P.E.S's Modern College of Engineering

Dept. of Electronics & Computer Engineering

Curriculum Booklet SE SEM-II 2019-Pattern

Vision of Institute

"To create a collaborative academic environment to foster professional excellence and ethical values"

Mission of the Institute

1. To develop outstanding engineers & professionals with high ethical standards capable of creatingand managing global enterprises.
2. To foster innovation and research by providing a stimulating learning environment.
3. To ensure equitable development of students of all ability levels and backgrounds.
4. To be responsive to changes in technology, socio-economic levels and environmental conditions.
5. To foster and maintain mutually beneficial partnerships with alumni and industry.

Vision of Department

"To strive for progressive excellence in electronics and computing field."

Mission of Department

1)To impart value based education to transform students into globally competent professionals.

2)To inculcate ethical values to produce promising professionals.

3)To practice research and innovation for sustainable techno-social development.

Program Educational Objectives (PEOs)

The Graduate of Electronics and Computer Engineering will:

PEO 1: Adapt ethics in practice and lifelong learning ability through various skills.

PEO 2: Become an entrepreneur, contribute in research field to meet global competencies.

PEO 3: Be sensitive to societal and environmental issues in professional carrier.

Program Specific Outcome (PSOs)

1. **PSO1**: Graduate will able to design, implement and test various electronic systems.
2.
3. **PSO2**: Graduate will able to design, realize and validate algorithms for real time problems
4.
5. **PSO3**: Graduate will able to pursue career in industries and strive for higher studies through
6. self-learning ability

Program Outcomes(POs)

1. Engineering knowledge:

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

2. Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

3. Design/development of solutions:

Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems:

Use research based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society:

Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant and cultural issues and the consequent responsibilities relevant to professional engineering practice.

7. Environment and Sustainability:

Understand the impact of professional engineering solutions in societal and professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

9. Individual and Team Work:

Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

10. Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation make effective presentations and give and receive clear instructions.

11. Project Management and Finance:

Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long Learning:

Recognize the need for and have the preparation and ability to engage in independent and preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Structure

Savitribai Phule Pune University, Pune
S.E. (Electronics & Computer Engineering) 2020 Course
(With effect from Academic Year 2021-22)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
	Signals & Systems	03	-	01	30	70	25	-	-	125	03	--	01	04
	Principles of Programming Language	03	-		30	70		-	-	100	03	-	-	03
	Principles of Communication System	03	-	-	30	70	-	-	-	100	03	-	-	03
	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
	System Programming & Operating Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
	Signals & System Lab	-	02	-	-	-	25	-	-	50	-	01	-	01
	Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
	Object Oriented Programming Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
	Employability Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
	Project Based Learning ¶	-	04	-	-	-	50	-	-	50	-	02	-	02
	Mandatory Audit Course 4[&]	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	15	14	01	150	350	125	50	25	700	-	-	-	-
										Total Credit	**15**	**06**	**01**	**22**

Abbreviations:

In-Sem: In semester | End-sem: End semester | TH : Theory | TW : Term Work

PR : Practical | OR : Oral | TUT : Tutorial

Note: Interested students of S.E. (Electronics/E&TC) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

1. Name of the Course - Signals &Systems

Weekly Work Load (in Hrs/week)	**Lecture**	**Tutorial**	**Practical**
	3	**1**	**1**

Online/ In-sem	**Theory**	**Practical**	**Oral**	**Term-work**	**Total Marks**	**Credit**
30	**70**	**25**	**-**	**25**	**150**	**5**

Syllabus

Unit I : Introduction to Signals and Systems **(7L)**

Signals: Introduction, Graphical, Functional, Tabular and Sequence representation of Continuous and Discrete time signals. Basics of Elementary signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal, Real exponential, Complex exponential, Rectangular pulse, Triangular, Signum, Sinc and Gaussian function.

Operations on signals: time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, signal multiplication. Communication, control system and Signal processing examples. **Classification of signals:** Deterministic, Random, periodic , Non periodic, Energy , Power, Causal , Non-Causal, Even and odd signal.

Systems: Introduction, Classification of Systems: Lumped Parameter and Distributed Parameter System, static and dynamic systems, causal and non-causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non- invertible systems.

Unit II : Time domain representation of LTI System **(7L)**

Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of

convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.

Unit III : Fourier Series **(7L)**

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, basis functions, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon.

Unit IV : Fourier Transform **(7L)**

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, Fourier Transform for periodic signals.

Unit V: Laplace Transform **(7L)**

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis.

Unit VI : Probability and Random Variables **(7L)**

Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Uniform and Gaussian probability models.

Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance.

