RSET
RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

Department of Applied Electronics & Instrumentation

RSET VISION

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

RSET MISSION

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

DEPARTMENT VISION

To evolve into a centre of academic excellence, developing professionals in the field of electronics and instrumentation to excel in academia and industry.

DEPARTMENTMISSION

Facilitate comprehensive knowledge transfer with latest theoretical and practical concepts, developing good relationship with industrial, academic and research institutions thereby moulding competent professionals with social commitment.

PROGRAMME EDUCATIONAL OBJECTIVES

PEOI: Graduates will possess engineering skills, sound knowledge and professional attitude, in electronics and instrumentation to become competent engineers.

PEOII: Graduates will have confidence to design and develop instrument systems and to take up engineering challenges.

PEOIII: Graduates will possess commendable leadership qualities, will maintain the attitude to learn new things and will be capable to adapt themselves to industrial scenario.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering sciences.

PO3. 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 publichealth and safety, and the cultural, societal, and environmental considerations.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and nee for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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.

PO12. 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 Outcome

Students of the program

PSO 1: will have sound technical skills in electronics and instrumentation.

PSO 2: will be capable of developing instrument systems and methods complying with standards.

PSO 3: will be able to learn new concepts, exhibit leadership qualities and adapt to changing industrial scenarios

INDEX

ASSIGNMENT SCHEDULE	
Week 4	**100903/MA400A: PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**
Week 5	**100902/EC400B: ANALOG CIRCUITS**
Week 5	**100902/EC400C: SIGNALS AND SYSTEMS**
Week 6	**100002/AE400D: MEASUREMENTS AND INSTRUMENTATION**
Week 7	**100908/CO900E : DESIGN & ENGINEERING**
Week 8	**100908/ES400F: CONSTITUTION OF INDIA**
Week 8	**100903/MA400A: PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**
Week 9	**100902/EC400B: ANALOG CIRCUITS**
Week 9	**100902/EC400C: SIGNALS AND SYSTEMS**
Week 12	**100002/AE400D: MEASUREMENTS AND INSTRUMENTATION**
Week 12	**100908/CO900E : DESIGN & ENGINEERING**
Week 13	**100908/ES400F: CONSTITUTION OF INDIA**

SCHEME

SEMESTER IV

COURSE CODE	COURSE NAME	L-T-P	HOURS	CREDIT
100903/MA400A	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	3-1-0	4	4
100902/EC400B	ANALOG CIRCUITS	3-1-0	4	4
100902/EC400C	SIGNALS AND SYSTEMS	3-1-0	4	4
100002/AE400D	MEASUREMENTS AND INSTRUMENTATION	3-1-0	4	4
100908/CO900E	DESIGN & ENGINEERING	2-0-0	2	2
100908/ES400F	CONSTITUTION OF INDIA	2-0-0	2	Pass/Fail
100902/EC422S	ANALOG CIRCUITS AND SIMULATION LAB	0-0-3	3	2
100002/AE422T	TRANSDUCERS AND MEASUREMENTS LAB	0-0-3	3	2
TOTAL			**26**	**22**

100903/MA400A: PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS

COURSE INFORMATION SHEET

PROGRAMME: AEI	***DEGREE: BTECH***
COURSE: PROBABILITY DISTRIBUTIONS, RANDOM PROCESSES AND NUMERICAL METHODS	**SEMESTER: 4 CREDITS:4**
COURSE CODE: 100908/MA400A ***REGULATION:***	**COURSE TYPE: CORE**
COURSEAREA/DOMAIN:	**CONTACT HOURS: 4 hours/Week.**
CORRESPONDING LAB COURSE CODE :	**LAB COURSE NAME:**

COURSE CODE	COURSE NAME	L	T
100908/MA400A	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	3	1

1. Preamble

This course introduces students to the modern theory of probability and statistics covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools.

2. Prerequisite

A basic course in one-variable and multi-variable calculus**.**

Syllabus

	COURSE PLAN	
	COURSE NO: MA204	L-T-P:3-1-0
	COURSE NAME: RANDOM PROCESSES AND QUEUING THEORY	CREDITS:4
MODULE	CONTENT	
I	**Module 1: Discrete probability distributions** **(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)** Discrete random variables and their probability distributions-Expectation, mean and variance, Binomial distribution, Poisson distribution-Poisson approximation to the binomial distribution, Discrete bivariate distributions-marginal distributions-Independent random variables-Expectation (multiple random variables).	

II	**Module 2: Continuous probability distributions** **(Text-1:*Relevant topics* from sections-4.1-4.4, 3.6, 5.1)** Continuous random variables and their probability distributions- Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables), i. i. d random variables and Central limit theorem (**without proof**).
III	**Module 3: Random Processes** **(**Text-2: ***Relevant topics*** **from sections-8.1-8.5, 8.7, 10.5)** Random processes and classification, mean and autocorrelation, Stationary Random Processes, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties (White noise excluded), Poisson process-distribution of inter-arrival times, combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes (results without proof).
IV	**Module 4: Numerical methods -I** **(Text 3- *Relevant topics* from sections 19.1, 19.2, 19.3, 19.5)** Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences- Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method, Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (Gauss Integration and Numerical Differentiation excluded, Proof or derivation of the formulae not required for any of the methods in this module)
V	**Module 5: Numerical methods –II** **(Text 3- *Relevant topics* from sections 20.3, 20.5, 21.1)** Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method (second order excluded) Adams- Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

4. Text Books

1. ***(Text-1) Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012.***
2. ***(Text-2) Oliver C. Ibe, Fundamentals of Applied Probability and Random Processes, Elsevier, 2005.***
3. ***(Text-3) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.***

Reference Books

1. ***Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)***
2. ***V. Sundarapandian, Probability, Statistics and Queueing theory, PHI Learning,***

2009

3. *Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University Press, 2006.*
4. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010*

6. Course Outcomes	
After the completion of the course the student will be able to	
CO1	Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena
CO2	Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena.
CO3	Analyze random processes using autocorrelation, power spectrum and Poisson process model as appropriate
CO4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations

COURSE PRE-REQUISITES: nil

7. Mapping of Course Outcomes with Program Outcomes

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

8. Assessment Pattern

Learning Objectives	**Continuous Internal Evaluation (CIE)**		**End Semester Examination (ESE out of 100)**
	Internal Examination 1* (50)	**Internal Examination 2* (50)**	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyze	20	20	20
Evaluate	10	10	10

Create			

***Internal examination (offline): 50 and Internal examination (online): 25**

9. Mark Distribution

Total	CIE				ESE
	Attendance	Internal Examination	Assignment/Quiz/ Course Project	Total	
150	10	25	15	50	100

10. End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

GAPS / TOPICS BEYOND THE SYLLABUS TO MEET THE INDUSTRIAL REQUIREMENT:

No gaps identified

WEB SOURCE REFERENCES:

1	**http://www.math.com/**
2	https://www.math.umn.edu/~olver/pdn.html,
3	http://www.mheducation.co.in
4	http://tutorial.math.lamar.edu/
5	http://nptel.ac.in/

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

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Approved by

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(HOD)

COURSE PLAN

No	Topic	No. of Lectures
1	**Module1 Discrete Probability distributions**	
1.1	Discrete random variables and their probability distributions, Expectation, mean and variance (discrete)	3
1.2	Binomial distribution-mean and variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expectation (multiple random variables)	3
2	**Module 2 Continuous Probability distributions**	
2.1	Continuous random variables and their probability distributions, Expectation, mean and variance (continuous)	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables), i. i. d random variables and Central limit theorem.	3
3	**Module 3 Random Processes**	
3.1	Random processes and classification	1
3.2	Mean and autocorrelation, Stationary Random Processes	2
3.3	WSS processes, autocorrelation and power spectral density of WSS processes and their properties, (White noise excluded)	2
3.4	Poisson process-distribution of inter-arrival times	2
3.5	combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes (results without proof)	2
4	**Module 4 Numerical methods-I**	
4.1	Roots of equations- Newton-Raphson, Regula-Falsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backward formula	3
4.3	Newton's divided difference method, Lagrange's method	2
4.4	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	**Module 5 Numerical methods-II**	
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares.	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of fourth order.	4
5.4	Adams-Moulton predictor-corrector methods	1

Module 1

Assignment

1. If the random variable X takes the values 1,2,3 and 4 such that $2P(X=1)=3P(X=2)=P(X=3)=5P(X=4)$, find the probability distribution and cumulative distribution function of X.
2. Suppose that the probabilities are 0.4, 0.3, 0.2, and 0.1 that there will be 0, 1, 2, or 3 power failures in a certain city during the month of July. Find the mean and variance of this probability distribution.
3. During one stage in the manufacture of integrated circuit chips, a coating must be applied. If 70 %of chips receive a thick enough coating, use Binomial distribution to find the probabilities that, among 15 chips
   (a) at least 12 will have thick enough coating;
   (b) at most 6 will have thick enough coating;
   (c) exactly 10 will have thick enough coating.
4. In an examination, a candidate has to answer 15 multiple choice questions each of which has 4 choices for the answer. He knows the correct answer to 10 questions and for the remaining 5 questions he chooses the answer randomly.
   (a) What is the probability that he answers 13 or more questions correctly?
   (b) What is the mean and variance of the number of correct answers he gives?
5. A complex electronic system is built with a certain number of backup components in its subsystems. One subsystem has four identical components, each with a probability of 0.2 of failing in less than 1000 hours. The subsystem will operate if any two of the four componentsare operating. Assume that the components operate independently. Find the probability that
   (a) exactly two of the four components last longer than 1000 hours.
   (b) the subsystem operates longer than 1000 hours.
6. If the sum of the mean and variance of a binomial distribution for 5 trials is 1.8, find the probability distribution function.
7. The probability of an item produced by a certain machine will be defective is 0.05. If the produced items are sent to the market in packets of 20, find the number of packets containing (i) atleast 2 (ii) exactly 2 (ii) atmost 2 defective items in a consignment of 1000 packets using Poisson distribution.
8. Customers arrive at a counter at an average of 1.5 per minute. Find the probability that:
   (a) at most 4 will arrive in any given minute
   (b) at least 3 will arrive during an interval of 2 minutes
9. A service station has both self-service and full-service islands. On each island, there is a single regular unleaded pump with two hoses. Let X denote the number of hoses being used on the self-service island at a particular time, and let Y denote the number of hoses on the full-service island in use at that time. The joint pmf of X and Y appears in the accompanying tabulation.

p(x,y)		y = 0	y = 1	y = 2
x	0	0.1	0.04	0.02
	1	0.08	0.2	0.06
	2	0.06	0.14	0.30

   (a) What is $P(X=1 and Y=1)$?
   (b) Compute $P(X \le 1)$ and $P(Y \le 1)$.
   (c) Give a word description of the event $\{X \neq 0 and Y \neq 0\}$, and compute the probability of this event.
   (d) Compute the marginal pmf of X and of Y.

10. An instructor has given a short quiz consisting of two parts. For a randomly selected student, let X be the number of points earned on the first part and Y be the number of points earned on the second part. Suppose that the joint pmf of X and Y is given in the accompanying table.

p(x,y)		y = 0	5	10	15
x	0	0.02	0.06	0.02	0.1
	5	0.04	0.15	0.2	0.1
	10	0.01	0.15	0.14	0.01

(a) If the score recorded in the grade book is the total number of points earned on the two parts, what is the expected recorded score $E(X+Y)$?

(b) If the maximum of the two scores is recorded, what is the expected recorded score?

Module2

Assignment

1. In commuting to work, I must first get on a bus near my house and then transfer to a second bus. If the waiting time (in minutes) at each stop has a uniform distribution with A = 0 and B = 5, then it can be shown that my total waiting time Y has the pdf

$$f(y) = \begin{cases} y/25 & 0 \le y < 5 \\ 2/5 - y/25 & 5 \le y \le 10 \\ 0 & otherwise \end{cases}$$

(a) Sketch a graph of the pdf.

(b) Verify that f is a pdf.

(c) What is the probability that total waiting time is at most 3 min?

(d) What is the probability that total waiting time is at most 8 min?

(e) What is the probability that total waiting time is between 3 and 8 min?

(f) What is the probability that total waiting time is either less than 2 min or more than 6 min?

2. Let X denote the amount of time a book on 2 - hour reserve is actually checked out, and suppose the cdf is

$$F(x) = \begin{cases} 0 & x < 0 \\ x^2/4 & 0 \le x < 2 \\ 1 & 2 \le x \end{cases}$$

Use the cdf to obtain the following:

(a) $P(X \le 1)$

(b) $P(.5 \le X \le 1)$

(c) $P(X > 1.5)$

(d) The median checkout duration

(e) the density function $f(x)$

(f) $E(X), V(X), \sigma_X$

3. Suppose the force acting on a column that helps to support a building is normally distributed with mean 15.0 kips and standard deviation 1.25 kips. What is the probability that the force

a. Is at most 18 kips?

b. Is between 10 and 12 kips?

c. Differs from 15.0 kips by at most 1.5 standard deviations?

4. The article "Reliability of Domestic-Waste Biofilm Reactors" (J. of Envir. Engr., 1995: 785–790) suggests that substrate concentration (mg/cm3) of influent to a reactor is normally distributed with mean = .30 and SD = .06.

   a. What is the probability that the concentration exceeds .25?

   b. What is the probability that the concentration is at most .10?

   c. How would you characterize the largest 5% of all concentration values?

5. The weight distribution of parcels sent in a certain manner is normal with mean value 12 lb and standard deviation 3.5 lb. The parcel service wishes to establish a weight value c beyond which there will be a surcharge. What value of c is such that 99% of all parcels are at least 1 lb under the surcharge weight?

6. Let X denote the distance (m) that an animal moves from its birth site to the first territorial vacancy it encounters. Suppose that for banner-tailed kangaroo rats, X has an exponential distribution with parameter $\lambda = .01386$ (as suggested in the article "Competition and Dispersal from Multiple Nests," Ecology, 1997: 873–883).

   a. What is the probability that the distance is at most 100 m? At most 200 m? Between 100 and 200 m?

   b. What is the probability that distance exceeds the mean distance by more than 2 standard deviations?

   c. What is the value of the median distance?

