Steady state error and static error coefficients ,Frequency domain specifications, correlation between time and frequency responses.	9
III	Concept of BIBO stability, absolute stability, Routh Hurwitz Criterion, Effect of P, PI & PID controllers,Introduction to root locus techniques, properties and its construction, Application to system stability studies. Illustration of the effect of addition of a zero and a pole	9
IV	Nyquist stability criterion: Fundamentals and analysis ,Relative stability: gain margin and phase margin. Stability analysis with Bode plot,Design of Compensators: Need of compensators, design of lag and lead compensators using Bode plots.	9
V	State Variable Analysis of Linear Dynamic Systems: State variables, state equations, state variable representation of electrical and mechanical systems, dynamic equations, merits for higher order differential equations and solution,Transfer function from State Variable Representation, Solutions of the state equations, state transition matrix,Concept of controllability and observability and techniques to test them - Kalman's Test.	13
	TOTAL HOURS	50

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION

T	Farid Golnaraghi, Benjamin C. Kuo, Automatic Control Systems, 9/e, Wiley India.
T	Gopal, Control Systems, 4/e, McGraw Hill Education India Education , 2012
T.	Ogata K., Discrete-time Control Systems, 2/e, Pearson Education
R	Gopal, Digital Control and State Variable Method, 4/e, McGraw Hill Education India 2012
R	Norman S. Nise, Control System Engineering, 5/e, Wiley India
R	Ogata K., Modern Control Engineering, Prentice Hall of India, 4/e, Pearson Education, 2002
R	Richard C Dorf and Robert H. Bishop, Modern Control Systems, 9/e, Pearson Education, 2001

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
EC 202	Signals & Systems	Basics of Signals & Systems	IV

COURSE OBJECTIVES:

1	To introduce the elements of control system and its modelling
2	To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3	To introduce stability analysis of control system.
4	To design control systems with compensating techniques.
5	To introduce the state variable analysis method.

COURSE OUTCOMES:

Sl. No.	DESCRIPTION
1	Students will be able to represent systems mathematically and derive their transfer function model.
2	Students will be able to analyse the time response and frequency response of the systems for various input signals
3	Students will be able to determine the stability of system
4	Students will be able to apply frequency domain techniques to assess the system performance and to design a control system with suitable compensation techniques.
5	Students will be able to perform state variable analysis of systems

CO-PO-PSO MAPPING:

	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2		1							2	1	1	
CO2	3	3	2		1							2	1	1	
CO3	3	3	3		1							2	1	1	
CO4	3	3	3		1							2	1	2	
CO5	3	3	3		1							2	1	1	

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PO1	3	Knowledge of differential equations, Laplace transforms and basic physics work together for modelling
CO1-PO2	3	Modelling in itself is a problem analysis
CO1-PO3	2	Problem is modelling and solution is a transfer function representing the system
CO1-PO5	1	Matlab can be utilized to verify the final model
CO1-PO12	2	
CO2-PO1	3	Analysing a system from different perspective to understand its behavior using the model
CO2-PO2	3	Kean analysis of response required to completely predict system behavior
CO2-PO3	2	This CO decides whether the system design meets the required criteria or not.
CO2-PO5	1	With modern tools generating system response is easier
CO2-PO12	2	
CO3-PO1	3	Understanding stability is the first step to controller design
CO3-PO2	3	Different system's stability are tested by students
CO3-PO3	3	The most important criteria is controller design is stability
CO3-PO5	1	Different plots can be constructed using Matlab to analyse stability
CO3-PO12	2	
CO4-PO1	3	
CO4-PO2	3	
CO4-PO3	3	
CO4-PO5	1	
CO4-PO12	2	

CO5-PO1	3	Apply state variable analysis for the solution of complex engineering problems
CO5-PO2	3	Students need to identify and formulate controller requirement and analyse
CO5-PO3	3	After formulation of problem controller design is done
CO5-PO5	1	Response analysis and stability check become easier with tools
CO5-PO12	2	

JUSTIFICATION FOR CO-PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PSO1	1	All the methods studied and skill acquired are directly used in industry
CO1-PSO2	1	EDA tools such as Matlab plays an important part
CO2-PSO1	1	Response analysis can be considered as a skill
CO2-PSO2	1	EDA tools such as Matlab plays an important part
CO3-PSO1	1	Stability analysis can be considered as a skill
CO3-PSO2	1	EDA tools such as Matlab plays an important part
CO4-PSO1	1	
CO4-PSO2	2	
CO5-PSO1	1	
CO5-PSO2	1	

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Effects of adding poles and zeroes in the transfer function – time domain	Class room teaching
2	Effects of adding poles and zeroes in the transfer function – Frequency domain	Class room teaching

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Design of compensation networks

WEB SOURCE REFERENCES:

1	http://nptel.ac.in/courses/108102043/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

• CHALK & TALK	• STUD. ASSIGNMENT	• WEB RESOURCES
☐ LCD/SMART BOARDS	• STUD. SEMINARS	• ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

☐-ASSIGNMENTS	☐ ~~STUD. SEMINARS~~	• TESTS/MODEL EXAMS	• UNIV. EXAMINATION
• STUD. LAB PRACTICES	• STUD. VIVA	• MINI/MAJOR PROJECTS	☐ ~~CERTIFICATIONS~~
☐ ~~ADD-ON COURSES~~	☐ ~~OTHERS~~		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY
☐ ~~ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS~~	☐ ~~OTHERS~~

Prepared by **Approved by**

Harsha A
Ramitha R
Ameera Sathar **HOD - ECE**

COURSE PLAN

UNIT	DETAILS	HOURS
I	Basic Components of a Control System, Applications, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system. Effects of Feedback on Overall Gain, Stability, External, disturbance or Noise. Types of Feedback Control Systems, Linear versus Nonlinear Control Systems, Time-Invariant versus Time-Varying Systems. Mathematical modelling of control systems - Electrical Systems and Mechanical systems. Block diagram representation and reduction methods. Signal flow graph and Mason's rule formula.	10
II	Standard test signals. Time response specifications. Time response of first and second order systems to unit step input, ramp inputs, time domain specifications. Steady state error and static error coefficients ,Frequency domain specifications, correlation between time and frequency responses.	9
III	Concept of BIBO stability, absolute stability, Routh Hurwitz Criterion, Effect of P, PI & PID controllers,Introduction to root locus techniques, properties and its construction, Application to system stability studies. Illustration of the effect of addition of a zero and a pole	9
IV	Nyquist stability criterion: Fundamentals and analysis ,Relative stability: gain margin and phase margin. Stability analysis with Bode plot,Design of Compensators: Need of compensators, design of lag and lead compensators using Bode plots.	9
V	State Variable Analysis of Linear Dynamic Systems: State variables, state equations, state variable representation of electrical and mechanical systems, dynamic equations, merits for higher order differential equations and solution,Transfer function from State Variable Representation, Solutions of the state equations, state transition matrix,Concept of controllability and observability and techniques to test them - Kalman's Test.	13
	TOTAL HOURS	50

SAMPLE QUESTIONS

MODULE I

- With the help of a block diagram, explain the basic components in a control system.
- List five applications of control systems
- Differentiate between open-loop and closed-loop control systems
- Explain the working of a control system, with an example.
- How does a control system affect the following system performance parameters? a. Gain b. Stability c. Noise
- How can control systems be classified? Explain.
- Describe the mathematical modelling of a series RLC circuit.
- Using an example, demonstrate the mathematical modelling of a mechanical system.
- Illustrate two techniques used in block diagram reduction.
- What is a signal flow graph? How is it different from a block diagram?
- What is Mason's rule? Explain.