1.1 Course Objectives

1. To Elaborate the Classification and different operations on signals.
2. To Describe the classification of Systems based on their Input-output relations and Impulse response.
3. To Illustrate the computation of LTI System response using Convolution Integral and Convolution Sum.
4. To Explain the analysis of signals in time and transformdomain.
5. To Introduce the basis of random variables to compute the probability and statistical parameters

1.2 Course Outcomes

At the end of the course the Student will be able to:

1. Perform the classification and different operations on signals. (Unit: I, BTL 2: Understand)
2. Categorize the Systems based on their Input-output relations and Impulse response. (Unit: I, II, BTL 2: Understand)
3. Obtain the response of LTI Systems using Convolution Integral and Convolution Sum. (Unit: II, BTL 2: Understand)
4. Analyze the signals using Fourier series, Fourier Transform and Laplace Transform. (Unit: III, IV, V, BTL 2: Understand)
5. Compute the probability of given event and different statistical parameters of Random Variables. (Unit: VI, BTL 2: Understand)

1.3 Text Books

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.
2. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.

1.4 Reference Books

1. Charles Phillips, "Signals, Systems and Transforms", Pearson Education, 3rd Edition.

2. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata McGraw Hill.

3. A. NagoorKanni "Signals and Systems", 2nd edition, McGraw Hill.

1.5 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

E1. Alan Oppenheim, "Signals & Systems", 2nd edition, PHE India

E2. Shaila Apte, "Signals and Systems-principles and applications", Cambridge University press.

E3. NPTEL Course "Principles of Signals & System"
https://nptel.ac.in/courses/108/104/108104100/

E4. Lecture Series on, "Signals & Systems"
http://www.nptelvideos.in/2012/12/signals-and-system.html

E5. ocw.mit.edu

1.6 Teaching Plan and CO Mapped

Unit	Topics to be covered	Book Referred	Total Lecture Planned	CO Mapped	PI Mapped
1	Introduction to Signals & Systems	T1, R3, E1	10	**1, 2**	1.1.1 -2 2.1.3-2
2	Time domain representation of LTI System	T1, R3, E1	8	**2, 3**	1.1.1 -2 1.4.1 - 2 2.1.3-2
3	Fourier Series	T1, R3, E1	7	**4**	1.1.1 -2 1.1.2 - 1 1.4.1 -2 2.1.3 – 2 2.4.1 - 2
4	Fourier Transform	T1, R3, E1	7	**4**	
5	Laplace Transform	T1, R3, E1	8	**4**	

6	Probability and Random Variables	R2, E2	7	**5**	1.1.1 – 2 2.1.3 – 2 2.4.1 - 2

1.7 Unit wise Lecture Plan

1.8 a. Unit No.-I

Introduction to Signals and Systems

Pre-requisites:- Basics of mathematics

Objectives: - 1. To Elaborate the Classification and different operations on signals.

2. To Describe the classification of Systems based on their input-output Relations.

3. Introduce elementary signals and their applications.

Outcomes: - at the end of the unit, students will be able to:

1. Perform the classification and different operations on signals.

2. Categorize the Systems based on their Input-output relations

3. Define the elementary signals in Continuous and Discrete time domain.

Lect .	**Details of the Topic to be**	**References**	**CO Ma**	**PI ped**
No.	Definition of signals and systems, communication and control systems as examples	T1, R3,	CO	1.1.1 - 2
2.	Sampling of analog signals, sampling theorem, Continuous time and Discrete time signal	T1, R3,		
3.	Classification of signals as even, odd, periodic and non periodic	T1, R3,		
4.	Energy and power signals	T1, R3,		

5.	**Elementary signals used for testing:** reasons for using standard test signals, exponential, sine, ramp, rectangular, triangular, signum, sinc.	T1, R3, E1		
6.	Impulse, step and its properties,	T1, R3, E1		
7.	**Systems:** Definition, Classification: linear and non linear, time variant and invariant	T1, R3, E1	CO2	1.1.1 -2 2.1.3-2
8.	Causality, inevitability	T1, R3, E1		
9.	Stability	T1, R3, E1		
10.	System classification	T1, R3, E1		

Question Bank Theory

Tutorial 1

CO Mapped – CO1

A. 1) Sketch and write mathematical expression for the following signals in CT and DT

a) Sine
b) Rectangular
c) Triangular
d) Exponential
e) Unit Impulse
f) Unit Step
g) Ramp
h) Signum
i) Sinc

2) Classify and find the respective value for the abovesignals

a) Periodic / Non Periodic
b) Energy / Power /Neither

B. Find out if the following signals are Power signals or Energy signals:

1. $x(t)=u(t)=$ 1, $t>0$

= 0, t<0

2. x(t)=δ(t)
3. x(t)=t
4. x(t)=sin(ωt)
5. x(t)=cos(ωt)
6. x(t)=Ae^(at)
7. rect(t)= A, -T≤t≤T
   = 0, ,Otherwise
8. x(t)=e^(-2t)u(t)
9. x(t)=e^(j2t+∏/4)
10. x(t)=cos(t)
11. x[n]=(1/2)^(n) u[n]