7. A consumer is trying to decide between two long-distance calling plans. The first one charges a flat rate of 10¢ per minute, whereas the second charges a flat rate of 99¢ for calls up to 20 minutes in duration and then 10¢ for each additional minute exceeding 20 (assume that calls lasting a non integer number of minutes are charged proportionately to a whole-minute's charge). Suppose the consumer's distribution of call duration is exponential with parameter λ.

   Which plan is better if expected call duration is 10 minutes? 15 minutes?

8. Each front tire on a particular type of vehicle is supposed to be filled to a pressure of 26 psi. Suppose the actual air pressure in each tire is a random variable— X for the right tire and Y for the left tire, with joint pdf

$$f(x,y) = \begin{cases} K(x^2+y^2) & 20 \le x \le 30, 20 \le y \le 30 \\ 0 & \text{otherwise} \end{cases}$$

   a. What is the value of K?

   b. What is the probability that both tires are underfilled?

   c. What is the probability that the difference in airpressure between the two tires is at most 2 psi?

   d. Determine the (marginal) distribution of air pressure in the right tire alone.

   e. Are X and Y independent rv's?

9. Annie and Alvie have agreed to meet for lunch between noon (0:00 P.M.) and 1:00 P.M. Denote Annie's arrival time by X, Alvie's by Y, and suppose X and Y are independent with pdfs

$$f_X(x) = \begin{cases} 3x^2 & 0 \le x \le 1 \\ 0 & otherwise \end{cases}$$

$$f_Y(y) = \begin{cases} 2y & 0 \le x \le 1 \\ 0 & otherwise \end{cases}$$

   What is the expected amount of time that the one who arrives first must wait for the other person?

10. Let $X_1, X_2, ..., X_{100}$ denote the actual net weights of 100 randomly selected 50-lb bags of fertilizer.

    a. If the expected weight of each bag is 50 and the variance is 1, calculate $P(49.9 \le X \le 50.1)$ (approximately) using the CLT.

    b. If the expected weight is 49.8 lb rather than 50 lb so that on average bags are underfilled, calculate $P(49.9 \le X \le 50.1)$.

Module 3

ASSIGNMENT

1. Let {X(t)} be a stochastic process with no periodic components and ACF is $R(\tau)=\frac{1+\tau^2}{2+3\tau^2}$

   Then find V(X(t)).

2. If X(t) =sin $(\omega t + Y)$ where Y is uniformly distributed in $(0, 2\pi)$, prove that {X(t)} is a WSS process.
3. If the PSD of a WSS process is given by

   $$S(\omega) = \omega^2, -1 \leq \omega \leq 1 \quad and\ 0, otherwise$$

   Find the ACF of the process.
4. Suppose that customers arrive at a bank according to a Poisson process with a mean rate of 3 per minute; find the probability that during a time interval of 2 min (i) exactly 4 customers arrive and (ii) more than 4 customers arrive.
5. A machine goes out of order, whenever a component fails. The failure of this part follows a Poisson process with a mean rate of 1 per week. Find the probability that 2 weeks have elapsed since last failure. If there are 5 spare parts of this component in an inventory and that the next supply is not due in 10 weeks, find the probability that the machine will not be out of order in the next 10 weeks.
6. A radioactive source emits particles at a rate of 5 per minute in accordance with Poisson process. Each particle emitted has a probability 0.6 of being recorded. Find the probability that 10 particles are recorded in 4-min period.
7. On the average, a submarine on patrol sights 6 enemy ships per hour. Assuming that the number of ships sighted in a given length of time is a Poisson variate, find the probability of sighting
   a. 6 ships in the next half-an-hour,
   b. 4 ships in the next 2 h,
   c. At least 1 ship in the next 15 min and
   d. At least 2 ships in the next 20 min.
8. Patients arrive randomly and independently at a doctor"s consulting room from 8 A.M. at an average rate of one in 5 min. The waiting room can hold 12 persons. What is the probability that the room will be full when the doctor arrives at 9 A.M.?
9. A radioactive source emits particles at a rate of 6 per minute in accordance with Poisson process. Each particle emitted has a probability of 1/3 of being recorded. Find the probability that at least 5 particles are recorded in a 5-min period.

Module 4

ASSIGNMENT

1. Use Newton-Raphson's Formula to solve $e^{-x} - \tan x = 0, x_0 = 1$.

2. Using Lagrange's interpolation formula, find the values of y when $x = 5$, from the following table

x	0	1	3	8
y	1	3	13	123

3. Using Newtons formula, interpolate the data $f(1.0) = 0.94608$, $f(1.5) = 1.32468$, $f(2.0) =$ 1.60541, $f(2.5) = 1.77852$. Find the value of $f(1.25)$.

4. Using Newton's Formula compute $\sqrt[3]{7}$.

5. The following table gives the population of the town during the last 6 census. Estimate, using Newton's interpolation formula, the increase in the population during the period 1946 to 1948.

Year	1911	1921	1931	1941	1951	1961
Population (in thousands)	12	15	20	27	39	52

6. Using Newton's divided difference formula find $f(3.75)$

x	2.5	3	3.5	4	4.5
y	24	22	20	18	17

7. Using Lagrange's interpolation formula, fit a polynomial to the given data and hence find $y(2)$.

x	1	3	4
y	1	27	64

Module 5

1. Solve by Jacobi's method

$$10x + 3y - 4z = 8$$
$$x - 10y + 2z = 6$$
$$x + y - 10z = 7$$

2. Solve the system of equations by (i) Gauss-Jacobi method (ii)Gauss- Seidel method.

$$10x + 2y + z = 9$$
$$2x + 20y - 2z = -44$$
$$-2x + 3y + 10z = 22.$$

3. Using the method of least squares, fit a straight line to (0,2), (2,0), (3,-2) , (5,-3) .
4. Using Euler's method, find an approximate value of y corresponding to $x = 1.5$ given that $\frac{dy}{dx} = x + 2y \; and \; y = 1 \; when \; x = 1$.
5. Using fourth order Runge- Kutta method solve the initial value problem $y' = x + y, y(0) = 1$ in the interval (0,).2) by taking $h = 0.1$.
6. Solve the following for $y(0.1), y(0.2)$ using Runge- Kutta method of (i)second order (ii) fourth order

   (a) $\frac{dy}{dx} + y = 0, y(0) = 1$ (b) $\frac{dy}{dx} + 2y = x, y(0) = 1$
7. Solve using Euler method , $y' + 0.2y = 0, y(0) = 5, h = 0.2$.
8. Apply Jacobi method to solve $5x - 2y + 3z = -1$

$$-3x + 9y + z = 2$$

$$2x - y - 7z = 3$$

9. Fit a straight line for the following data

x	1	3	4	6	8	9	11	14
y	1	2	4	4	5	7	8	9

10. Fit a parabola to the data
    (0,1) ,(1,1.8), (2,1.3), (3,2.5),(4,6.3)

TUTORIALS

Module-1 : Discrete Probability Distributions
Tutorial

1. A random variable X has the following probability mass function

X:	0	1	2	3	4	5	6	7
P(X):	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$

   Find (i) the value of k (ii) $P(0 < X < 5)$ (iii) $P(X \geq 6)$

2. A random variable X takes values 0,1, 2 and 3 with probabilities
   $P(X=0) = \frac{8}{15}$, $P(X=1) = \frac{1}{3}$, $P(X=2) = P(X=3) = \frac{1}{15}$.
   Find the mean and variance of X.
   If $Y = 1000 + 300X$, find $P(Y \geq 1500)$ and $E[Y]$.

3. An insurance company agent accepts policies of 5 men, all of identical age and good health. Probability that a man of this age will be alive 30 years is $\frac{2}{3}$. Find the probability that in 30 years (i) all 5 men will be alive (ii) at least one man will be alive.

4. The probability that a component is acceptable is 0.93. Ten components are picked at random. What is the probability that:
   (i) At least nine are acceptable ii) At most three are acceptable.

5. In a given city 6% of all drivers get at least one parking ticket per year. Use the Poisson approximation to the binomial distribution to determine the probabilities that among 80 drivers (randomly chosen in this city)
   (a) 4 will get at least one parking ticket in any given year
   (b) at least 3 will get at least one parking ticket in any given year
   (c) anywhere from 3 to 6 inclusive, will get at least one parking ticket in any given year.

Module-2 : Continuous Probability Distributions
Tutorial

1. What can you say about $P(X = a)$ for any real number a when X is a (i) discrete random variable? (ii) continuous random variable?

2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?

3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?

4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following and exponential distribution with parameter λ. Find $P(X + Y \leq 1)$.

5. Find the mean and variance of the continuous random variable X with probability density function

$$f(x) = \begin{cases} 2x - 4 & 2 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

MODULE III RANDOM PROCESSES

TUTORIAL

1. Find the PSD function of a stationary process whose ACF is $e^{-|\tau|}$.
2. If X(t) = $Y \cos t + Z \sin t$ for all t where Y and Z are independent binary r.v's , each of which assumes the values -1 and 2 with probabilities 2/3 and 1/3 respectively , prove that {X(t)} is a WSS process.
3. Calculate the autocorrelation function of the process X(t) = A sin $(\omega t + Y)$ where Y is uniformly distributed in $(0, 2\pi)$ and A and ω are constants.
4. If X(t) is a WSS process with ACF $R(\tau) = e^{-\tau^2}$ the find the PSD function
5. If X(t) = A sin $(\omega t + \theta)$ where A and ω are constants and θ is uniformly distributed in $(-\pi, \pi)$, find the autocorrelation of {Y(t)} , where $Y(t) = X^2(t)$.

MODULE IV
NUMERICAL TECHNIQUES -I

TUTORIAL

1. Find the real root of $\cos x - x + 2 = 0$, correct to five decimal places using Regula-falsi method.
2. Calculate the Lagrange Polynomial for the values $\Gamma(1.00) = 1.0000$, $\Gamma(1.02) = 0.9888$, $\Gamma(1.04) = 0.9784$ of the Gamma function and from it approximations of $\Gamma(1.01)$ and $\Gamma(1.03)$.
3. Apply Newton's method to compute the roots of $2x - \cos x = 0$, $x_0 = 1$
4. Given $\sin 45^\circ = 0.7071$, $\sin 50^\circ = 0.7660$, $\sin 55^\circ = 0.8192$, $\sin 60^\circ = 0.8660$, find $\sin 52^\circ$, usingNewton's forward interpolation formula.
5. Evaluate the integral $\int_0^1 e^{x^2}$ by rectangular rule with subintervals of length 0.1.

TUTORIAL QUESTIONS

1. Using Gauss-Seidel method, solve the system of equations
$$5x + 2y + z = 12$$
$$x + 4y + 2z = 15$$
$$x + 2y + 5z = 20$$
2. Fit a parabola through (0,5), (2,4) ,(4,1), (6.6), (8,7) using method of least squares.
3. Solve $\frac{dy}{dx} = y - \frac{2x}{y}$, $y(0) = 1, h = 0.1$. Find $y(0.2)$ using Euler's method.
4. Using Runge- Kutta method of second order, find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$, take $h = 0.1$.
5. Solve the IVP by Adam-Moulton method $y' = y$, $y(0) = 1, h = 0.1$, $y(0.1) = 1.105171$, $y(0.2) = 1.221403$, $y(0.3) = 1.349858$.

100902/EC400B: ANALOG CIRCUITS

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics & Instrumentation Engineering	DEGREE: BTECH
COURSE: ANALOG CIRCUITS	SEMESTER: IV CREDITS: 4
COURSE CODE: **100902/EC400B** REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: 3+1(Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): ECL 202	LAB COURSE NAME: ANALOG CIRCUITS AND SIMULATION LAB

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Wave shaping circuits:** First order RC differentiating and integrating circuits, First order RC low pass and high pass filters. Diode Clipping circuits - Positive, negative and biased clipper. Diode Clamping circuits - Positive, negative and biased clamper. **Transistor biasing:** Need, operating point, concept of DC load line, fixed bias, self bias, voltage divider bias, bias stabilization.	10
II	**BJT Amplifiers:** RC coupled amplifier (CE configuration) – need of various components and design, Concept of AC load lines, voltage gain and frequency response. Small signal analysis of CE configuration using small signal hybrid-pi model for mid frequency and low frequency. (gain, input and output impedance). High frequency equivalent circuits of BJT, Miller effect, Analysis of high frequency response of CE amplifier.	9
III	**MOSFET amplifiers:** MOSFET circuits at DC, MOSFET as an amplifier, Biasing of discrete MOSFET amplifier, small signal equivalent circuit. Small signal voltage and current gain, input and output impedance of CS configuration. CS stage with current source load, CS stage with diode-connected load. **Multistage amplifiers** - effect of cascading on gain and bandwidth. Cascode amplifier.	9
IV	**Feedback amplifiers:** Effect of positive and negative feedback on gain, frequency response and distortion. The four basic feedback topologies, Analysis of discrete BJT circuits in voltage-series and voltage-shunt feedback topologies - voltage gain, input and output impedance. **Oscillators:** Classification, criterion for oscillation, Wien bridge oscillator, Hartley and Crystal oscillator. (working principle and design equations of the circuits; analysis of Wien bridge oscillator only required).	10

V	**Power amplifiers:** Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, complementary-symmetry class B and Class AB power amplifiers, efficiency and distortion (no analysis required) **Regulated power supplies:** Shunt voltage regulator, series voltage regulator, Short circuit protection and fold back protection, Output current boosting.	7
	TOTAL HOURS	**45**

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
1	Sedra and Smith: *Microelectronic Circuits*, 4/e, Oxford University Press 1998.
2	B. Razavi , "*Fundamentals of Microelectronics*", Wiley
3	Donald A Neamen. : *Electronic Circuit Analysis and Design*, 3/e, TMH.
4	Millman and Halkias: *Integrated Electronics*, TMH, 2004.
5	Spencer &Ghausi: *Introduction to Electronic Circuit Design,* Pearson Education, 2003.
6	Roger T. Howe, Charles G. Sodini**:** *Microelectronics: An Integrated Approach,* Pearson Education, 1997.
7	R E Boylstead and L Nashelsky: *Electronic Devices and Circuit Theory*, 9/e, Pearson Education

COURSE PRE-REQUISITES

C.CODE	*COURSE NAME*	*DESCRIPTION*	*SEM*
EST130	Basics of Electrical and Electronics Engineering	Students should know about basic electronics components like BJT, diode, Resistor etc&its working	1st Sem

COURSE OBJECTIVES:

1	To understand the concept of first order RC circuits& diodes
2	To provide insight into the working , analysis and design of basic analog circuits using BJT
3	To provide insight into the working , analysis and design of basic analog circuits using MOSFET
4	To understand different types of feedback amplifiers& Oscillators
5	To provide insight into the working of different types power amplifiers and regulated power supply circuits.