MODULE II

- Define the time response specifications of a system.
- What is the typical response of a first order system to (a) a unit step input (b) a ramp input?
- What is the typical response of a second order system to (a) a unit step input (b) a ramp input?
- What is meant by steady state error?
- What are static and dynamic error coefficients?

MODULE III

- What are the different methods by which the stability of a linear control system can be determined? What is Routh-Hurwitz criterion?
- Explain the Root Locus Technique.
- What are the frequency domain specifications that characterize a system?
- What is the correlation between time and frequency responses?

MODULE IV

- Explain the Nyquist stability criterion
- What is meant by (a) Gain margin (b) Phase Margin (c) Gain cross-over point (d) Phase crossover frequency?
- What is meant by Bode plot? Explain.
- How can the stability of a system be determined from its Bode plot?
- What is the function of each component in a PID controller?
- What is a PID controller? What is its advantage over a PI controller?
- Explain, in detail, the design of a phase-lead controller. Provide an application.
- Explain, in detail, the design of a phase-lag controller. Provide an application.
- What is a lag-lead controller? Why is it used?

MODULE V

- What is meant by state-space representation of a system? What are state variables?
- How can the transfer function be determined from its state space representation?
- Define state transition matrix.
- Define observability and controllability. Explain.
- What is Kalman's test. Explain.
- What is Gilbert's test. Explain.

HUT300

INDUSTRIAL ECONOMICS AND FOREIGN TRADE

COURSE INFORMATION SHEET

PROGRAMME: COMMON TO ALL BRANCHES	**DEGREE:** B.TECH
COURSE: INDUSTRIAL ECONOMICS AND FOREIGN TRADE	**SEMESTER:** V **CREDITS:** 3
COURSE CODE: HUT 300 **REGULATION:** 2019	**COURSE TYPE:** CORE
COURSE AREA/DOMAIN: APPLIED ECONOMICS	**CONTACT HOURS:** 3-0-0
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME:** NA

Preamble: To equip the students with basic economic concepts to take industrial decisions and to create an awareness of economic environment.

Prerequisite: Nil

SYLLABUS:

MODULE	DETAILS	HOURS
I	**Basic Concepts and Demand and Supply Analysis:** • Scarcity and Choice - Basic Economic Problems- PPC • Firms and its Objectives – Types of Firms • Utility – Law of Diminishing Marginal Utility • Demand and its Determinants – Law of Demand – Elasticity of Demand - measurement of Elasticity and its applications • Supply, Law of Supply and Determinants of Supply • Equilibrium – Changes in Demand and Supply and its effects • Consumer Surplus and Producer Surplus (Concepts) • Taxation and Deadweight Loss.	**7**
II	**Production and Cost:** • Production Function – Law of Variable Proportion – Economies of Scale – Internal and External Economies • Isoquants, Isocost Line and Producer's Equilibrium – Expansion path • Technical Progress and its Implications – Cobb-Douglas Production Function • Cost concepts – Social Cost: Private Cost and External Cost – Explicit and Implicit Cost – Sunk Cost • Short Run Cost Curves - Long Run Cost Curves • Revenue (concepts) • Shutdown Point – Break-even Point.	**7**
FIRST INTERNAL EXAM		
III	**Market Structure**: • Perfect and Imperfect Competition • Monopoly, Regulation of Monopoly • Monopolistic Competition (features and equilibrium of a firm) • Oligopoly – Kinked Demand Curve – Collusive Oligopoly (meaning) • Non-price Competition • Product Pricing – Cost Plus Pricing – Target Return Pricing - Penetration Pricing – Predatory Pricing – Going Rate Pricing – Price Skimming.	**6**

IV	**Macro-Economic Concepts:** • Circular Flow of Economic Activities • Stock and Flow – Final Goods and Intermediate Goods - Gross Domestic Product • National Income • Three Sectors of an Economy- Methods of Measuring National Income • Inflation- Causes and Effects – Measures to Control Inflation- Monetary and Fiscal Policies • Business Financing- Bonds And Shares -Money Market And Capital Market – Stock Market – Demat Account And Trading Account - SENSEX And NIFTY	**7**
SECOND INTERNAL EXAM		
V	**International Trade:** • Advantages and Disadvantages of International Trade • Absolute and Comparative Advantage Theory • Heckscher - Ohlin Theory • Balance of Payments – Components – Balance of Payments – Deficit and Devaluation • Trade Policy – Free Trade Versus Protection – Tariff and Non-Tariff Barriers.	**8**
TOTAL HOURS		**35**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
T	Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
T	Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
T	Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
T	Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

COURSE OBJECTIVES:

1.	To familiarise the underlying concepts like scarcity, choice, demand and supply, and utility in economics
2.	To understand the concepts related to cost and apply while analysing production function of a firm
3.	To differentiate between different market structures and evaluate the competitive conditions of each market feasible for firms
4.	To effectively analyse reasons behind economic fluctuations occurring in the country by learning important macroeconomic indicators and policies
5.	To logically identify the link between domestic and international market and its implications on the host country

COURSE OUTCOMES:

COURSE OUTCOME	EXPLANATION
CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

CO-PO MAPPING

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2										3	
CO 2	2	2			2	2	3				3	
CO 3	2	2	1								3	
CO 4	2	2	1			1					3	
CO 5	2	2	1								3	

CO-PO MAPPING (JUSTIFICATION)