COURSE OUTCOMES:

SNO	DESCRIPTION
1	Students will be able to **understand** the working and **design** of first order RC circuits& diodes
2	Students will be able to **analyze** basic amplifier configuration using BJT.

3	Students will be able to **analyze** basic amplifier configuration using MOSFET.
4	Students can **apply** the principle of different feedback amplifiers& Oscillators.
5	Students can **apply** the principle of power amplifiers& regulated power supply circuits.

CO-PO AND CO-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	3	2	1
2	3	3										2	3	2	1
3	3	3										2	3	2	1
4	3	3										2	3	2	1
5	3	3										2	3	2	1
EC010 205	**3**	**3**										**2**	**3**	**3**	**1**

JUSTIFATIONS FOR CO-PO MAPPING

MAPPING	*LOW/MEDIUM/ HIGH*	*JUSTIFICATION*
CO.1- PO1	H	Working of diodes and RC circuits require mathematical background, to solve engineering problems
CO.1 – PO2	H	Understanding the basic diode circuits helps students to reach better conclusions when faced similar cases
CO.1 – PO12	M	Understanding the design of basic circuits with diodes helps students in learning new circuits in future
CO.1 - PSO1	H	Good understanding of concepts in electronics
CO.1 – PSO2	M	To develop new circuits with the knowledge of basic diode circuits
CO.1 – PSO3	L	Ability to use the basic knowledge of working of RC circuits & diodes to build new skills
CO.2 - PO1	H	Fundamental knowledge of basic BJT amplifier helps in applying this knowledge for solving new problems
CO.2– PO2	H	Analyzing the working of BJT amplifier gives good understanding of the concept
CO.2 – PO12	M	Analyzing basic circuits like BJT configurations facilitates lifelong learning
CO.2 - PSO1	H	Sound knowledge of the core concept of working of BJT as an

		amplifier
CO.2 – PSO2	M	Analyzing basic BJT amplifier working helps in developing new systems
CO.2 – PSO3	L	Doing simulations with BJT helps in team building and leadership
CO.3- PO1	H	Fundamental knowledge of basic MOSFET amplifier helps in applying this knowledge for solving new problems
CO.3 – PO2	H	Analyzing the working of MOSFET amplifier gives good understanding of the concept
CO.3 – PO12	M	Analyzing basic circuits like MOSFET amplifier facilitates lifelong learning
CO.3 – PSO1	H	Sound knowledge of the core concept of working of BJT as an amplifier
CO.3 – PSO2	M	Analyzing basic MOSFET amplifier working helps in developing new systems
CO.3 – PSO3	L	Doing simulations with MOSFET helps in team building and leadership
CO.4- PO1	H	Applying the basic knowledge of feedback amplifiers helps in controlling the gain in practical amplifiers
CO.4 – PO2	H	Applying the basic knowledge of feedback amplifiers & oscillators helps in analyzing research problems
CO.4 – PO12	M	Learning to apply knowledge of feedback amplifiers & oscillators provides better understanding of new concepts in future
CO.4 – PSO1	H	Knowledge of feedback amplifiers & oscillators is important for better understanding of instrumentation systems
CO.4 – PSO2	M	Proper selection of feedback amplifiers/oscillators equips the student to develop new instruments
CO.4 – PSO3	L	Learns to adapt to new industrial scenarios
CO.5- PO1	H	Applying these concepts builds the foundation for building new circuits for solving engineering problems
CO.5 – PO2	H	Ability to review new research literature on power amplifiers & regulators
CO.5 – PO12	M	Ability to implement circuit for daily life applications
CO.5 - PSO1	H	Knowledge of power amplifiers & regulators is important for better understanding of instrumentation systems

CO.5 – PSO2	M	Selection of power amplifiers & regulators for the correct application equips the student to develop new instruments systems
CO.5 – PSO3	L	Learns to adapt to new industrial scenarios

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

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Introduction to switching circuits	Lecture/Simulation assignments

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	DESCRIPTION	PROPOSED ACTIONS
1	To learn TINA TI software by simulating the circuits in the syllabus and this will help the students to perform well in the lab also.	1,2,3,4,5,6,9,10

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	Micro/Mini/Main 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**

Dr. Poornima S **Dr. Hari C V., HOD**

COURSE PLAN

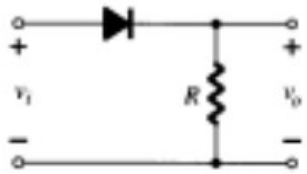
Day	Module	Topic
1	1	Introduction to waveshaping circuits
2	1	RC LPF & HPF - Response to step input - Qualitative and Quantitative analysis
3	1	RC LPF & HPF - Response to pulse input - Qualitative and Quantitative analysis
4	1	RC LPF & HPF - Response to square wave inputs - Qualitative and Quantitative analysis
5	1	RC Integrator & Differentiator
6	1	RC Integrator & Differentiator
7	1	Shunt Clippers - transient waveform and transfer function
8	1	Shunt Clippers - transient waveform and transfer function
9	1	Series Clippers - transient waveform and transfer function
10	1	Clampers - transient waveform and transfer function
11	1	Tutorial1 - RC circuits
12	1	Additional problems - RC circuits
13	1	Additional problems - Clippers & clampers
14	1	Biasing - need, stabilization & stability factors
15	1	BJT biasing circuits - Fixed and Emitter bias circuits
16	1	BJT biasing circuits - Voltage divider and Collector feedback circuits Tutorial - BJT Biasing circuits
17	1	Transistor in the active region; Fixing of Q-point
18	2	RC Coupled amplifier & Concept of AC and DC loadlines Small-signal hybrid pi model of a BJT
19	2	Small signal analysis of CE amplifier
20	2	Small signal analysis of CE amplifier
21	2	Small signal analysis of CE amplifier without emitter bypass capacitor Small signal analysis of CB amplifier
22	2	Small signal analysis of BJT amplifiers - Tutorial
23	2	High frequency equivalent circuit of BJT, short circuit current gain, cut- off frequency
24	2	Miller effect, Analysis of High frequency response of CE Amplifier
25	3	MOSFET circuits at DC
26	3	MOSFET as an amplifier, Biasing of discrete MOSFET amplifier
27	3	Small signal equivalent circuit MOSFET CS configuration
28	3	Small signal voltage and current gain, input and output impedances of CS configuration.

29	3	Small signal voltage and current gain, input and output impedances of CS configuration.
30	3	CS stage with current source load, CS stage with diode-connected load.
31	3	CS stage with current source load, CS stage with diode-connected load.
32	3	**Multistage amplifiers** - effect of cascading on gain and bandwidth. Cascode amplifier.
33	4	Feedback Amplifiers - Effect on gain, frequency response and distortion
34	4	Feedback topologies & circuits, effect of feedback on input & output impedances
35	4	Analysis of discrete circuits in each feedback topologies
36	4	Oscillators - Classification, Barkheusen criterion,
37	4	Analysis of Wien Bridge Oscillator
38	4	Working of Hartley and Crystal oscillators
39	5	Power Amplifiers - Classification, Transformer coupled Class A power amplifier
40	5	Power Amplifiers - Push-pull class B and class AB power amplifiers
41	5	complementary- symmetry class B and Class AB power amplifiers, efficiency and distortion
42	5	Transformerless class B and class AB power amplifiers, class C power amplifier
43	5	Principle of Linear Regulated power supplies, Shunt voltage regulator
44	5	Series voltage regulator
45	5	Short circuit protection and fold back protection, Output current boosting

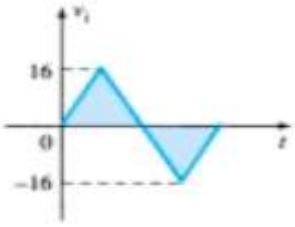
Assignment 1

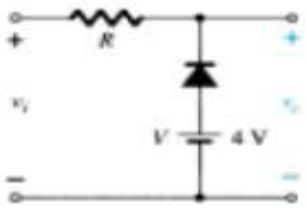
CLIPPERS

1. Sketch the transfer characteristics of the following circuit, for a 10Vpp sine wave input:(Assume ideal diodes)

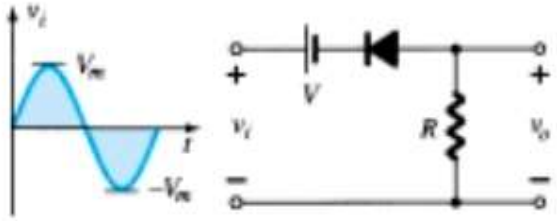


2. Sketch the output of the following circuit (a) for an ideal diode (b) for a non-ideal diode.

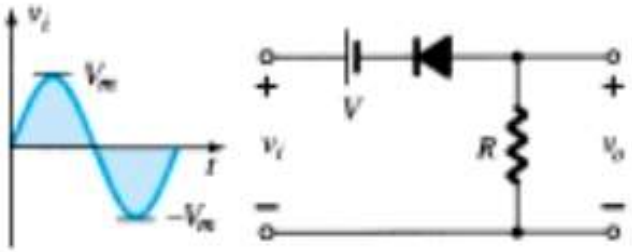




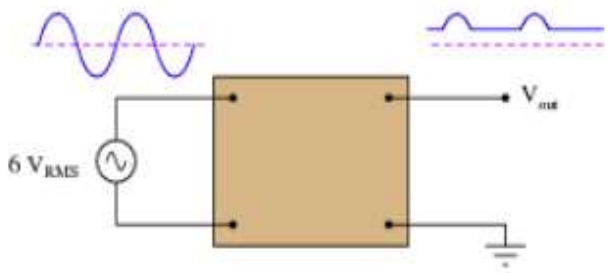
3. Sketch the output for the following circuit, for a 20Vpp input sine wave, given V=5V. (Assume ideal diodes)



4. 3. Sketch the output for the following circuit, for a 20Vpp input sine wave, given V=5V.(Assume ideal diodes)

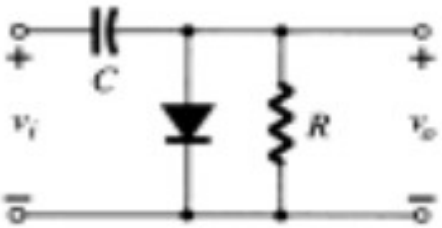


5. Design a clipper circuit that clips any portion of the input AC waveform below 4 volts:

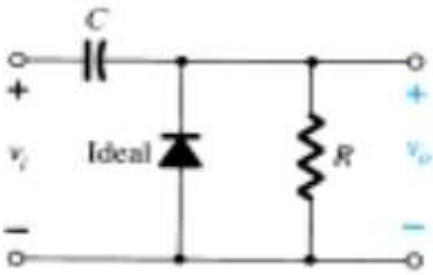


CLAMPERS

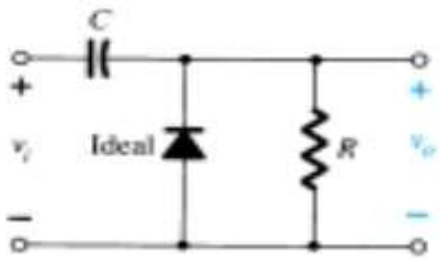
1. Sketch the output of the following circuit if the input is a 20Vpp sine wave.



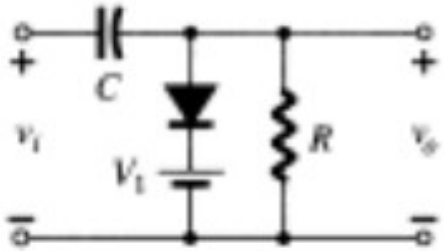
2. Sketch the output of the following circuit if the input is a 20Vpp sine wave



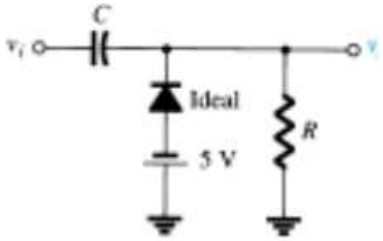
3. Sketch the output of the following circuit if the input is a 20Vpp sine wave (Assumediode drop =0.7V)



4. Sketch the output of the following circuit if the input is a 20Vpp sine wave and V1=5V.

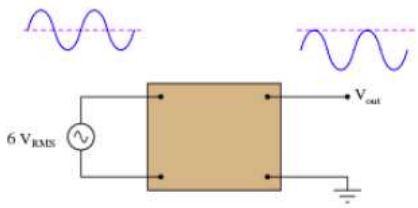


5. Sketch the output of the following circuit if the input is a 20Vpp sine wave and V1=5V.



6.

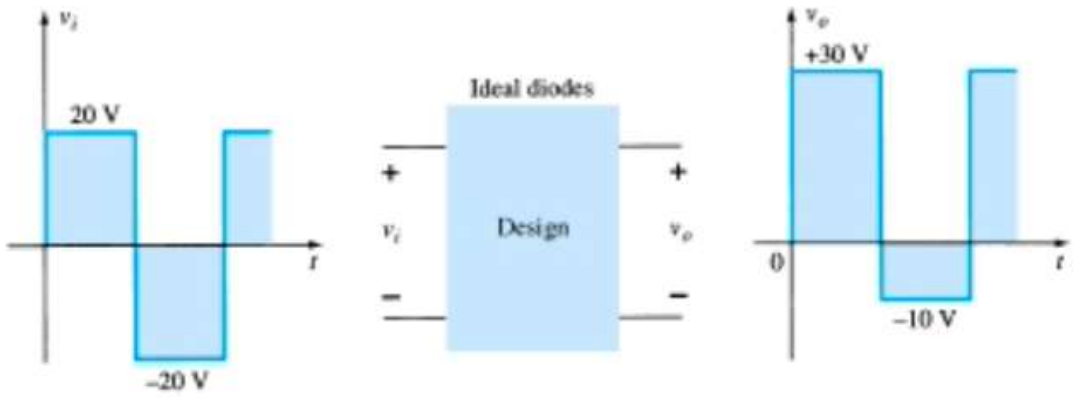
Design a clamper circuit that biases the AC waveform so it lies completely *below* (negative) the zero line:



7. Sketch the circuit of a biased positive clamper with a biasing voltage of +2V for a ±10V square wave input. Also plot its output voltage waveform and explain its operation.

8. Design a clamper circuit using diode to obtain sine wave output with its negative peak clamped to +2.6V. (Assume diode drop as 0.6)

40. Design a clamper to perform the function indicated in Fig. 2.163.



* **41.** Design a clamper to perform the function indicated in Fig. 2.164.

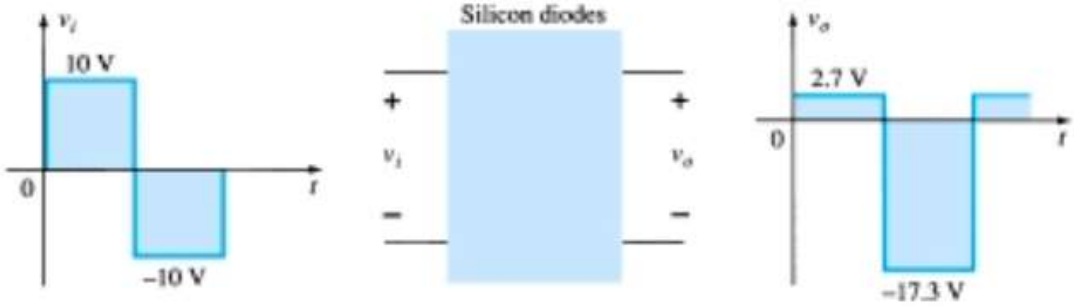


Figure 2.164 Problem 41

Tutorial Questions.

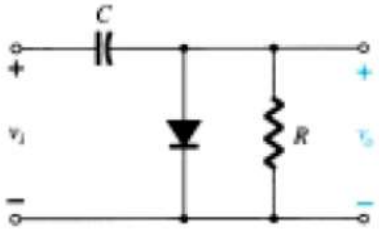
MODULE 1

RC CIRCUITS

1. **Design a differentiator circuit to differentiate a square wave of 20V peak to peak amplitude and 1.5KHz frequency.**
2. **What is the condition for an RC circuit to behave as an integrator& differentiator respectively?**
3. **A square wave of peak to peak amplitude 4V extending ±2V with respect to ground is applied to a low pass RC circuit. The duration of positive section is 0.2sec and that of negative section is 0.1sec. Plot the output waveform. The time constant of the circuit is 0.2sec.**
4. **Design an integrator for an input frequency of 1kHz.**
5. **A high pass RC circuit has a 3dB cut off frequency of 10Hz. Plot the output waveform of the circuit, if a 20Hz symmetric square wave with 2V peak to peak is applied to it. Mark the time and voltage levels accurately.**
6. **Plot the response of high pass RC circuit to symmetrical square wave input of 2V peak to peak, 20Hz. Given the cut off frequency of filter is 10Hz**
7. **Derive 3-dB frequency of a high pass RC circuit.**
8. **Show how an RC circuit behaves as an integrator.**
9. **Plot the response of high pass RC circuit to symmetrical square wave input of 2V peak to peak, 20Hz. Given the cut off frequency of filter is 10Hz.**

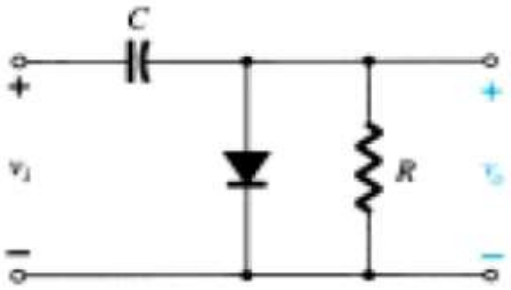
CLIPPERS

5. **Design a suitable circuit to obtain the output level clipped at +3V and -4V for a 10V peak to peak sinusoidal input voltage.**
6. **What is the circuit given in the figure called ?**

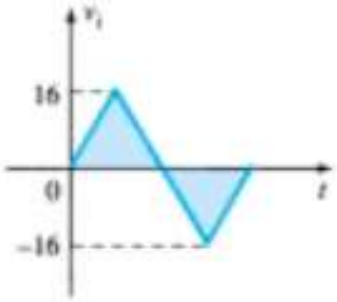


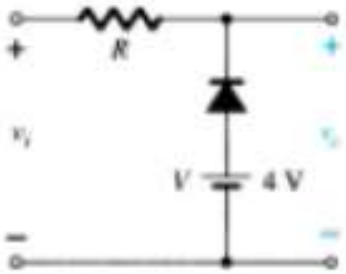
(a) Clipper (b) Clamper (c) Half wave rectifier (d) Full wave rectifier

7. **What is the peak value of the output waveform of the following figure, if the input is a 20Vpp sine wave? (Assume diode is ideal)**



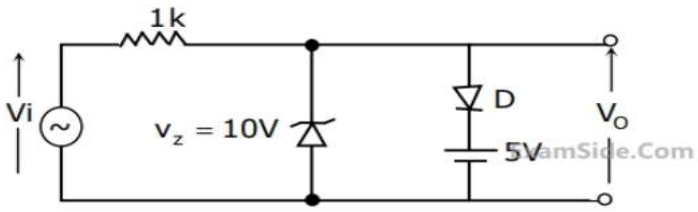
8. **Sketch the output of the following circuit (a) for an ideal diode (b) for a non-ideal diode**





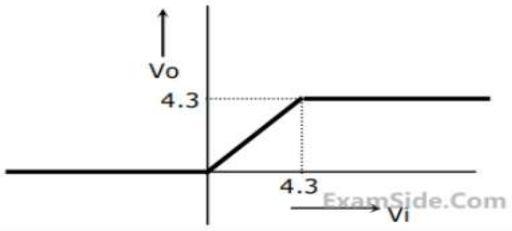
9. **For the following figure, let the input be a 20Vppsinewave.**

A clipper Circuit is shown below

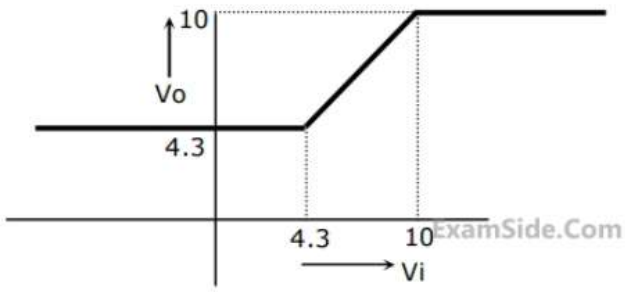


Assuming forward voltage drops of the diodes to be $0.7V$, the input-output trai characteristics of the circuit is

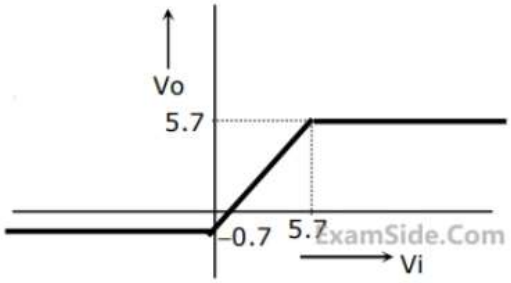
A



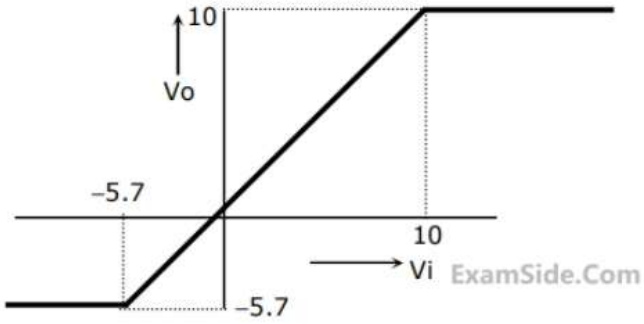
B


10
Vo
4.3
4.3
10
Vi
ExamSide.Com

C


Vo
5.7
–0.7
5.7
Vi
ExamSide.Com

D


10
Vo
–5.7
10
Vi
–5.7
ExamSide.Com

100902/EC400C: SIGNALS AND SYSTEMS

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics & Instrumentation	*DEGREE: BTECH*
COURSE: SIGNALS & SYSTEMS	**SEMESTER: IV CREDITS: 4**
COURSE CODE: 100902/EC400C REGULATION: 2019	**COURSE TYPE: CORE**
COURSE AREA/DOMAIN: SIGNALS & SYSTEMS	**CONTACT HOURS: 3(L)+1(T)hours/week**
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME:**

SYLLABUS:

UNIT	*DETAILS*	*HOURS*
I.1	Elementary Signals, Classification and representation of continuous time and discrete time signals, Signal operations	4
I.2	Continuous time and discrete time systems – Classification, Properties.	3
I.3	Representation of systems: Differential equation representation of continuous time systems. Difference equation representation of discrete systems.	2
I.4	Continuous time LTI systems and convolution integral.	2
I.5	Discrete time LTI systems and linear convolution.	2
I.6	Stability and causality of LTI systems.	2
I.7	Correlation between signals, Orthogonality of signals.	1
II.1	Frequency domain representation of continuous time signals -continuous time Fourier series and its properties.	4
II.2	Continuous time Fourier transform and its properties. Convergence and Gibbs phenomenon	3
II.3	Review of Laplace Transform, ROC of Transfer function, Properties of ROC, Stability and causality conditions.	3
II.4	Relation between Fourier and Laplace transforms.	1
III.1	Analysis of LTI systems using Laplace and Fourier transforms. Concept of transfer function, Frequency response, Magnitude and phase response.	4
III.2	Sampling of continuous time signals, Sampling theorem for low pass signals, aliasing.	3
IV.1	Frequency domain representation of discrete time signals, Discrete time fourier series for discrete periodic signals. Properties of DTFS.	4
IV.2	Discrete time fourier transform (DTFT) and its properties. Analysis of discrete time LTI systems using DTFT. Magnitude and phase response.	5
V.1	Z transform, ROC, Inverse transform, properties, Unilateral Z transform.	3
V.2	Relation between DTFT and Z-Transform, Analysis of discrete time LTI systems using Z transforms Transfer function. Stability and causality using Z transform.	4
	TOTAL HOURS	**50**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Alan V. Oppenheim and Alan Willsky, Signals and Systems, PHI, 2/e, 2009
T2	Simon Haykin, Signals & Systems, John Wiley, 2/e, 2003
R1	Anand Kumar, Signals and Systems, PHI, 3/e, 2013.
R2	B P. Lathi, Priciples of Signal Processing & Linear systems, Oxford University Press.
R3	Gurung, Signals and System, PHI.
R4	Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.
R5	P Ramakrishna Rao, Shankar Prakriya, Signals and System, MC Graw Hill Edn 2013.
R6	Rodger E. Ziemer, Signals & Systems - Continuous and Discrete, Pearson, 4/e, 2013

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
		NIL	

COURSE OBJECTIVES:

1	This course aims to lay the foundational aspects of signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing, image processing, communication theory and control systems.

COURSE OUTCOMES:

Sl.No	Description	Blooms' Taxonomy Level
C0.1	Apply properties of signals and systems to classify them	Understand and Apply (level 2, 3)
C0.2	Represent signals with the help of series and transforms	Understand and Apply (level 2, 3)
C0.3	Describe orthogonality of signals and convolution integral.	Understand and Apply (level 2, 3)
C0.4	Apply transfer function to compute the LTI response to input signals.	Understand and Apply (level 2, 3)
C0.5	Apply sampling theorem to discretize continuous time signals	Understand and Apply (level 2, 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	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-

CO – PO mapping justification

MAPPING	LOW/ MEDIUM /HIGH	JUSTIFICATION
CO1-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of signals & systems.
CO1-PO2	H	Differential and difference equation representation of systems using the first principles of mathematics and engineering sciences.
CO1– PSO1	H	Properties of signals and systems are applied to design and implement various electronics and instrumentation systems.
CO2-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to represent signals with the help of series and transforms.
CO2-PO2	H	Analyze signals with the help of Fourier series, Laplace, Fourier & Z transforms and study the properties of different transforms using the first principles of mathematics.
CO2-PO3	H	Analyzing signals with the help of series and transforms helps in design solutions for complex engineering problems
CO2– PSO3	M	New concepts are studied.
CO3-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to describe orthogonality of signals and convolution integral.
CO3-PO2	H	Concept of orthogonality and convolution integral requires the first principles of mathematics.
CO3-PO3	H	Analyzing orthogonality of signals & convolution integral helps in design solutions for complex engineering problems.
CO3– PSO2	M	Knowledge about the orthogonality of signals and convolution integral helps in the development of instrumentation systems.

CO4-PO1	H	Apply the knowledge of mathematics and engineering fundamentals to compute the LTI response of a system to input signals
CO4-PO2	H	Analysis and characterization of LTI systems using Laplace and Z-Transform
CO5-PO1	H	Apply the knowledge of mathematics and engineering fundamentals to understand the importance of sampling theorem to discretize continuous time signals.
CO5-PO2	H	Understand the Nyquist criteria and evaluate different sampling criteria using the first principles of mathematics and engineering sciences.
CO5-PO3	H	The analysis of sampling theorem provides design solutions for different signal processing algorithms.
CO5– PSO2	H	Apply sampling theorem to discretize continuous time signals for developing instrumentation systems.