CO/PO	PO 1	PO 2	PO 3	PO 5	PO 6	PO 7	PO 11
CO 1	Knowledge of economic						Module I helps to apply the concept of

	concepts elaborated in Module I are required to understand, analyse and find solutions to societal problems.						scarcity considering the major economic problems and finding the feasible output production at a point of time. Eg: PPF
CO 2	Knowledge of economic concepts elaborated in Module II are required to analyse and evaluate the cost of production and find optimum output at firm level.	The concepts related to Production cost in Module II like TC, AC, MC etc, in identifying the variations in production function and its impact on an industrial undertaking.	.	As an economy progresses technological advancement and inclusive development are indispensable. The resource utilization and its optimal utilization is of greater importance during this advancement. Module II provides theoretical understanding about Law of Variable Proportions, Optimal output production etc for firms/industry who engage in experimenting with new methods of production/technology.	Every firm level/industrial level activity has its repercussion on the society. This impact can be identified using the cost concepts in Module III. For example, calculating social cost.	A firm in order to sustain should have an idea about profitability, that is about cost and revenue. The idea of social cost for example provides the impact of a firm's activity on the society/environment. Shut down point helps a firm to minimise its loss. Module II gives this idea of Production costs.	Module II helps to apply the concepts of production like AC,VC & MC to determine the prices of factors of production, to calculate the cost of production, to identify optimal pricing and ways to minimise loss.
CO 3	Knowledge of economic concepts elaborated in Module III are required to understand and evaluate various forms of market structures and identify feasible markets for different types of firms.	Knowledge of types of markets and their features in Module III are required to identify the types of market, the comparison between firms in different types of markets.	Module III details about different kinds of markets feasible for different kinds of firms. Identifying the exact market for a product will increase the scope for more innovations and solutions.				Module III provides knowledge on markets where every market has different features and hence it gives an idea about which product will sustain in which market. Identifying market types give an idea about various market strategies that help firms to survive competitions in such markets.
CO 4	Knowledge of economic concepts elaborated in Module IV are important macroeconomic indicators like GDP, Inflation, etc to analyse and evaluate how variations in these indicators affect the economic	Module IV provides insight in to the endogenous factors affecting firm/industry. This helps in solving/finding solutions to industrial problems within a country.	Not all layers of the economy are equal. Every segment of the society deals with different kinds of problem. A policy impact may sometimes become boon to some segments but it can be a curse to some other segments of the economy.	The economic activities in a country are interdependent. An investment, the launch of a new product, expansion of an industry, inclusion of new technology create more employment opportunities, more revenue, increased demand, market failure etc. Module IV provides an understanding of how these economic activities are linked to each other and the changes resulting			Launching a product or service in a society has its own implications, since every economic activity is interdependent. Module IV gives an idea on macroeconomic indicators required to understand the practicality of a an industrial activity. The understanding of share market

	conditions within an economy.		Module IV gives a general understanding of the macroeconomic indicators and policy framework of our country.	from this interdependence.			gives an idea about share capital, competition among firms and the money market as a whole.
CO 5	Domestic and international markets are linked in a complex way in this era of globalization. Module V lays down the basic concepts to understand that link between the two markets.	Module V gives an insight in to how a firm is linked to a global network and the repercussions. It provides an idea about the exogenous forces affecting a firm's/industry's survival.	When firms/industries go global it is important to understand how export and import prices affect pricing of a product. This decides the profitability of a product and thereby the firm. Module V deals with foreign trade and its impact on the growth of a firm globally.				Entering a global market invites new technological spill over, export receipts, more investment, cost and more competition. Module V provides the complexities of international trade and the challenges the firm might face. This gives ground knowledge about how versatile a leader should be while managing a global firm/industry.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1.	Cost Engineering	Audio PPT
2.	Location Theories	Assignment
3.	Industrial Policy and Growth in India	Classroom Discussion
4.	Methods of evaluating Investment Decisions	Audio PPT
5.	Patents	Assignment
6.	Risk Analysis and Decision Making	Audio PPT
7.	Innovation and Rivalry	Classroom Discussion

Proposed Actions: Topics beyond Syllabus/Assignment/Industry Visit/Guest Lecturer/Nptel Etc

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1.	Theories of Industrial Location and Regional Development
2.	Industrial Investment –Trends – Kerala Model
3.	Trends and Pattern of Regional Development in Kerala

4.	Theories of Growth of Firms
5.	Industrial Finance – Sources of Finance
6.	Social Cost Benefit Analysis

WEB SOURCE REFERENCES:

1.	https://www.india.gov.in/topics/industries	National Portal of India
2.	https://www.cii.in/	The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.
3.	https://commerce.gov.in/	The Department formulates, implements and monitors the Foreign Trade Policy (FTP) which provides the basic framework of policy and strategy to be followed for promoting exports and trade
4.	http://mospi.nic.in/annual-survey-industries	The ASI frame is based on the lists of registered factories / units maintained by the Chief Inspector of Factories in each State and those maintained by registration authorities in respect of bidi and cigar establishments and electricity undertakings.
5.	https://msme.gov.in/	MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	✓ WEB RESOURCES	□LCD/SMART BOARDS
✓ STUD. SEMINARS	□ ADD-ON COURSES	✓ ICT ENABLED CLASSES	✓ ONLINE CLASSES USING GOOGLE MEET

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	✓ STUDENT SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIVERSITY EXAMINATION
□ STUD. LAB PRACTICES	□ STUD. VIVA	□ MINI/MAJOR PROJECTS	□ CERTIFICATIONS
□ ADD-ON COURSES	□ OTHERS	✓ GROUP DISCUSSION	

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
□ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	□ OTHERS

Prepared by
Ms Lekshmi Vijayakumar
Ms. Neethu George
Ms Saritha V

Approved by
Dr. Sonia Paul
Head of the Department of Basic Sciences & Humanities

COURSE PLAN

MODULE	DETAILS	HOURS
I	**Basic Concepts and Demand and Supply Analysis:** • Scarcity and Choice - Basic Economic Problems- PPC • Firms and its Objectives – Types of Firms • Utility – Law of Diminishing Marginal Utility • Demand and its Determinants – Law of Demand – Elasticity of Demand - measurement of Elasticity and its applications • Supply, Law of Supply and Determinants of Supply • Equilibrium – Changes in Demand and Supply and its effects • Consumer Surplus and Producer Surplus (Concepts) • Taxation and Deadweight Loss.	**7**
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FIRST INTERNAL EXAM		
III	**Market Structure**: • Perfect and Imperfect Competition • Monopoly, Regulation of Monopoly • Monopolistic Competition (features and equilibrium of a firm) • Oligopoly – Kinked Demand Curve – Collusive Oligopoly (meaning) • Non-price Competition • Product Pricing – Cost Plus Pricing – Target Return Pricing - Penetration Pricing – Predatory Pricing – Going Rate Pricing – Price Skimming.	**6**
IV	**Macro-Economic Concepts:** • Circular Flow of Economic Activities • Stock and Flow – Final Goods and Intermediate Goods - Gross Domestic Product • National Income • Three Sectors of an Economy- Methods of Measuring National Income • Inflation- Causes and Effects – Measures to Control Inflation- Monetary and Fiscal Policies • Business Financing- Bonds And Shares -Money Market And Capital Market – Stock Market – Demat Account And Trading Account - SENSEX And NIFTY	**7**

SECOND INTERNAL EXAM		
V	**International Trade:** • Advantages and Disadvantages of International Trade • Absolute and Comparative Advantage Theory • Heckscher - Ohlin Theory • Balance of Payments – Components – Balance of Payments – Deficit and Devaluation • Trade Policy – Free Trade Versus Protection – Tariff and Non-Tariff Barriers.	**8**
TOTAL HOURS		**35**