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

SNO	*DESCRIPTION*	*PROPOSED ACTIONS*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
1	MATLAB Simulations	Assignments, projects	1,5	PSO3

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

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	*DESCRIPTION*	*PROPOSED ACTIONS*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
1	Discrete Fourier Transform (DFT)	Video lectures	1,2	1
2	Fast Fourier Transform (FFT)	Video lectures	1,2	1

WEB SOURCE REFERENCES:

1	*Signals and Systems NPTEL online IIT Mumbai*
2	*www.nptel.iitm.ac.in/courses/117104074/*
3	www.ece.gatech.edu/users/bonnie/book/worked_problems.html
4	*www.ece.jhu.edu/~cooper/courses/214/**signalsandsystems**notes.pdf*
5	*link.springer.com/journal/498*

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

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

BOARDS			

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
Dr. Hari C.V.
Course in charge

Approved by
Dr. Hari C.V.
(HoD/ DAEI)

COURSE PLAN

Sl.No	Module	Topic
1	1	Elementary Signals
2	1	Classification and representation of continuous time and discrete time signals
3	1	Signal operations
4	1	Signal operations
5	1	Continuous time and discrete time systems – Classification, Properties.
6	1	Continuous time and discrete time systems – Classification, Properties.
7	1	Continuous time and discrete time systems – Classification, Properties.
8	1	Representation of systems: Differential equation representation of continuous time systems
9	1	Difference equation representation of discrete systems
10	1	Continuous time LTI systems and convolution integral
11	1	Continuous time LTI systems and convolution integral
12	1	Discrete time LTI systems and linear convolution.
13	1	Discrete time LTI systems and linear convolution.
14	1	Stability and causality of LTI systems
15	1	Stability and causality of LTI systems
16	1	Correlation between signals, Orthogonality of signals.
17	2	Frequency domain representation of continuous time signals
18	2	Frequency domain representation of continuous time signals
19	2	Continuous time Fourier series and its properties.
20	2	Continuous time Fourier series and its properties.
21	2	Continuous time Fourier transform and its properties.
22	2	Convergence and Gibbs phenomenon
23	2	Convergence and Gibbs phenomenon

24	2	Review of Laplace Transform
25	2	ROC of Transfer function, Properties of ROC
26	2	Stability and causality conditions
27	2	Relation between Fourier and Laplace transforms.
28	3	Analysis of LTI systems using Laplace and Fourier transforms.
29	3	Concept of transfer function
30	3	Frequency response
31	3	Magnitude and phase response
32	3	Sampling of continuous time signals
33	3	Sampling of continuous time signals
34	3	Sampling theorem for low pass signals, aliasing.
35	4	Frequency domain representation of discrete time signals
36	4	Frequency domain representation of discrete time signals
37	4	Discrete time fourier series for discrete periodic signals
38	4	Discrete time fourier series for discrete periodic signals
39	4	Properties of DTFS
40	4	Properties of DTFS
41	4	Discrete time fourier transform (DTFT) and its properties
42	4	Discrete time fourier transform (DTFT) and its properties
43	4	Discrete time fourier transform (DTFT) and its properties
44	4	Analysis of discrete time LTI systems using DTFT
45	4	Analysis of discrete time LTI systems using DTFT
46	4	Magnitude and phase response
47	5	Z transform, ROC

48	5	Z transform, ROC
49	5	Inverse transform
50	5	Inverse transform
51	5	Properties, Unilateral Z transform
52	5	Relation between DTFT and Z-Transform
53	5	Analysis of discrete time LTI systems using Z transforms, Transfer function
54	5	Analysis of discrete time LTI systems using Z transforms, Transfer function
55	5	Stability and causality using Z transform.
56	5	Stability and causality using Z transform.
57	5	Revision
58	5	Revision

ASSIGNMENT I

1. Check whether the following signals are periodic. If periodic, find the fundamental time period.
   (a) $x(t) = cos(60\pi t) + sin(50\pi t)$
   (b) $x(n) = e^{j(\frac{2\pi}{3})n} + e^{j(\frac{2\pi}{4})n}$
2. Determine whether the following signals are energy signals, power signals, neither energy nor power signals.
   (a) $x(t) = tu(t)$
   (b) $x(n) = (\frac{1}{3})^n u(n)$
3. Obtain the linear convolution of $x_1(t)$ and $x_2(t)$, where $x_1(t) = r(t)$ and $x_2(t) = e^{-2t}u(t)$
4. Find the convolution of
   (a) $x(n) = u(n) - u(n-7)$ and $h(n) = u(n-1) - u(n-4)$
   (b) $x(n) = u(n)$ and $h(n) = 2^n u(n)$
5. Find whether the following systems are stable or not if $x()$ represents input, $y()$ represents output and $h()$ represents impulse response
   (a) $y(t) = e^{x(t)}$, where $|x(t)| \leq 8$
   (b) $h(t) = e^{2t}u(t)$
   (c) $y(n) = \delta(n) + \frac{1}{2}\delta(n-1) + \frac{1}{4}\delta(n-2)$
   (d) $h(n) = a^n$ for $0 < n < 11$
   (e) $h(t) = (t+5)u(t)$
6. Find even and odd components of the following signals.
   (a) $x(t) = cos(t) + sin(t) + cos(t)\,sin(t)$
   (b) $x(n) = \{-2, 1, \underset{\uparrow}{2}, -1, 3\}$
7. A system has the transfer function

$$H(S) = \frac{3s-1}{s^2+5s+6}$$

   (a) Find the impulse response by assuming that the system is
      i. Stable
      ii. Causal
   (b) Can this system be both stable and causal ? Justify
8. Find the transfer function of the system described by the differential equation

$$\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + y(t) = \frac{d}{dt}x(t) - 2x(t)$$

9. Determine the transfer function and the impulse response for the causal linear time-invariant system described by the differential equation

$$\frac{d^2}{dt^2}y(t) + 3\frac{d}{dt}y(t) + 2y(t) = 2\frac{d}{dt}x(t) - 3x(t)$$

10. Determine the unit step response for the causal LTI system described by the differential equation

$$\frac{d^2}{dt^2}y(t) + 3\frac{d}{dt}y(t) + 2y(t) = \frac{d}{dt}x(t) + 10x(t)$$

ASSIGNMENT 2

1. Explain the Gibbs phenomenon.
2. State and prove the properties of Continuous Time Fourier Transform.

Tutorial 1

1. Find the inverse Z transform of

$$X[z] = \frac{\frac{1}{4}z^{-1}}{(1-\frac{1}{2}z^{-1})(1-\frac{1}{4}z^{-1})}$$

if ROC is $\frac{1}{4} < |z| < \frac{1}{2}$

2. A system has the transfer function

$$H(S) = \frac{3s-1}{s^2+5s+6}$$

(a) Find the impulse response by assuming that the system is

i. Stable

ii. Causal

(b) Can this system be both stable and causal ? Justify

3. Find the transfer function and the impulse response of the for the causal linear time-invariant system described by the differential equation

$$\frac{d^2}{dt^2}y(t)+3\frac{d}{dt}y(t)+2y(t)=2\frac{d}{dt}x(t)-3x(t)$$

4. Determine the unit step response for the causal LTI system described by the differential equation

$$\frac{d^2}{dt^2}y(t)+3\frac{d}{dt}y(t)+2y(t)=\frac{d}{dt}x(t)+10x(t)$$

Tutorial 2

1. Determine the transfer function of the system described by the difference equation $y(n) = x(n) + 0.81x(n-1) - 0.81x(n-2) - 0.45y(n-2)$, where $y(n)$ represents the output and the $x(n)$ represents the input.

2. Determine the impulse response of the causal LTI system described by the difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ where $y(n)$ represents the output and the $x(n)$ represents the input.

3. A causal linear time invariant system has an impulse response $h(n) = \left(\frac{1}{3}\right)^n u(n)$. Determine the transfer function and difference equation representation of the system. Also determine the input to the system if the output is given by $y(n) = \left(\frac{1}{2}\right)u(n) + \frac{1}{4}\left(\frac{-1}{3}\right)^n u(n)$, where $u(n)$ represents the unit step signal.

100002/AE400D MEASUREMENTS AND INSTRUMENTATION

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics and Instrumentation	*DEGREE: BTECH*
COURSE: MEASUREMENTS AND INSTRUMENTATION	SEMESTER: 4 CREDITS: 4
COURSE CODE: AET 206 *REGULATION: KTU 2019*	COURSE TYPE: CORE
COURSE AREA/DOMAIN: INSTRUMENTATION	CONTACT HOURS: 4 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): AEL204	LAB COURSE NAME: TRANSDUCERS AND MEASUREMENTS LAB

SYLLABUS:

UNIT	*DETAILS*	*HOURS*
1	Principles of Measurements, Standards- Calibration of Meters- Qualities of Measurements-Accuracy, precision, sensitivity, resolution, loading effect. - Characteristics, safety measures - Errors in Measurement and its Analysis	9
2	Indicating instruments Deflection type-principles and operation, moving coil, moving iron, dynamometer, induction, thermal, electrostatic and rectifier type meters Grounding and Shielding of measuring systems.	8
3	Transducers, principles, application of basic transducers: LVDT, temperature sensors, thermocouples, RTD, LDR, displacement transducer, strain gauges, accelerometers, piezoelectric transducers, Hall effect transducers, manometers, photoelectric transducers	9
4	Dc Bridges: Introduction, Sources And Detectors For Dc Bridges, General Equation For Bridge At Balance, Types Of Bridges- Wheatstone, Kelvin, Carry Foster Slide Wire Bridge. Ac Bridges: Introduction, Source And Detectors For Ac Bridges, General Equation For Bridge At Balance, Maxwells Inductance-Capacitance Bridge, Anderson Bridge, Shering bridge.	9
5	Cathode ray oscilloscopes, principles, construction and limitations- Delayed time base, Analog storage and Sampling oscilloscopes. Digital storage oscilloscopes-principles, Measurements using CROs and DSOs, Recording instruments: Strip chart recorder, X-Y plotter, LCD displays. Waveform analyzing instruments: Spectrum analyzer, Distortion meter, Watt-hour meter, -meter, Power factor, Instrument transformers, Peak response voltmeter, True RMS meter.	10
TOTAL HOURS		45

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*

T-1	John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education,
T-2	S.M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore, 1994.
T-3	S. Renganathan "Transducer Engineering", Allied publishers Limited, Chennai, 2003.
R-1	Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995.
R-2	Neubert H.K.P, "Instrument Transducers - An Introduction to their Performance and Design", 2nd Edition, Oxford University Press, Cambridge, 1999.
R-3	Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.
R-4	Waldemar Nawrocki, "Measurement Systems and Sensors", Artech House, 2005.
R-5	Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003.

COURSE PRE-REQUISITES:

C.CODE	*COURSE NAME*	*DESCRIPTION*	*SEM*
	NIL		

COURSE OBJECTIVES:

1	*To give a hands on experience to students in various transducers and instrumentation.*

COURSE OUTCOMES:

Sl. No.	*DESCRIPTION*	*Blooms' Taxonomy Level*
C1	Illustrate the working principles of electronic measuring instruments	
C2	Identify various types of errors in measuring systems and choose methods for minimization of the errors	
C3	Summarize the concepts of DC and AC bridges used in measurement systems.	
C4	Apply the principles and functions of various types of Transducers in measuring systems.	
C5	Explain the concepts of CRO, DSO, various recording devices and waveform analyzing instruments.	

CO-PO AND CO-PSO MAPPING:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
1	2											1	3		

2	3	2										1	3		
3	3				1							1	3	2	
4	3				1							1	3	2	
5	2											1	3		

JUSTIFICATIONS FOR CO-PO-PSO MAPPING:

MAPPING	*LOW/MEDIUM/HIGH*	*JUSTIFICATION*
AET206.1- PO1	M	Identifying the errors and formulating method for minimizing the errors
AET206.1-PO12	L	Design and developing calibrated measuring instruments
AET206.2-PO1	H	Interpretation of data requires measuring systems
AET206.2-PO2	M	Data acquisition requires measuring instruments
AET206.2-PO12	L	Helps in developing instrument systems
AET206.3-PO1	H	Working principle of transducers required for the design of instrument system
AET206.3-PO5	L	Knowledge of working principle essential for the outcome of lifelong learning
AET206.3-PO12	L	Working principle essential for developing instrument system
AET206.4-PO1	H	Helpful in changing the industrial scenario
AET206.4-PO5	L	Design and development of solutions requires the knowledge of instruments
AET206.4-PO1	L	Design of instruments required for the synthesis of information
AET206.5-PO1	M	Applicable for technological change
AET206.5-PO12	L	Selection of instruments for the change in industrial scenario
AET206.1- PO1	M	Identifying the errors and formulating method for minimizing the errors
AET206.1-PO12	L	Design and developing calibrated measuring instruments
AET206.1- PSO1	H	Knowledge of the basic characteristics of the measuring instruments
AET206.2-PSO1	H	Design and development of calibrated measuring instruments
AET206.3- PSO1	H	Understanding measuring instruments working for industrial application
AET206.3- PSO2	M	Design and developing instrumentation systems.
AET206.4- PSO1	H	Design of instruments for data display
AET206.4- PSO2	M	Developing instruments for data recording
AET206.5- PSO1	H	Analyzing the recorded data for further processing.

GAPS IN THE SYLLABUS

Sl.NO:	DESCRIPTION	PROPOSED ACTIONS	PO Mapping
1	Application of transducers in level measurement. Compensation schemes for thermocouple	NPTEL, Theory Class	PO1, PO3,PSO1

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Sound transducers	NPTEL, Extra	PO1, PO3,	PSO3

		Lab Classes		

WEB SOURCE REFERENCES:

1	***http://nptel.iitm.ac.in***
2	http://nptel.ac.in/courses/112103174/3
3	http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/intro.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
Lekshmi M S
(Faculty)

Approved by

(HoD)

Sl.No	Module	Planned Date	Topics
No	**Date**	**Module**	**Planned**
1	Day 1	1	Introduction -Measurement system
2	Day 2	1	Qualities of measurement
3	Day 3	1	Qualities of measurement
4	Day 4	1	Principles of loading
5	Day 5	1	Characteristics of measurement
6	Day 6	1	Errors in measurement-instrumental errors, environmental errors
7	Day 7	2	Introduction to indicating instruments
8	Day 8	2	Working of Permanent magnet moving coil
9	Day 9	2	Electrodynamometer
10	Day 10	2	Moving iron instrument
11	Day 11	2	Electrothermal instrument
12	Day 12	2	Hot wire anemometer
13	Day 13	2	Induction type instruments
14	Day 14	2	Class test Module I
15	Day 15	2	Electrostatic type
16	Day 16	3	Introduction to transducers
17	Day 17	3	Characteristics of transducers
18	Day 18	3	Potentiometer, Strain gauge
19	Day 19	3	Strain gauge types
20	Day 20	3	Thermal transducers
21	Day 21	3	Temperature transducers
22	Day 22	3	Objective test on mod 1 and 2
23	Day 23	3	Displacement transducers-Introduction to inductance transducers
24	Day 24	3	Displacement transducers
25	Day 25	3	Capacitive transducers
26	Day 26	3	Capacitive transducers
27	Day 27	3	MCQ On transducers
28	Day 28	3	Photoelectric transducers
29	Day 29	3	Piezoelectric transducers
30	Day 30	3	Hall effect transducers
31	Day 31	3	Accelerometers, Manometers
32	Day 32	4	Bridges-Introduction, types of bridges, Source and detectors of DC bridges
33	Day 33	4	Wheatstone bridge
34	Day 34	4	Carey foster sliding wire bridge
35	Day 35	4	Kelvin bridge and kelvin double bridge
36	Day 36	4	AC bridges, Sources of Ac bridges, Balancing Equation
37	Day 37	4	Maxwells inductance bridges, maxwells capacitance bridge
38	Day 38	4	Anderson bridge, Schering bridge
39	Day 39	4	Tutorial problems on Bridges

40	Day 40	5	Cathode ray oscilloscopes, principles, construction and limitations- Delayed time base,
41	Day 41	5	Analog storage and Sampling oscilloscopes. Digital storage oscilloscopes-principles
42	Day 42	5	Measurements using CROs and DSOs, Recording instruments: Strip chart recorder,X-Y plotter
43	Day 43	5	LCD displays. Waveform analyzing instruments: Spectrum analyzer, Distortion meter,
44	Day 44	5	Watt-hour meter, Q -meter, Power factor, Instrument transformers Peak response voltmeter, True RMS meter.