SAMPLE QUESTIONS

MODULE I

1. Explain in detail the fundamental problems of an economy. (Problem of scarcity+ 3 problems).
2. Elaborate the role of Business economics in managerial decision making (definition + any 5 points).
3. Define the following concepts with an example:
   I. Problem of scarcity
   II. Tradeoff
   III. Opportunity cost
   IV. Diminishing Marginal Utility (diagram - marking)
   V. Resource allocation
3. With the help of a diagram and table depict a production possibility frontier (diagram + mark 3 areas clearly). What does a PPF represent? State the assumptions of a PPF. Depict choice, tradeoff and opportunity cost in the diagram
4. Sate the law of diminishing marginal utility (LDMU) with the help of a table and diagram (draw the two diagram + 3 different levels of utility. Mark the core points where TU is maximum MU is zero). List out the assumptions of LDMU**.**
5. Define an equilibrium price. How is an equilibrium price determined in the market? Explain the same with the help of a diagram and table. Explain the stages of excess demand and excess supply.
6. Solve the following:
   I. Consider the demand for a good. At price Rs 4, the demand for the good is 25 units. Suppose price of the good increases to Rs 5, and as a result, the demand for the good falls to 20 units. Calculate the price elasticity
   II. Consider the demand curve D(p)=10 – 3p. What is the elasticity at price 5/3?
   III. Suppose the price elasticity of demand for a good is – 0.2. If there is a 5 % increase in the price of the good, by what percentage will the demand for the good go down?

IV. Suppose the price elasticity of demand for a good is – 0.2. How will the expenditure on the good be affected if there is a 10 % increase in the price of the good?

7. Define (a) normal good (b) inferior good (c) substitute good (d) complement good and, (e) Giffen goods

8. Explain the concept dead weight loss.

9. Differentiate between consumer surplus and producer plus.

10. Explain the reason behind shift in demand and supply curves.

11. Suppose the price of Covishield vaccine is ₹750 per dose, and the market demand curve for Covishield vaccine is a usual downward slopping curve and the supply curve for the same is upward slopping. With the help of a diagram depict the equilibrium price and quantity as P* and Q* respectively. Suppose that in Kerala the government intervenes at this point, finding that there is less inclusion of vaccinated people due to the high price and the government sets a price floor of ₹250 per dose. What change would this bring to the demand curve, given there would be supply of the vaccine accordingly and why? Indicate the new equilibrium. Now suppose that the IMA (Indian Medical Association) announces that Covaxin is more effective than Covishield and the Central government intervene at this point and sets a price floor of Covaxin ₹150 per dose. Explain how would this impact the market for Covishield? Indicate the new equilibrium. Now, if the price of Covishield falls further to ₹100, will it have an impact on the demand for Covishield? Explain your answer fully with the aid of diagrams.

12. Discuss any five determinants of demand and supply.

13. Explain with the help of a diagram how a lump sum tax can minimise both consumer and producer surplus and create deadweight loss.

14. Discuss various situation that leads to deadweight loss.

15. Discuss different types of firms with examples.

MODULE II

1. State the law of variable proportion and explain it with the help of a diagram and table. (Clearly mark the III stages and also mention the rational stage. Briefly explain what happens in each stage)
2. Write a note on Cobb – Douglas production function (define equation and write the properties)

i. Let the production function of a firm $AK^{1/2}L^{1/2}$ Find out the maximum possible output that the firm can produce with 100 units of L and 100 units of K.

ii. Let the production function of a firm be $AK^{1/2}L^{1/2}$. Find out the maximum possible output that the firm can produce with 5 units of L and 2 units of K. What is the

maximum possible output that the firm can produce with zero unit of L and 10 units of K?

3. Does the term shut down mean closing down the entire production unit? If no, then explain the term "shut down point" with the help of diagram (draw the correct diagram). Give a clear explanation for the diagram and substantiate why a firm should continue its production until shutdown point?

4. With the help of a diagram explain the term break-even. From the given data below, calculate:
   I. P/V ratio
   II. Fixed cost
   III. Sales volume

   To earn a profit of Rs. 80,000.

   Given, Sales = 200000

   Profit gained = 20000

   Variable cost = 70 %

   (1, 40,000)
5. Find Margin of Safety from the following:
   i. Total sales: 300000
   ii. VC = 150000
   iii. 10000
6. How the internal economies differ from external economies?
7. List any three reason for the expansion path.
8. Explain the concepts TFC, TVC, TC, AFC, AVC and AC with equations.
9. Explain the following concepts with the help of an example:
   a. Social Cost: Private Cost and External Cost
   b. Explicit and Implicit Cost
   c. Sunk Cost
10. Explain with the help of a diagram Producer's equilibrium.
11. Explain how long – run AC curve is derived and how optimal output is determined.
12. Explain the properties of Isoquant and Iso cost curves with the help of a diagram.
13. Discuss the concepts Total Revenue, Average Revenue and Marginal Revenue with the help of a diagram.
14. Derive Marginal Product of Labour and Capital from the Cobb Douglas Production Function $A\ L^{\alpha}\ K^{\beta}$. Suppose we know that output in the economy is given by the production

function: $Y_T = A_t Kt^{1/3} Lt^{2/3}$. If technology is growing at a rate of 1% per year, the capital stock by 3%, and the labor supply by 2%, what will total growth in the economy be?

15. Discuss the assumptions of short run production function.

MODULE III

1. State any five differences between (a) Monopoly and Oligopoly (b) Monopoly and Monopolistic competition.
2. How price skimming is different from cost plus pricing?
3. How equilibrium price is determined under monopoly market. Why monopolist is known as the price maker?
4. In perfect competition industry is the price maker and firm is the price taker. Elaborate the statement with the help of suitable diagram and explanation.
5. What are the methods of non-price competition under oligopoly?
6. Explain about the kinked demand curve under the oligopoly market. Why in certain stages demand curve is elastic and inelastic?
7. How penetration pricing is different from predatory pricing?
8. Differentiate between perfect competition and monopolistic competition.
9. Explain collusive oligopoly and its features.
10. Discuss why under perfect competition the demand curve is perfectly elastic.
11. Explain with the help of a diagram, how price and output are determined under monopoly.
12. Explain with the help of a diagram, how price and output are determined under monopolistic competition.
13. Explain with the help of a diagram, how price and output are determined under oligopoly.
14. Explain with the help of a diagram, how price and output are determined under perfect competition.
15. Explain why the demand curve under monopolistic competition is a more elastic demand curve.

MODULE IV

1. Explain the four sector model of circular flow of income with the help of a neat diagram. Explain each transaction between the players.
2. Explain the following with correct formula from GDP @ MP:
    a. Gross Domestic Product at Factor cost

b. Gross National Product at Market Price
c. Net National Product at Factor Cost
d. Suppose the GDP at market price of a country in a particular year was Rs 1,100 crores. Net Factor Income from Abroad was Rs 100 crores. The value of Indirect taxes – Subsidies was Rs 150 crores and National Income was Rs 850 crores. Calculate the aggregate value of depreciation.

3. Define Inflation. Explain with the help of a diagram (a) Cost push Inflation (b) Demand pull inflation
4. How does inflation affect fixed income group and wage earners?
5. State any five differences between demat account and trading account.
16. Differentiate between money market and capital market.
17. Is GDP a perfect measure of national income? Substantiate.
18. Explain the three different methods of National Income with suitable equations.
19. Differentiate between stock and flow with suitable example.
20. Explain how to open a Demat account.
21. Explain the four sector model of circular flow of income.
22. Explain GDP deflator with formula.
23. Write a note on SENSEX and NIFTY.

MODULE V

1. What is devaluation?
2. Distinguish between free trade and protection
3. List any six arguments in favour of protection?
4. What is free trade? What are its disadvantages?
5. What do you mean by absolute advantage theory? Explain with the help of a nation's trade relation example.
6. Explain the Heckscher Ohlin theory with a suitable diagram?
7. What are the different types of equilibrium in BOP? Explain the causes for and the methods of correcting disequilibrium in BOP.
8. Distinguish between the tariff and non-tariff barriers
9. Discuss any three tariff barriers and its impact on exporting and importing nations.
10. Discuss any three non-tariff barriers and explain its impact on exporting nd importing nations.
11. What are the advantages and disadvantages of international trade?

MCN301

DISASTER MANAGEMENT

COURSE INFORMATION SHEET

PROGRAMME: All	**DEGREE**: BTECH
COURSE: DISASTER MANAGEMENT	**SEMESTER:** S5 **L-T-P-CREDITS**: 2-0-0-0
COURSE CODE: MCN301 **REGULATION**: 2019	**COURSE TYPE**: ELECTIVE
COURSE AREA/DOMAIN: Non-credit	**CONTACT HOURS**: 2 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS:

UNIT	DETAILS	HOURS
I	Systems of earth - Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	5
II	Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability. Disaster risk assessment –approaches, procedures	5
III	Disaster risk management -Core elements and phases of Disaster Risk Management Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness. Disaster response- objectives, requirements; response planning; types of responses. Relief; international relief organizations	5
IV	Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk	5
V	Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India. The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles	5
TOTAL HOURS		**25**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	R. Subramanian, Disaster Management, Vikas Publishing House, 2018
T2	M. M. Sulphey, Disaster Management, PHI Learning, 2016

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T3	UNDP, Disaster Risk Management Training Manual, 2016
T4	United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEMESTER
Nil			

COURSE OBJECTIVES:

1	The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

COURSE OUTCOMES:

Sl No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**)											
		2				2				2		2
2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).											
	2	3	2		2	2	3			3		2
3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).											
	2	3	2	2	2	2	3			3		2
4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)											
	3	3	3		2	2	3					2
5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).											
	3	3			2	2	3					2
6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).											
	3					2	3	3				2

JUSTIFICATION FOR CO-PO MAPPING:

CO	PO	MAPPING	JUSTIFICATION
CO1	PO2	2	Awareness of standard terms used in disaster management will help students address practical engineering problems in challenging environments.
	PO6	2	Awareness of standard terms used in disaster management will help students assess the societal, health, and safety issues relevant to professional engineering practice.
	PO10	2	Awareness of standard terms used in disaster management will help students communicate effectively with the engineering community and society during an emergency.
	PO12	2	Awareness of standard terms used in disaster management will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO2	PO1	2	Various mathematical and numerical tools are used in vulnerability assessment.
	PO2	3	Extensive research and a basic understanding of mathematics are needed to conduct vulnerability assessments.
	PO3	2	Assessing vulnerability helps the stakeholders to design a practical disaster management framework.
	PO5	2	Complex analytical and numerical modeling tools are used in vulnerability assessment.
	PO6	2	Awareness of different hazard types and vulnerabilities will help the students to assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	3	Assessing vulnerability is essential in improving the capacity to reduce the risks related to disasters.
	PO10	3	The students will identify the vulnerable community/society/individuals and communicate with them effectively.
	PO12	2	Awareness of disasters and vulnerability will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO3	PO1	2	Various empirical and analytical methods are used in risk assessment.
	PO2	3	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to conduct a risk assessment.
	PO3	2	Risk assessment helps the stakeholders to design a practical disaster management framework.
	PO4	2	Research-based knowledge and a basic understanding of data analysis, data interpretation, and information synthesis are required to carry out a risk assessment.

CO	PO	MAPPING	JUSTIFICATION
	PO5	2	Complex analytical and numerical modeling tools are used to assess natural hazards like floods, earthquakes, landslides, etc.
	PO6	2	Awareness of risk assessment fundamentals will help the students assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	3	Understanding elements at risk and risk assessment are essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO10	3	The students will identify the community/society/individuals at risk and communicate with them effectively.
	PO12	2	Awareness of future risks and risk assessment will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO4	PO1	3	A basic understanding of engineering sciences and mathematics is needed to reduce disaster risks across sectors and communities.
	PO2	3	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to develop risk reduction measures.
	PO3	3	A decent disaster management framework helps the stakeholders to develop risk reduction measures.
	PO5	2	GIS and numerical modeling softwares can be used to analyze natural hazards like floods, earthquakes, landslides, etc.
	PO6	2	Awareness of disaster risk management fundamentals will help the students assess the societal, health, and safety issues relevant to the professional engineering practice.
	PO7	3	Understanding the core elements and phases of disaster risk management is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO12	2	Awareness of disaster risk management strategies will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO5	PO1	3	A basic understanding of engineering and social sciences is needed to formulate disaster response strategies.
	PO2	3	Extensive research and a basic understanding of science, mathematics, and social sciences are needed to develop disaster response measures.
	PO5	2	Modern tools like GIS, GPS, etc., are used to develop emergency plans for natural hazards.
	PO6	2	Awareness of the fundamentals of disaster response will help the students to assess the societal, health, and safety issues relevant to the professional engineering practice

CO	PO	MAPPING	JUSTIFICATION
	PO7	3	Understanding disaster response strategies is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO12	2	Awareness of disaster response strategies will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.
CO6	PO1	3	Awareness of various legislations, policies, and frameworks in disaster management will help students address practical engineering problems in challenging environments.
	PO6	2	Awareness of various legislations, policies, and frameworks in disaster management will help students assess the societal, health, and safety issues relevant to professional engineering practice.
	PO7	3	Understanding various legislations, policies, and frameworks in disaster management is essential in strengthening the capacity, developing sustainable mitigation measures, and improving resilience.
	PO8	3	A professional engineer should be aware of various legislations, policies, and frameworks in disaster management.
	PO12	2	Awareness of various legislations, policies, and frameworks in disaster management will help students pursue independent and life-long learning in the broadest context of technological change post-pandemic.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl No	DESCRIPTION	PROPOSED ACTIONS
1	Case study of Kerala Floods 2018	Assignment
2	Case studies of natural hazards	Classroom lectures

CONTENTS TAKEN BEYOND THE SYLLABUS:

Sl No	DESCRIPTION	PROPOSED ACTIONS
1	Early warning systems for Tsunami and Cyclone	Classroom lectures