ASSIGNMENT QUESTIONS

ASSIGNMENT 1

1. Write briefly on Grounding and Shielding in measuring instruments.

2. Write briefly on Standards of Measurement System.

ASSIGNMENT 2

1. Explain with block diagram the working principle of CRO

TUTORIAL QUESTIONS

1. A Maxwell's inductance–capacitance bridge is used tomeasure a unknown inductive impedance. The bridgeconstants at bridge balance are: Pure resistance arms = 2.5kΩ and 50 kΩ. In between these two resistors, the third armhas a capacitor of value 0.012 μF in series with a resistor ofvalue 235 kΩ. Find the series equivalent of the unknown impedance.

2. The four arms of a bridge are connected as follows:Arm AB: A choke coil L1 with an equivalent series resistance r1Arm BC: A noninductive resistance R3Arm CD: A mica capacitor C4 in series a noninductive resistance R4Arm DA: A noninductive resistance R2When the bridge is supplied from a source of 450 Hz is given between terminals A andC and the detector is connected between nodes B and D, balance is obtained the followingconditions: R2 = 2400 Ω, R3 = 600 Ω, C4 = 0.3 μF and R4 = 55.4 Ω. Series resistance ofthe capacitor is 0.5 Ω. Calculate the resistance and inductance of the choke coil.

100908/CO900E : DESIGN & ENGINEERING

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics and Instrumentation	*DEGREE: BTech*
COURSE: DESIGN ENGINEERING	SEMESTER: **S4** CREDITS: **2**
COURSE CODE:REGULATION: : 100908/CO900E	COURSE TYPE: **Theory**
COURSE AREA/DOMAIN: DESIGN AND ANALYSIS	CONTACT HOURS: **2+0+0 (THEORY) hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	*DETAILS*	*HOURS*
I	Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.	5
II	Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment	8
III	Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design	8
IV	Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Biomimicry, Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.	6
V	Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design	6
	TOTAL HOURS	25

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
T	YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process,Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285
T	Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051
R	Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
R	Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
R	Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

COURSE PRE-REQUISITES: NIL

COURSE OBJECTIVES:

1	*To excite the student on creative design and its significance*
2	To make the student aware of the processes involved in design
3	To get an exposure as to how to engineer a design

COURSE OUTCOMES:

SNO	DESCRIPTION
1	Appreciate the different concepts and principles involved in design engineering.
2	Apply design thinking while learning and practicing engineering.
3	Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering
	Explain how to develop new designs for simple products through value engineering
	Analyze the different designs around you in your daily life and made you to think creatively.

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PS O 3
1	2	1					1			1			1		
2		2				1		1				2			2
3			2			1	1		2	2		1		2	
4	3			1						2				2	
5	2		2						1						3

JUSTIFATIONS FOR CO-PO MAPPING

MAPPING	LOW/MED IUM/HIGH	JUSTIFICATION
EST200.1- PO1	M	Understanding of various design problems helps the students in better formation of design objectives and constraints
EST200.1-PO2	L	Knowledge in design and engineering helps the students in problem analysis
EST200.1-PO10	L	Identification of need or problems is an important step in the development of solutions
EST200.2-PO2	M	Design problems related to current environmental and social issues
EST200.2-PO6	L	Students could identify safety health and cultural issues, evolving concepts to overcome such issues
EST200.2-PO8	L	Working principle of transducers required for the design of instrument system
EST200.2-PO12	H	Helps in applying the design process in life cycle design and sustainability design.
EST200.3 –PO2	M	Knowledge of working principle essential for the outcome of lifelong learning
EST200.3-PO6	L	Working principle essential for developing instrument system
EST200.3-PO7	L	Helpful in changing the industrial scenario
EST200.3-PO9	M	Projects can be done by student teams in two levels based on assigned task as lab work.
EST200.3-PO10	M	Proper communication between individuals and society is essential for effective team works
EST200.3-PO12	L	Design of instruments required for the synthesis of information
EST200.3-PO1	H	Helps in understanding how mathematics can be used for designing
EST200.3-PO4	L	Knowledge in collecting data for modifying existing design
EST200.3-PO9	M	Help in understanding how to work in a team

EST200.3-PO1	M	Knowledge in design and engineering using physics and mathematics for problem analysis
EST200.3-PO3	M	Working in a team for social benefit and society upliftment
EST200.3-PO9	L	Working in a team for developing communication
EST200.1- PSO1	L	Understanding the design process for a particular application.
EST200.2-PSO3	M	Developing and designing new instrumentation systems
EST200.3- PSO2	M	Design thinking process demands learning new concepts.
EST200.4- PSO2	M	Designing new products from existing one creatively.
EST200.5- PSO3	H	Developing new designs by working in a eam

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

SNO	*DESCRIPTION*	*Proposed Action*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
1	Strategies adopted for extended life	Discuss in class	PO7	PSO1,2

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

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	*DESCRIPTION*	*Proposed Action*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
1	Requirements of multidisciplinary team	Discussion in class	PO9	PSO1

WEB SOURCE REFERENCES:

1	*E-Book: http://opim.wharton.upenn.edu/~ulrich/designbook.html*
2	http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_ for_x_notes

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			

ASSESSMENT METHODOLOGIES-INDIRECT

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

Prepared by

Ms. Lekshmi M S

Approved by

Dr. Hari CV
(HOD)

COURSE PLAN

Sl.No	Module	Planned
1	1	Introduction to Design and Engineering Design.
2	1	Defining a Design Process-: Detailing Customer Requirements
3	1	Defining a Design Process-: Setting Design Objectives, Identifying Constraints, Establishing Functions.
4	1	Defining a Design Process-: Generating Design Alternatives and Choosing a Design.
5	1	Case Studies:- Stages of Design Process.
6	2	Introduction to Design Thinking
7	2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test.
8	2	Design Thinking as Divergent-Convergent Questioning
9	2	Design Thinking in a Team Environment
10	2	Case Studies: Design Thinking Approach.
11	3	Communicating Designs Graphically.
12	3	Communicating Designs Orally and in Writing.
13	*3*	*Communicating Designs Orally and in Writing.*

ASSIGNMENT QUESTIONS

Assignment 1

Show the designing of a TV remote control going through the various stages of the design process. Use hand sketches to illustrate the processes.

Assignment 2

Describe the difference between a prototype, a model, and a proof of concept. Suppose you are designing a portable electric guitar, at which stages in the design would you want to use a proof of concept, a model, and a prototype?

Assignment 3

Write a value addition to the following:-

Laser printer

A Ladder

A Jacket for winter

100908/ES400F:
CONSTITUTION OF INDIA

COURSE INFORMATION SHEET

PROGRAMME: Applied Electronics and Instrumentation	*DEGREE: B.TECH*
COURSE: Constitution of India	**SEMESTER: 4** **CREDITS:** 3
COURSE CODE: 100908/ES400F *REGULATION: 2020*	**COURSE TYPE:** CORE
COURSE AREA/DOMAIN: HUMANITICS	**CONTACT HOURS:** 2-0-0
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME:** NA

SYLLABUS:

UNIT	*DETAILS*
I	• Historical Background, Salient features of the Constitution. • Preamble of the Constitution • Union and its Territory. • Meaning of citizenship, Types, Termination of Citizenship
II	• Definition of State • Fundamental Rights, General Nature, Classification, Right to Equality, Right to Freedom, Right Against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies. Protection in Respect of Conviction for Offences. • Directive Principles of State Policy, Classification of Directives • Fundamental Duties.
III	• The Union Executive, The President, The Vice President, The Council of Ministers, The Prime Minister, Attorney-General, Functions. • The Parliament, Composition, Rajya Sabha, Lok Sabha, Qualification and Disqualification of Membership, Functions Of Parliament. • Union Judiciary, The Supreme Court, Jurisdiction, Appeal by Special Leave.
IV	• The State Executive, The Governor, The Council of Ministers, The Chief Minister, Advocate General • Union Territories. • The State Legislature, Composition, Qualification and Disqualification of

	Membership, Functions. • The State Judiciary, The High Court, Jurisdiction, Writs Jurisdiction.
V	• Relations between the Union and the States, Legislative Relation, Administrative Relation, Financial Relations, Inter State council, Finance Commission. • Emergency Provision, Freedom of Trade Commerce and Inter course, Comptroller and Auditor General of India, Public Services, Public Service Commission, Administrative Tribunals.

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
R1	Ministry of law and justice, The constitution of India, Govt. of India, New Delhi
R2	J N Pandey, The constitutional law of India, Central Law agency, Allahabad
R3	M V Pylee, India's Constitution, S Chand and company, New Delhi

COURSE OBJECTIVES:

1	***To familiarize the prospective engineers with elementary Principles of Economics and Business Economics.***
2	To acquaint the students with tools and techniques that are useful in their profession in Business Decision Making which will enhance their employability;
3	To apply business analysis to the "firm" under different market conditions;
4	To apply economic models to examine current economic scenario and evaluate policy options for addressing economic issues
5	To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
6	To prepare and analyse various business tools like balance sheet, cost benefit analysis and rate of returns at an elementary level

COURSE OUTCOMES:

SLNO	*DESCRIPTION*
1	Explain the background of the present constitution of India and features
2	Utilize the fundamental rights and duties
3	Understand the working of the union executive, parliament and judiciary
4	Understand the working of the state executive, legislature and judiciary Utilize the special provisions and statutory institutions

5	Show national and patriotic spirit as responsible citizens of the country

MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME CO-PO MAPPING

CO / PO	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1						**2**	**2**	**2**		**2**		
CO2						**3**	**3**	**3**		**2**		
CO3						**3**	**2**	**3**		**2**		
CO4						**3**	**2**	**3**		**2**		
CO5						**3**	**2**	**3**		**2**		
CO 6						**3**	**3**	**3**		**3**		

Attainment Pattern

Learning Objectives	*Continuous Internal Evaluation (CIE)*		
	Internal Examination I (50)	**Internal Examination II (50)**	**End Semester Examination (ESE) (100)**
Remember	**20**	**20**	**40**
Understand	**20**	**20**	**40**
Apply	**10**	**10**	**20**

LIVERY/INSTRUCTIONAL METHODOLOGIES:

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

ASSESSMENT METHODOLOGIES-DIRECT

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

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. LekshmiVijayakumar

(Faculty DBSH)

Approved by
(Head of the Department)

GENERAL COURSE PLAN FOR SEMESTER IV *SUBJECT: CONSTITUTION OF INDIA*		
DAYS	**MODULE**	**GENERAL COURSE PLAN**
DAY 1	I	Definition of constitution, salient features of the constitution.
DAY 2	I	Historical back ground
DAY 3	I	Preamble of the constitution, union and its territory.
DAY 4	I	Meaning of citizenship, types, termination of citizenship.
DAY 5	II	Definition of state, fundamental rights, general nature, classification.
DAY 6	II	Right to equality, right to freedom , right against exploitation
DAY 7	II	Right to freedom of religion, cultural and educational rights, right to constitutional remedies
DAY 8	II	Protection in respect of conviction for offences.
DAY 9	II	Directive principles of state policy, classification of directives, Fundamental duties
DAY 10	III	The Union executive, the President, the vice President, the council of ministers
DAY 11	III	The Prime minister, Attorney-General, functions.
DAY 12	III	The parliament, composition, Rajyasabha, Loksabha
DAY 13	III	Qualification and disqualification of membership, functions of parliament.
DAY 14	III	Union judiciary, the supreme court, jurisdiction, appeal by special leave
DAY 15	IV	The State executive, the Governor, the council of ministers
DAY 16	IV	The Chief minister, advocate general, union Territories
DAY 17	IV	The State Legislature, composition, qualification and disqualification of membership, functions.
DAY 18	IV	The state judiciary, the high court, jurisdiction, writs jurisdiction.
DAY 19	V	Relations between the Union and the States
DAY 20	V	Union and States - legislative relation, administrative relation
DAY 21	V	Union and States -, financial Relations, Inter State council, finance commission.
DAY 22	V	Emergency provision, freedom of trade commerce and inter course
DAY 23	V	Auditor general of India, public Services, public service commission, administrative Tribunals.
DAY 24	V	Official language
DAY 25	V	Elections
DAY 26	V	Special provisions relating to certain classes
DAY 27	V	Amendment of the Constitution
DAY 28	V	Amendment of the Constitution

ASSIGNMENT I

1. Federal Constitutions as a rule are rigid as most of them have extremely difficult and even complicated procedures of amendment. It should be understood that a constitution being a dynamic document should grow with a growing nation and should suit the changing needs and circumstances of a growing and changing people. Amending a federal constitution of many countries is the most difficult process in contrast, the Constitution of India presents a must simpler picture.

- Prepare a write upon on Constitutional amendments made in India.
- MODE: Online, Upload Scanned copy of the assignment (Use A4 Sheet)
- Rubric: 10 Marks

Content Clarity	Presentation Style	Depth of the Topic Covered	Timely Submission
4	2	3	1

ASSIGNMENT II

- What were the situations to declare National Emergencies in India? Elucidate with case study.
- National Emergency (1975-77) was regarded as the darkest hours of Indian Democracy. Why?
- MODE: Online - Upload Scanned copy of the assignment (Use A4 Sheet)
- Rubric: 5 Marks.