WEB SOURCE REFERENCES:

Sl No	DESCRIPTION
1	https://nptel.ac.in/courses/105/104/105104183/
2	https://nptel.ac.in/courses/124/107/124107010/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

CHALK & TALK	✓	**STUD. ASSIGNMENT**	✓	WEB RESOURCES	✓
LCD/SMART BOARDS		STUD. SEMINARS		ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT:

ASSIGNMENTS	✓	STUD. SEMINARS		**TESTS/MODEL EXAMS**	✓	**UNIV. EXAMINATION**	✓
STUD. LAB PRACTICES		STUD. VIVA		MINI/MAJOR PROJECTS		CERTIFICATIONS	
ADD-ON COURSES		OTHERS					

ASSESSMENT METHODOLOGIES-INDIRECT:

ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓	**STUDENT FEEDBACK ON FACULTY (TWICE)**	✓
ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS		OTHERS	

Prepared by
Karunakara P Menon
Nitheesh Kurian

Approved by

Dr. Rithu James
HoD, ECE

COURSE PLAN

UNIT	DETAILS	HOURS
I	Systems of earth - Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	5
II	Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability. Disaster risk assessment –approaches, procedures	5
III	Disaster risk management -Core elements and phases of Disaster Risk Management Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness. Disaster response- objectives, requirements; response planning; types of responses. Relief; international relief organizations	5
IV	Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk	5
V	Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India. The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles	5
TOTAL HOURS		**25**

SAMPLE QUESTIONS

Module1

- Explain disaster risk management.
- Explain and classify hazards with suitable examples.
- Explain the subsystems of Earth.
- Explain;
    - Risk (ii) Vulnerability (iii) Exposure (iii) Resilience
- Illustrate the evidences of climate change with examples
- Elucidate the impacts of climate change.
- Write a short note on Greenhouse effect. List the greenhouse gases and mention their sources.
- Discuss the causes of climate change.
- Explain Global Warming. Enumerate the causes and suggest some methods to reduce it.
- Discuss vulnerability in the context of Kerala floods. Also explain how we can reduce the vulnerability associated with flood hazards by disaster risk management.

Module 2

- What is hazard mapping? What are its objectives?
- What is participatory hazard mapping? How is it conducted? What are its advantages?
- Explain the applications of hazard maps
- Explain the types of vulnerabilities and the approaches to assess them
- Differentiate between hazards and disaster with examples
- Differentiate between preparedness and mitigation
- "While doing vulnerability assessment, it is essential to collect historical data on the magnitude of the hazard and the damage that it caused to specific elements." Substantiate this statement by providing a suitable example.

Module 3

- Explain briefly the concept of 'disaster risk'
- List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
- What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy.
- What is disaster prevention? Distinguish it from disaster mitigation giving examples
- Explain the core elements of disaster risk management
- Explain the factors that decide the nature of disaster response
- Explain the different disaster response actions

- How important is vulnerability and risk assessment for pre-disaster management? As an administrator, what are key areas that you would focus on in a Disaster Management System?
- Explain the standard operating procedures during normal times, alert/warning, during disaster and rehabilitation

Module 4

- What are the steps to effective disaster communication? What are the barriers to communication?
- Explain capacity building in the context of disaster management
- Briefly explain the levels of stakeholder participation in the context of disaster risk
- reduction
- Explain the importance of communication in disaster management
- Explain the benefits and costs of stakeholder participation in disaster management
- How are stakeholders in disaster management identified?
- Discuss the measures for disaster risk reduction. Elucidate the process of strengthening the capacity in terms of reducing risk.
- Explain different levels of stakeholders.

Module 5

- Explain the salient features of the National Policy on Disaster Management in India
- Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
- What are Tsunamis? How are they caused?
- Explain the earthquake zonation of India
- Explain 3 objectives of national policy on disaster management
- Explain common disaster types in India

ECL 331

ANALOG INTEGRATED CIRCUITS AND SIMULATION LAB

COURSE INFORMATION SHEET

PROGRAMME: : ELECTRONICS AND COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: ANALOG INTEGRATED CIRCUITS AND SIMULATION LAB	SEMESTER: V CREDITS: 2
COURSE CODE: ECL 331 REGULATION: 2019	COURSE TYPE: LAB
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: 3 (LAB) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

List of Experiments

I. Fundamentals of operational amplifiers and basic circuits [Minimum seven experiments
are to be done]
1. Familiarization of Operational amplifiers - Inverting and Non inverting amplifiers, frequency response, Adder, Integrator, Comparators.
2. Measurement of Op-Amp parameters.
3. Difference Amplifier and Instrumentation amplifier.
4. Schmitt trigger circuit using Op–Amps.
5. Astable and Monostable multivibrator using Op-Amps.
6. Waveform generators using Op-Amps - Triangular and saw tooth
7. Wien bridge oscillator using Op-Amp - without & with amplitude stabilization.
8. RC Phase shift Oscillator.
9. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF).
10. Notch filters to eliminate the 50Hz power line frequency.
11. Precision rectifiers using Op-Amp.

II. Application circuits of **555 Timer/565 PLL/ Regulator(IC 723) ICs** [Minimum three experiments are to be done]
1. Astable and Monostable multivibrator using Timer IC NE555
2. DC power supply using IC 723: Low voltage and high voltage configurations, Short circuit and Fold-back protection.
3. A/D converters- counter ramp and flash type.
4. D/A Converters - R-2R ladder circuit
5. Study of PLL IC: free running frequency lock range capture range

III. Simulation experiments [The experiments shall be conducted using SPICE]
1. Simulation of any three circuits from Experiments 3, 5, 6, 7, 8, 9, 10 and 11 of section I
2. Simulation of Experiments 3 or 4 from section II

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1.	D. Roy Choudhary, Shail B Jain, "Linear Integrated Circuits,"
2.	M. H. Rashid, "Introduction to Pspice Using Orcad for Circuits and Electronics", Prentice Hall
3.	Gayakwad : Op-Amps and Linear Integrated Circuits , 4/e, Prentice Hall of India..
4.	Sergio Franco: Design with Operational Amplifiers and Analog Integrated Circuits, 3/e,Tata Mc.Graw Hill.
5.	David A.Johns, Ken Martin: Analog Integrated Circuit Design, Wiley India, 2008
6.	Gray, Hurst, Lewis and Meyer Analysis and Design of Analog Integrated Circuits, Wiley

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECL 202	Analog Circuits and Simulation Lab	R, L, C Components, Diodes, Transistors	IV

COURSE OBJECTIVES:

1	To familiarize students with the Analog Integrated Circuits and Design and implementation of application circuits using basic Analog Integrated Circuits.
2	To familiarize students with simulation of basic Analog Integrated Circuits.