Content Clarity	Presentation Style	Interpretation by the student	Timely submission
2	0.5	1.5	1

100902/EC422S: ANALOG CIRCUITS AND SIMULATION LAB

COURSE INFORMATION SHEET

PROGRAMME: APPLIED ELECTRONICS & INSTRUMENTATION	***DEGREE: BTECH UNIVERSITY: APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY***
COURSE: Analog Circuits and Simulation Lab	**SEMESTER:** 4 **CREDITS:** 2
COURSE CODE: 100902/EC422S REGULATION: 2019	**COURSE TYPE:** CORE
COURSE AREA/DOMAIN: ELECTRONICS CIRCUITS	**CONTACT HOURS:** 3 Practical Hours/Week.
CORRESPONDING THEORY COURSE CODE (IF ANY): 100902/EC400B:	**THEORY COURSE NAME: ANALOG CIRCUITS**

SYLLABUS:

UNIT	***DETAILS***	***HOURS***
	PART A	
1	RC integrating and differentiating circuits (Transient analysis with different inputs and frequency response)	3
2	Clipping and clamping circuits (Transients and transfer characteristics)	3
3	RC Coupled CE amplifier - frequency response characteristics.	3
4	MOSFET amplifier (CS) - frequency response characteristics.	3
5	Cascade amplifier – gain and frequency response	3
6	Cascode amplifier – frequency response	3
7	Feedback amplifiers (current series, voltage series) - gain and frequency response	3
8	Low frequency oscillators – RC phase shift, Wien bridge	3
9	Power amplifiers (transformer less), Class B and Class AB.	
10	Transistor series voltage regulator (load and line regulation)	3
	PART B	
1	RC integrating and differentiating circuits (Transient analysis with different inputs and frequency response)	3
2	Clipping and clamping circuits (Transients and transfer characteristics)	3
3	RC Coupled CE amplifier - frequency response characteristics.	3
4	MOSFET amplifier (CS) - frequency response characteristics.	3
5	Cascade amplifier – gain and frequency response	3
6	Cascode amplifier – frequency response	3
7	Feedback amplifiers (current series, voltage series) - gain and frequency response	3
8	Low frequency oscillators – RC phase shift, Wien bridge	3
9	Power amplifiers (transformer less), Class B and Class AB.	9

10	Transistor series voltage regulator (load and line regulation)	10

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
R	Microelectronic Circuits / Sedra and Smith /OUP
R	Pulse, Digital and Switching Waveforms / Millman and Taub / McGraw Hill
R	Electronic Circuits – Analysis and Design / Neamen D. / TMH
R	Microelectronic Circuits – Analysis and Design / Rashid M. H. / Cengage Learning
R	Introduction to Electronic Circuit Design / Spencer R.R. and M. S. Ghausi / Pearson
R	Fundamentals of Microelectronics / Razavi B. / Wiley
R	Electronics Lab Manual Vol. 1 / K. A. Navas /

COURSE PRE-REQUISITES:

C.CODE	*COURSE NAME*	*DESCRIPTION*	*SEM*
EST 130	Basics of Electrical and Electronics Engineering	Students should know about basic electronics components like BJT, diode, Resistor etc&its working	EST 130
ESL 130	Electrical and Electronics Workshop	Students should familiar with breadboard and electronic components	ESL 130

COURSE OBJECTIVES:

1	***To familiarize students with the Analog Circuits Design through the mplementation of basic Analog Circuits using discrete components.***
2	To familiarize students with simulation of basic Analog Circuits.

COURSE OUTCOMES:

SNO	*DESCRIPTION*	*Bloom Taxonomy Level*
C0.1	Students will be able to ***design*** and ***demonstrate*** the functioning of basic analog circuits using discrete components.	Understand and analyze (level 2 ,4)
C0.2	Students will be able to ***design*** and ***simulate*** the functioning of basic analog circuits using simulation tools.	Understand and apply (level 2 ,3)
C0.3	Students will be able to function effectively as an individual and in a team to accomplish the given task.	Understand (level 2)

CO – PO 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	3	-	-	-	-	-	2	-	-	2	2	-	-
CO2	3	3	3	-	3	-	-	-	2	-	-	2	2	3	-
CO3	3	3	3	-		-	-	-	3	-	-	3	-	-	3

CO-PO mapping justification

MAPPING	*LOW/ MEDIUM /HIGH*	*JUSTIFICATION*
CO1-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of basic analog circuits using discrete components.
CO1-PO2	H	Problem analysis of basic analog circuits
CO1-PO3	H	Design of basic analog circuits using discrete components.
CO1-PO9	M	Function effectively as an individual and in a team to accomplish the given task.
CO1-PO12	M	The students will be able to design advanced analog circuits in the broadest context of technological change
CO2-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of basic analog circuits using simulation tools.
CO2-PO2	H	Basic analog circuit design and simulation using simulation tools helps in analyzing circuits for complex Engineering problems
CO2-PO3	H	Basic analog circuit design and simulation using simulation tools helps in designing solutions for complex Engineering problems
CO2-PO5	H	The usage of simulation tools for basic analog circuit design and simulation helps in using latest advanced tools for complex Engineering activities
CO2-PO9	M	Conduct of experiments using simulation tools in teams helps to function effectively as an individual and as a member or leader in diverse teams
CO2-PO12	M	The students will be able to understand and use the latest tools developed in the broadest context of technological change
CO3-PO1	H	Basic knowledge and understanding of the analog circuit design and simulation helps in functioning effectively as an individual and a team member.
CO3-PO2	H	Contributions as an individual and a team member helps in the analyzes of complex Engineering problems
CO3-PO3	H	Contributions as an individual and a team member helps in

		designing solutions for complex Engineering problems
CO3-PO9	H	Conduct of experiments in teams helps to function effectively as an individual and as a member or leader in diverse teams
CO3-PO12	H	Individual and team member skills helps in the life long learning of project management.
CO1-PSO1	M	Demonstrate their skills in designing,implementing and testing analogue electronic circuits
CO2-PSO1	M	Demonstrate their skills in designing,implementing and testing analogue electronic circuits using simulation tools
CO2-PSO2	H	Students could simulate,design and implement analog circuits in this laboratory and helps to understand the usage of EDA tools

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

SNO	*DESCRIPTION*	*PROPOSED ACTIONS*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
1	Rectifiers with L, LC, π filters – waveforms, ripple factors.	Included as an additional experiment	PO1,PO2,PO3	PSO1

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

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

WEB SOURCE REFERENCES:

1	***www.nptel.iit.a.c.in***
2	https://kicad.org/
3	http://qucs.github.io/
4	https://www.ti.com/tool/TINA-TI

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

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

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**

Dr. Poornima S.

Ms. Liza Annie Joseph

(Course in charge) **(HOD)**

COURSE PLAN

Sl.No.	Planned
1	RC integrating and differentiating circuits (Transient analysis with different inputs and frequency response)- Simulation
2	Clipping and clamping circuits (Transients and transfer characteristics) - Simulation
3	RC Coupled CE amplifier - frequency response characteristics. - Simulation
4	MOSFET amplifier (CS) - frequency response characteristics.- Simulation
5	Cascade amplifier – gain and frequency response- Simulation
6	Cascode amplifier – frequency response- Simulation
7	Feedback amplifiers (current series, voltage series) - gain and frequency response- Simulation
8	Low frequency oscillators – RC phase shift, Wien bridge- Simulation
9	Power amplifiers (transformer less), Class B and Class AB.- Simulation
10	Transistor series voltage regulator (load and line regulation)- Simulation
11	RC integrating and differentiating circuits (Transient analysis with different inputs and frequency response) - using discrete components
12	Clipping and clamping circuits (Transients and transfer characteristics)
13	RC Coupled CE amplifier - frequency response characteristics.- using discrete components
14	MOSFET amplifier (CS) - frequency response characteristics.- using discrete components
15	Cascade amplifier – gain and frequency response- using discrete components
16	Cascode amplifier – frequency response- using discrete components
17	Feedback amplifiers (current series, voltage series) - gain and frequency response- using discrete components
18	Low frequency oscillators – RC phase shift, Wien bridge- using discrete components
19	Power amplifiers (transformer less), Class B and Class AB.- using discrete components
20	Transistor series voltage regulator (load and line regulation)- using discrete components

Experiment Questions(PART A & PART B)

1. To design and set up various clipping and clamping circuits using diodes and to plot their output waveforms & transfer characteristics.
   Design the following clipping and clamping circuits and plot the necessary waveforms, given a 10Vpp, 1kHz sine wave input.
   CLIPPING CIRCUITS:
   i) positive shunt clipper
   ii) negative shunt clipper
   iii) positive shunt clipper with positive bias of 2V
   iv) negative shunt clipper with negative bias of 2V
   v) slicer (positive clipper at 4V and negative clipper at -3V)
   vi) positive series clipper
   vii) negative series clipper
   viii) positive series clipper with positive bias of 2V
   ix) negative series clipper with negative bias of 2V
   CLAMPING CRCUITS:
   x) unbiased positive clamper
   xi) unbiased negative clamper
   xii) positive clamper with a bias of 5V
   xiii) negative clamper with a bias of -5V

2. a) Plot the frequency response of RC Low pass and high pass circuits (given cut off frequency =1KHz).
   b) Plot the output waveform of RC Low pass circuit with a 10Vpp square wave input and determine rise time for different time constants.
   i) R C >>T ii) RC = T iii) RC<<T
   c) Plot the output waveform of RC High pass circuit with a 10Vpp square wave input and determine the percentage tilt for different time constants. i) RC>>T ii) RC = T iii) RC<<T.
   d) Plot the output waveforms of RC Differentiator and Integrator for sinusoidal, square wave and pulse inputs.
3. To design and set up an RC Coupled amplifier using BJT for a gain of 100 and find its 3dB bandwidth from the frequency response characteristics curve. (Given Vcc = 12V &Ic =1mA &β=100)
4. To design and set up:
   a. Zener regulator with and without emitter follower.
   b. To plot load regulation and line regulation graphs.

100002/AE422T: TRANSDUCERS AND MEASUREMENTS LAB

COURSE INFORMATION SHEET

PROGRAMME: **APPLIED ELECTRONICS & INSTRUMENTATION**	DEGREE: B.TECH
COURSE: TRANSDUCERS AND MEASUREMENTS LAB	SEMESTER: 4 CREDITS: 2
COURSE CODE: 100002/AE422T	COURSE TYPE: CORE
REGULATION: 2019	
COURSE AREA/DOMAIN: INSTRUMENTATION	CONTACT HOURS: 0+0+3 (LAB) hours/ Week.
CORRESPONDING THEORY COURSE CODE (IF ANY):	THEORY COURSE NAME: AE 204 SENSORS AND TRANSDUCERS

SYLLABUS:

Sl. NO:	DETAILS	HOURS
	Part A (At least 8 experiments are mandatory)	
1	1. Determination of characteristics optical transducers using LDR 2. Determination of characteristics of LVDT 3. Measurement of strain and load using strain gauge 4. Level measurement using capacitive/resistive transducer 5. Determination of characteristics of RTD 6. Determination of characteristics of thermocouple 7. Determination of characteristics of thermistor 8. Determination of pressure using strain gauge/piezoelectric pickup 9. Determination of sound pressure level using sound level meter 10. Calibration of pressure gauge using dead weight tester 11. Measurement of speed using photoelectric pickup 12. Measurement of speed using stroboscope 13. Determination of characteristics of hall effect transducer 14. Measurement of displacement using inductive transducer 15. Determination of characteristics of capacitive displacement transducer 16. Pressure measurement using U-tube manometer 17. Study of loading effect in potentiometer 18. Measurement of frequency and phase using Lissajous figures	8*3
	Part B (At least 4 experiments are mandatory)	
2	19. Measurement of temperature 20. Measurement of level in water tank 21. Measurement of pressure 22. Wind velocity measurement 23. Measurement of humidity 24. Simulation of Wheatstone bridge using LabVIEW	4*3

	25. Simulation of Anderson's bridge using LabVIEW 26. Simulation of Maxwell's inductance bridge and Maxwell's inductance capacitance bridge using LabVIEW	
	TOTAL HOURS	54

TEXT/REFERENCE BOOKS:

1	John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education.
2	S.M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore, 1994.
3 4	S. Renganathan "Transducer Engineering", Allied publishers Limited, Chennai, 2003 Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995.
5	Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003. Neubert H.K.P, "Instrument Transducers - An Introduction to their Performance and Design", 2nd Edition, Oxford University Press, Cambridge, 1999.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	NIL		

COURSE OBJECTIVES:

1	***Familiarize the students with various types of sensors and transducers***
2	Enable students to select and design suitable instruments to meet requirements of various industrial applications

COURSE OUTCOMES:

Sl. No.	*DESCRIPTION*	*Blooms' Taxonomy Level*
1	Graduates will be able **make use of basic transducers for the**	**Apply**(level 3)

	measurement of physical variables like pressure, temperature etc.	
2	Graduates will be able to **analyze with various measuring instruments and bridges**	**Analyze** (level 4)
3	Graduates will be able to **create sensor based measurement systems using modern tools**	**Create** (level 6)

CO-PO AND CO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO.1	2	-	2	1	-	-	-	-	2	1	-	1	-	-	1
CO.2	2	-	2	1	-	-	-	-	2	1	-	2	2	2	-
CO.3	2	-	2	1	2	2	-	-	2	1	2	3	-	2	2

JUSTIFICATIONS FOR CO-PO-PSO MAPPING:

MAPPING	*LOW/MEDIUM /HIGH*	*JUSTIFICATION*
CO.1- PO1	M	The concept of multidisciplinary approach is understood.
CO.1- PO3	M	Concepts are defined and learned.
CO.1- PO4	L	Can extend the basic concepts learnt to build better systems
CO.1-PO9	M	Various fundamental key elements are described.
CO.1-PO10	L	Understands the work of different elements in combination
CO.1-PO12	L	Instrument developing methods are focused
CO.1-PSO3	L	A new concept that suits the changing industrial scenario is being implemented.
CO.2- PO1	M	Different concepts are being analyzed to produce engineering solutions.
CO.2 –PO3	M	Studying/practicing the concepts helps to develop solutions for different systems.
CO.2 –PO4	L	Analyzing skill is improved.
CO.2 –PO9	M	Can engage in lifelong learning with ability to communicate effectively in a team.
CO.2 –PO10	L	Measurement and documentation practices will be helpful in real time activities.
CO.2 –PO12	M	Different systems are analyzed.
CO.2–PSO1	M	Understanding different types of transducer, solutions for its development are identified
CO.2 –PSO2	M	Circuit analysis to find suitable solutions for its design can be effected.