COURSE OUTCOMES:

After the completion of the course the student will be able to

No.	DESCRIPTION	BLOOM'S TAXONOMY LEVEL
CO1	Use data sheets of basic Analog Integrated Circuits and **design and implement** application circuits using Analog ICs.	Analyze (4) & Apply(6)
CO2	**Design** and simulate the application circuits with Analog Integrated Circuits using simulation tools.	Analyze (4) & Apply(6)
CO3	Function effectively as an individual and in a team to accomplish the given task.	Understand (2)

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	3	3						2			2
CO 2	3	3	3	2	3				2			2
CO 3	2	2	2		2				3	2		3

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PO1	3	Analog integrated circuits can be designed and modified to provide solutions to real-life problems
CO1-PO2	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO1-PO3	3	Analog integrated circuits can be designed and modified to provide solutions to real-life problems

CO1-PO9	2	Op-amp based circuits will help to conduct investigations, solve complex problems
CO1-PO12	2	With prior knowledge of op-amp fundamentals, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO2-PO1	3	Design & demonstration of experiments will help to identify the problems and lead to modifications
CO2-PO2	3	Analog integrated circuits can be designed and modified to provide solutions to real-life problems
CO2-PO3	3	Design & demonstration of simulation experiments will help to identify the problems and lead to modifications
CO2-PO4	2	Op-amp based circuits will help to conduct investigations, solve complex problems in different applications.
CO2-PO5	3	Analog integrated circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO2-PO9	2	Op-amp based simulated circuits will help to conduct investigations, solve complex problems.
CO2-PO12	2	With prior knowledge of op-amp basics, students can use their knowledge to simulate, experiment & develop newer applications in real life.
CO3-PO1	2	Function effectively as an individual and in a team to accomplish the given task. Analog integrated circuits can be designed and modified to provide solutions to real-life problems.
CO3-PO2	2	Design & demonstration of experiments will help the students to function effectively as an individual and in a team to identify the problems and lead to modifications.
CO3-PO3	2	Analog integrated circuits can be designed and modified to provide solutions to real-life problems. And students function effectively as an individual and in a team to accomplish the given task.
CO3-PO5	2	Analog integrated circuits can be designed and modified using model simulation tools to provide solutions to different applications. These experiments allow them to function effectively as an individual and in a team to accomplish the given task..
CO3-PO9	3	Analog circuits can be designed and modified using model simulation tools to provide solutions to different applications.
CO3-PO10	2	Function effectively as an individual and in a team to accomplish the given task.
CO3-PO12	3	With prior knowledge of op-amp basics, students can Function effectively as an individual and in a team to use their knowledge to simulate, experiment & develop newer applications in real life to accomplish the given task.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Differential amplifier using BJT	Lecture	1,2	1

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Voltage Regulator	Lecture	**1,2,3**	**1,2**
2	VCO, PLL	Lecture	1,2	1

WEB SOURCE REFERENCES:

1	www.srmuniv.ac.in/sites/default/files/
2	www.pmu.edu/web/ece_liclab.html
3	www.eeecube.com/2011/12/131452-linear-and-digital-integrated.html

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

□ CHALK & TALK	□ STUD. ASSIGNMENT	□ WEB RESOURCES	
□ ~~LCD/SMART BOARDS~~	□ ~~STUD. SEMINARS~~	□ ~~ADD-ON COURSES~~	

ASSESSMENT METHODOLOGIES-DIRECT

□ ASSIGNMENTS	~~□ STUD. SEMINARS~~	□ TESTS/MODEL EXAMS	□ UNIV. EXAMINATION
□ STUD. LAB PRACTICES	□ STUD. VIVA	□ ~~MINI/MAJOR PROJECTS~~	□ ~~CERTIFICATIONS~~
□ ~~ADD-ON COURSES~~	□ ~~OTHERS~~		

ASSESSMENT METHODOLOGIES-INDIRECT

□ ~~ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)~~	□ STUDENT FEEDBACK ON FACULTY (TWICE)
~~□ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS~~	~~□ OTHERS~~

Prepared by
Ms. S. Santhi Jabarani
Dr. Jisa David
Mr. Jaison Jacob

Approved by

Dr. Rithu James
(HOD)

COURSE PLAN

PART A (Using discrete components)

1. Inverting Amplifier, Non-Inverting Amplifier
2. Measurement Of Op-Amp Parameters
3. Summing Amplifier
4. Integrator
5. Comparator,Schmitt Trigger
6. Astable & Monostable Multivibrator Using 555 Ic

PART B (Simulation Experiments)

1. Difference Amplifier & Inastrumentation Amplifier
2. Astable & Monostable Multivibrator Using Op Amp
3. Triangular Wave & Sawtooth Wave Generator
4. Difference Amplifier & Inastrumentation Amplifier
5. Rc Phase Shift Oscillator & Wein Bridge Oscillator

ECL 333

DIGITAL SIGNAL PROCESSING LAB

COURSE INFORMATION SHEET

PROGRAMME: Electronics & Communication Engineering	DEGREE: BTECH
COURSE: Digital Signal Processing Lab	SEMESTER: 5 CREDITS: 2
COURSE CODE: ECL333 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: Signal Processing using MATLAB	CONTACT HOURS: 3 hrs.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME: Digital Signal Processing Lab

SYLLABUS:

Sl.No	DETAILS	HOURS
	All experiments are mandatory	
1	Simulation of Signals	3 hrs.
2	Verification of the Properties of DFT	3 hrs.
3	Familiarization of DSP Hardware	3 hrs.
4	Linear convolution	3 hrs.
5	FFT of signals	3 hrs.
6	IFFT with FFT	3 hrs.
7	FIR low pass filter	3 hrs.
8	Overlap Save Block Convolution	3 hrs.
9	Overlap Add Block Convolution	3 hrs.
TOTAL HOURS		27 hrs.

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	Vinay K. Ingle, John G. Proakis, “Digital Signal Processing Using MATLAB.”
2	Allen B. Downey, “Think DSP: Digital Signal Processing using Python.”
3	Rulph Chassaing, “DSP Applications Using C and the TMS320C6x DSK (Topics in Digital Signal Processing)”

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
ECT303	Digital Signal Processing		3
EST 102	Programming in C		4

COURSE OBJECTIVES:

1	The experiments are designed to make the student do real time DSP computing.
2	Dedicated DSP hardware (such as TI or Analog Devices development/evaluation boards) will be used for realization.

COURSE OUTCOMES:

SNO	DESCRIPTION
1	Simulate digital signals.
2	Verify the properties of DFT computationally
3	Familiarize the DSP hardware and interface with computer.
4	Implement LTI systems with linear convolution.
5	Implement FFT and IFFT and use it on real time signals.
6	Implement FIR low pass filter.
7	Implement real time LTI systems with block convolution and FFT.