CO.3 –PO1	M	Knowledge of engineering fundamentals in design aspect is well understood.
CO.3 –PO3	M	Knowledge of traditional approach helps to solve complex engineering problems.
CO.3 –PO4	L	Complex engineering solutions can be designed.
CO.3 –PO5	M	Interpretations of the systems can be done with the acquired knowledge.
CO.3 –PO6	M	Sensor based modern tools can be developed for the betterment of the society
CO.3 –PO9	M	Team work in different activities will enable greater effectiveness in bigger projects
CO.3 –PO10	L	Team work also supports effective reports and design documentation
CO.3 –PO11	M	Sensor based systems supports multidisciplinary activities
CO.3 –PO12	H	Basic knowledge in the systems strengthens lifelong learning
CO.3 –PSO2	M	The student can be effective in contributing to development of standard systems
CO.3 –PSO3	M	The student can confidently contribute to changing industrial conditions

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

Sl. No.	*Description*	*Proposed Actions*	*Relevance with POs*	*Relevance with PSOs*
1	Capacitive Microphone:	Web reference [3]	1,2,3,4	3

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	Level measurement using capacitive/resistive transducer	Extra Lab Classes	1,2,3,4	3
2	Measurement of speed			

	using photoelectric pickup			

WEB SOURCE REFERENCES:

1	***http://nptel.iitm.ac.in***
2	http://nptel.ac.in/courses/112103174/3
3	http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/intro.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
Mary Hexy.

(Course in charge)

Approved by

(HOD

Lab Cycle

Cycle 1

1. CHARACTERISTICS OF LVDT
2. MEASUREMENT OF STRAIN AND LOAD USING STRAIN GAUGE
3. CHARACTERISTICS OF CAPACITIVE DISPLACEMENT TRANSDUCER
4. CHARACTERISTICS OF THERMOCOUPLE
5. CHARACTERISTICS OF RTD
6. PRESSURE MEASUREMENT USING U- TUBE MANOMETER
7. CALIBRATION OF PRESSURE GAUGE USING DEAD WEIGHT TESTER
8. CHARACTERISTICS OPTICAL TRANSDUCERS USING LDR

Cycle 2

1. MEASUREMENT OF TEMPERATURE USING LabVIEW-ARDUINO INTERFACE
2. MEASUREMENT OF LEVEL USING LabVIEW- ARDUINO INTERFACE
3. SIMULATION OF WHEATSTONE BRIDGE USING LabVIEW
4. SIMULATION OF ANDERSON'S BRIDGE USING LabVIEW

Open/Viva Questions

1. What is a transducer?
2. What is the principle of operation of LVDT?
3. Why LVDT is called Linear Variable Differential Transformer?
4. What are the physical variables that can be measured by LVDT?
5. What is the significance of residual voltage in an LVDT?
6. What is sensitivity of a transducer?

7. What are active and passive transducers? Give examples
8. What is a strain gauge?
9. What is the principle of operation of a strain gauge?
10. Mention the different types of strain gauges available for various applications.
11. What are the physical variables that can be measured with a strain gauge?
12. What is the output of a strain gauge?
13. What is the unit of strain?

14. What is a capacitive transducer?
15. How is the capacitance of a capacitive transducer expressed?
16. What are the variables measured with capacitive transducers?
17. What is a variable capacitor?
18. Mention a few applications of variable capacitors
19. What is a temperature sensor? Give examples

20. What is a thermocouple?
21. What is the principle of operation of a thermocouple?
22. What is a 'Cold' junction in a thermocouple?
23. What are the standards of representing a thermocouple?
24. What are the types of thermocouple?
25. Give examples of alloy combination for the thermocouple construction.

26. What is a Resistance Temperature detector?
27. What is the basic material used in the construction of RTD?
28. What is the function of a RTD?
29. What is the difference between a thermistor and RTD?
30. What are the differences between 2, 3, or 4 wire configurations?
31. What does Pt 500 represent?

32. What is a manometer?
33. What is it used for?
34. Define the terms atmospheric pressure, absolute pressure, differential pressure, gauge pressure.
35. Mention the units of pressure.
36. What are the other devices with which pressure can be measured?

37. What is calibration?
38. What is the need for calibrating an equipment?
39. What is a dead weight tester?
40. What are the parameters that can be measured with a dead weight tester?
41. What is 'dead weight' in a dead weight tester?
42. What are the applications of a dead weight tester?

43. What is a Light Dependent Resistor?
44. How does it operate?
45. What are the materials commonly used in LDRs?
46. What is dark resistance of the LDR?
47. What are the applications of LDR?

100002-AE401H: INSTRUMENTATION SYSTEM DESIGN

COURSE INFORMATION SHEET

PROGRAMME: APPLIED ELECTRONICS AND INSTRUMENTATION	*DEGREE: B.TECH UNIVERSITY: APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY*
COURSE: INSTRUMENTATION SYSTEM DESIGN	SEMESTER: **S4** CREDITS: **4**
COURSE CODE: AET 292 REGULATION: 2019	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: INSTRUMENTATION SYSTEM DESIGN	CONTACT HOURS: **4 hours/week**
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

No.	*Topic*	*No. of Lectures*
1	Concepts of instrument design	9
1.1	functional requirements and specifications	3
1.2	Standards –military, industrial, and commercial standards	3
1.3	BIS standards, ANSI standards, NEMA standards, DIN standards. Instruments symbols and signals	3
2	Performance characteristics and selection criteria	9
2.1	Performance characteristics and selection criteria for flow, pressure and level transducers	3
2.2	Smart transmitters	3
2.3	display devices and plotting devices	3
3	Calibration and testing standards	9
3.1	Calibration and testing standards for instruments transducers and display devices	3
3.2	Measurement and performance tests	4
3.3	Design of instrumentation amplifier, isolation amplifier, active	2
4	Control panel design	9
4.1	Operating console and control room panel design	2
4.2	Control of room environment for electronic equipment 1	1
4.3	Heat dissipation, forced air circulation and humidity considerations. Grounding and shielding. Protection against electrostatic discharge. Electromagnetic interference and compatibility	3
4.4	Design guidelines for PCB s: layout schemes, PCB sizes design rules	3

	digital, analog, single and multilayer PCB s. automated PCB design, CAD packages and tools.	
5	Principles and design of controllers	9
5.1	Proportional controllers, Proportional Integral, controllers and their characteristics	2
5.2	Proportional Integral Derivative controllers and their characteristics 1APPLIED ELECTRONICS & INSTRUMENTATION	1
5.3	Microprocessor based control.	1
5.4	Control valves –applications, design and control	1
5.5	principles of MTTR, MTBF	1
5.6	Failure rate analysis, Product quality variance report 1	1
5.7	Control charts, SQC, TQM Principles.	1
5.8	Quality standards procedure, Certification, Quality audit	1

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
T1	Bela G Lipton Process Control, instrument engineers handbook 3 rd Edition Elsevier 1995
T2	D.Patranabis , Sensors and Transducers, PHI 2nd edition 2003
T3	Golding E W and Widdis F C Electrical Measurements and Measuring systems, Wheeler &co 1993
T4	R. S Handpick, Printed Circuit Boards, McGraw Hill Professional, 2005
T5	E. Balaguruswamy , Reliability engineering , Mc Graw Hill-2017
T6	Dale Besterfield et al, Total Quality Management, Pearson 5e 2017
R1	Warenboxleitner ,Electrostatic Discharge and Electronic Equipment , IEEE Press 1999
R2	Kim R Fowler , Electronic Instrument Design , Oxford reprint 2015
R3	Kalsi HS, Electronic Instrumentation and Measurements, Mc Graw hill, 4 ed 2019.
R4	A K Swahny, A Course in Electronic Measurements and Instrumentation , 2015, Dhanpath Rai & Co

COURSE PRE-REQUISITES:

C.CODE	*COURSE NAME*	*DESCRIPTION*	*SEM*
-	NIL		

COURSE OBJECTIVES:

1	***This courseaims to lay the foundational aspects of signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing, image processing, communication theory and control systems.***

COURSE OUTCOMES:

SL. NO.	*DESCRIPTION*	*Blooms' Taxonomy*

		Level
C0.1	Graduate will able to identify different standards employed in the manufacture of devices and instruments.	Understand and Apply (level2, 3)
C0.2	Graduate can utilize the selection criteria employed in the selection of transducers and instruments in instrumentation.	Understand and Apply (level2, 3)
C0.3	Graduate can summarize the calibration employed for transducers and instruments.	Understand and Apply (level2, 3)
C0.4	Graduate can apply the principles governing installation of control panels and their operation	Understand and Apply (level2, 3)
C0.5	Graduate will explain the concept of various control scheme used in feedback systems and the principles of reliability, failure analysis and quality control	Understand and Apply (level2, 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	3	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-

JUSTIFATIONS FOR CO-PO MAPPING

MAPPING	***LOW/MEDIUM/ HIGH***	***JUSTIFICATION***
CO1-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts instrumentation system.
CO1– PSO1	H	Different standards are used for the design and implement various electronics and instrumentation systems.
CO2-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals for the selection of transducers and instruments in instrumentation
CO2-PO2	H	Analyze the instrumentation system using the principles of mathematics.
CO2-PO3	H	Analyzing signals with the help of series and transforms helps

		in design solutions for complex engineering problems
CO2– PSO3	M	New concepts are studied.
CO3-PO1	H	Apply the knowledge of mathematics, science and engineering fundamentals to describe orthogonality of signals and convolution integral.
CO3-PO2	H	Concept of orthogonality and convolution integral requires the first principles of mathematics.
CO3-PO3	H	Analyzingorthogonality of signals & convolution integral helps in design solutions for complex engineering problems.
CO3– PSO2	M	Knowledge about the orthogonality of signals and convolution integral helps in the development of instrumentation systems.
CO4-PO1	H	Apply the knowledge of mathematics and engineering fundamentals to compute the LTI response of a system to input signals
CO4-PO2	H	Analysis and characterization of LTI systems using Laplace and Z-Transform
CO5-PO1	H	Apply the knowledge of mathematics and engineering fundamentals to understand the importance of sampling theorem to discretize continuous time signals.
CO5-PO2	H	Understand the Nyquist criteria and evaluate different sampling criteria using the first principles of mathematics and engineering sciences.
CO5-PO3	H	The analysis of sampling theorem provides design solutions for different signal processing algorithms.
CO5– PSO2	H	Apply sampling theorem to discretize continuous time signals for developing instrumentation systems.

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

SL NO	*DESCRIPTION*	*PROPOSED ACTIONS*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
	Nil			

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	*DESCRIPTION*	*PROPOSED ACTIONS*	*RELEVANCE WITH POs*	*RELEVANCE WITH PSOs*
	NIL			

WEB SOURCE REFERENCES:

1	
2	*www.nptel.iitm.ac.in/courses/117104074/*

3	www.ece.gatech.edu/users/bonnie/book/worked_problems.html
4	*www.ece.jhu.edu/~cooper/courses/214/**signalsandsystems**notes.pdf*
5	*link.springer.com/journal/498*

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. Mary Hexy

(Faculty in Charge)

Approved by

Dr. Hari C.V.
(HOD, DAEI)

Course Plan

Sl.No	Module	Planned
1	1	Concepts of instrument design
2	1	Concepts of instrument design
3	1	Concepts of instrument design
4	1	Functional requirements and specifications
5	1	Functional requirements and specifications
6	1	Standards –military, industrial, and commercial standards
7	1	Standards –military, industrial, and commercial standards
8	1	BIS standards, ANSI standards, NEMA standards, DIN standards. Instruments symbols and signals
9	1	BIS standards, ANSI standards, NEMA standards, DIN standards. Instruments symbols and signals
10	1	BIS standards, ANSI standards, NEMA standards, DIN standards. Instruments symbols and signals
11	1	BIS standards, ANSI standards, NEMA standards, DIN standards. Instruments symbols and signals
12	2	Performance characteristics and selection criteria: Performance characteristics and selection criteria for flow,
13	2	Pressure and level transducers.
14	2	Smart transmitters
15	2	Range specifications and standards
16	2	Interfacing of sensors and end devices.
17	2	Display devices and plotting devices.
18	3	Calibration and testing standards: Calibration and testing standards for instruments transducers and display devices.
19	3	Measurement and performance tests – impedance, resolution, noise, threshold and life tests.
20	3	Measurements of voltage current, phase and frequency.
21	3	Design of instrumentation amplifier
22	3	Isolation amplifier
23	3	Active filter
24	3	Guidelines for the design of electronic circuits.
25	4	Control panel design: Operating console and control room panel design
26	4	Control of room environment for electronic equipment
27	4	Heat dissipation forced air circulation and humidity considerations
28	4	Grounding and shielding
29	4	Protection against electrostatic discharge
30	4	Electromagnetic interference and compatibility
31	4	Design guidelines for PCB s: layout schemes,
32	4	PCB sizes design rules digital, analog, single and multilayer PCB s. Automated PCB design, CAD packages and tools.
33	4	PCB sizes design rules digital, analog, single and multilayer PCB s. Automated PCB design, CAD packages and tools.
34	5	Principles and design of controllers : Proportional
35	5	Principles and design of controllers : Proportional

36	5	Proportional Integral , Proportional Integral
37	5	Proportional Integral , Proportional Integral
38	5	Derivative controllers and their characteristics.
39	5	Relative merits and demerits. Microprocessor based
40	5	control. Control valves –applications , design and control .
41	5	Reliability: principles
42	5	MTTR, MTBF
43	5	Failure rate analysis
44	5	Product quality variance report.
45	5	Control charts, SQC,
46	5	TQM Principles.
47	5	ISO series,
48	5	Quality standards procedure,
49	5	certification, Quality audit.

Assignment

Design guidelines for PCB s: layout schemes, PCB sizes design rules

Digital, analog, single and multilayer PCB s. automated PCB design, CAD packages and tools.