CO MAPPING WITH PO, PSO															
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	2	3	0	0	0	3	0	0	1	1	0	0
CO 2	3	3	1	2	3	0	0	0	3	0	0	1	1	0	0
CO 3	3	3	3	2	3	0	0	0	3	0	0	1	1	1	0
CO 4	3	3	1	2	3	0	0	0	3	0	0	1	1	1	0
CO 5	3	3	1	1	3	0	0	0	0	0	0	1	1	0	0
CO 6	3	3	1	1	3	0	0	0	0	0	0	1	1	0	0
CO 7	3	3	1	3	3	0	0	0	3	0	0	0	1	0	0

Justification for the correlation level assigned in each cell of the table above.															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Representation of signals and their operations require mathematical background.	Students gain the ability to identify, formulate, and analyze engineering problem related to signal simulation.	Students become capable of designing and developing solutions related to differed signals.	Students gain the ability to conduct investigation of complex problems related to signal simulation.	Students can use modern tools like Matlab to simulate different types of elementary signals.	-	-	-	Students gain the capability of working as an individual and as a team.	-	-	The knowledge of being able to simulate different signals using modern tool s is a life long learning for	The graduates will be able to implement programs for simulating different types of signals.		

												stud ents .			
CO 2	Verif ying the prope rties of DFT requi re good math emati cal back grou nd.	Stud ents gain the capa bility to anal yze engi neeri ng probl ems throu gh the appli catio n of prop ertie s of DFT /.	Stude nts beco me able to desig n and devel op soluti ons for probl ems that woul d requir e verifi catio n of the prope rties of DFT.	Stude nts gain the capab ility to invest igate comp lex probl ems by the appli catio n of prope rties of DFT.	Stude nts learn to use mode rn tools in verify ing the prope rties of DFT.	-	-	-	Stu den ts gai n the cap abil ity of wor kin g as an indi vid ual and as a tea m.	-	-	The abili ty to veri fy the prop ertie s can be a life long lear ning .	The gradu ates will be able to imple ment progr ams for verify ing the prope rties of DFT of signal s.	-	-
CO 3	The abilit y to interf ace the DSP hard ware with comp	Stud ents beco me able to anal yze probl ems and	Stude nts beco me capab le of desig ning and devel oping	Stude nts can use the DSP hard ware interf aced to	The famili arizat ion and interf acing of DSP hard ware	-	-	-	Stu den ts gai n the cap abil ity of wor	-	-	The abili ty to inter face a DSP hard war e to a	The stude nts devel op the capab ility to desig n and	The stud ents deve lop the capa bilit y to cond uct	-

	uters enable students to find solutions for complex problems.	decide if DSP hardware is require for implementing solution of the same.	solutions to problems using the DSP hardware.	computers for analysis of data and synthesis of information.	enable the students to easily use other processors in future.				king as an individual and as a team.			computer can be a life long learning for students.	implement solutions to problems using the DSP hardware.	experiments and develop solution using the DSP hardare.	
CO 4	Good mathematical and engineering fundamental knowledge is require to implement systems using convolution.	The capability to implement systems can help in analyzing engineering problems.	Students gain the capability to develop systems which can lead to solutions for engineering problems.	Students can perform analysis and synthesis of data using the system developed.	Modern tools can be used in the development of systems.	-	-	-	Students gain the capability of working as an individual and as a team.	-	-	The capability to develop different systems using convolution can be a life long learning.	Students gain the skill to implement systems that can be used for signal processing.	Students gain the capabilit y to use different tools to develop systems using convolution	-

CO5	Good mathematical and engineering fundamental knowledge is require to implement FFT and IFFT.	The capability to implement FFT and IFFT can help in analyzing engineering problems.	Students gain the capability to solve engineering problems by the implementation of FFT and IFFT.	Students can investigate complex engineering problems by the implementation of FFT and IFFT	Implementation of FFT and IFFR require Matlab, DSP processor or other modern tools.	-	-	-	-	-	-	The capability to implement FFT and IFFT can be a life long learning.	With the implementation of FFT and IFFT students demonstarte their abilit y to design, implement and test systems for signal processing.	-	-
CO6	Good mathematical and engineering fundamental knowledge	The capability to implement FIR filter can help in anal	Students gain the capability to solve engineering problems	Students can investigate complex engineering problems by	Implementation of FIR filters require Matlab, DSP processor	-	-	-	-	-	-	The capability to implement FIR filters can be a life	With the implementation of FIR filters students demonstarte	-	-

	is requi re to imple ment FIR filter s	yzin g engi neeri ng probl ems.	by the imple ment ation of FIR filters .	the imple ment ation of FIR filters .	or other mode rn tools.							long lear ning .	their abilit y to desig n, imple ment and test syste ms for signal proce ssing.		
C O 7	Good math emati cal and engin eerin g funda ment al know ledge is requi re to imple ment LTI syste ms with block conv oluti on and	The capa bility to impl eme nt LTI syste ms with bloc k conv oluti on and FFT. can help in anal yzin g engi neeri ng	Stude nts gain the capab ility to solve engin eerin g probl ems by the imple ment ation of LTI syste ms with block conv olutio n and	Stude nts can invest igate comp lex engin eerin g probl ems by the imple ment ation of LTI syste ms with block conv olutio n and FFT..	Imple menta tion of LTI syste ms with block convo lution and FFT requir e Matla b, DSP proce ssor or other mode rn tools.	-	-	-	Stu den ts gai n the cap abil ity of wor kin g as an indi vid ual and as a tea m.	-	-	-	With the imple ment ation of LTI syste ms with block conv olutio n and FFT stude nts demo nstart e their abilit y to desig n, imple ment	-	-

	FFT.	problems.	FFT..										and test systems for signal processing.		

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING	PSO Mapping
1	Properties of System	Test	1,2,3,7,9,12	1,2

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl. No.	DESCRIPTION	PO MAPPING	PSO MAPPING
1	IIR filter Design without using function	1,2,3,4,6,7	1,2,3

WEB SOURCE REFERENCES:

1	http:// www.nptel.iitm.ac.in/
2	http:// www.slideshare.net

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

CHALK & TALK	~~STUD. ASSIGNMENT~~	WEB RESOURCES	
LCD/SMART BOARDS	~~STUD. SEMINARS~~	ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

ASSIGNMENTS	~~STUD. SEMINARS~~	TESTS/MODEL EXAMS	UNIV. EXAMINATION
STUD. LAB PRACTICES	STUD. VIVA	Advance Experiments	~~CERTIFICATIONS~~
~~ADD-ON COURSES~~	~~OTHERS~~		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES(BY FEEDBACK, ONCE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS

☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ OTHERS

Prepared by
Dr. Rithu James
Ms. Ramitha Rajesh
Ms. Jasmin Sebastin

Approved by

Dr. Rithu James
(HOD)

COURSE PLAN

Sl.No	DETAILS	HOURS
	All experiments are mandatory	
1	Simulation of Signals	3 hrs.
2	Verification of the Properties of DFT	3 hrs.
3	Familiarization of DSP Hardware	3 hrs.
4	Linear convolution	3 hrs.
5	FFT of signals	3 hrs.
6	IFFT with FFT	3 hrs.
7	FIR low pass filter	3 hrs.
8	Overlap Save Block Convolution	3 hrs.
9	Overlap Add Block Convolution	3 hrs.
TOTAL HOURS		27 hrs.