C. Find out if the signal is Periodic orNon periodic:

1. x(t)=je^(10t)
2. x(t)=e^(-1+j)t
3. x[n]=e^(j7∏n)
4. x[n]=3e^([3∏(n+1/2)/5]
5. x[n]=e^[j(3n/5 + 3/10)]
6. x[n]=u[n]+u[-n]
7. x(t)=3cos(4t+∏/3)
8. x(t)=e^[j(∏t-1)]
9. x(t)=cos^(2) (2t-∏/3)
10. x(t)=7cos[3∏t/8]+8sin[5∏t/16]

Tutorial 2

CO Mapped – CO1

A. Take any CT and DT signals and perform the following operation Amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting andfolding.

Q. 1 **Sketch the waveforms**

(a) $x(t) = u(t) - u(t-2)$

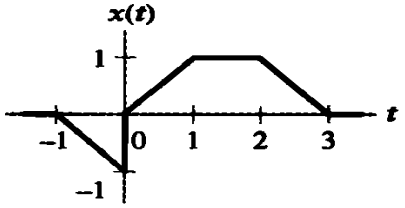
(b) $x(t) = u(t+1) - 2u(t) + u(t-1)$

(c) $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

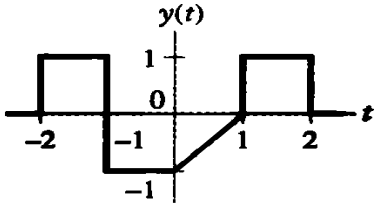
(d) $y(t) = r(t+1) - r(t) + r(t-2)$

(e) $y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$

Q.2 **Follow the precedence rule and sketch for the following**



(a)



(b)

(a) $x(t)y(t-1)$

(b) $x(t-1)y(-t)$

(c) $x(t+1)y(t-2)$

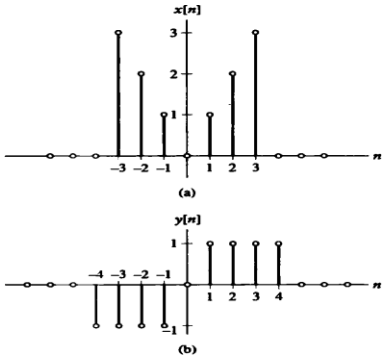
(d) $x(t)y(-1-t)$

(e) $x(t)y(2-t)$

(f) $x(2t)y\left(\frac{1}{2}t+1\right)$

(g) $x(4-t)y(t)$

Q.3 **Follow the precedence rule and sketch for the following**



(a) $x[2n]$
(b) $x[3n-1]$
(c) $y[1-n]$
(d) $y[2-2n]$
(e) $x[n-2]+y[n+2]$
(f) $x[2n]+y[n-4]$
(g) $x[n+2]y[n-2]$
(h) $x[3-n]y[n]$
(i) $x[-n]y[-n]$
(j) $x[n]y[-2-n]$
(k) $x[n+2]y[6-n]$

Tutorial 3

CO Mapped – CO2

Express system mathematical expressions in input output relation form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time invariant, Invertible.

1. y(t)=t x(t)
2. y(t)=x^2.t
3. y(t)=x(t-2)+x(2-t)
4. y(t)=[cos(3t)].x(t)
5. y(t)= $\int_{-\infty}^{2t}$ □(□)
6. y(t) =0 , t<0

=x(t)+x(t-2), $t \geq 0$

7.y(t) =0 , $x(t)<0$

=x(t)+x(t-2) , $x(t) \geq 0$

8. y(t)=x(t/3)

9. y(t)=d/dt [x(t)]

10. y[n]=x[-n]

11. y[n]=x[n-2]-2x[n-8]

12. y[n]=n x[n]

13. y[n]=x[n] , $n \geq 1$

=0 , n=0

=x[n+1] , $n \leq -1$

14. y[n]=x[n] , $n \geq 1$

=0 , n=0

=x[n] , $n \leq -1$

15. y[n]=n[4n+1]

Question Bank: Multiple Choice Questions (MCQs)

CO Mapped – CO1, CO2

- Determine whether the following signals are periodic. If they are, find fundamental time period.

1. $x(t) = [\cos(2\pi t)]^2$

a. 1 b. ½ c. 2 d. Aperiodic

2. $x(t) = 2e^{j(2t + \pi/4)}$

a. $\pi/2$ b. $\pi/4$ c. π d. Aperiodic

3. $x[n] = \sin[(7\pi/3)n + (2\pi/3)]$

a. 7 b. 6 c. 5 d. Aperiodic

4. $x(t) = 5\cos(\pi t) + \sin(5\pi t)$

a. 2 b. 1/2 c. 2/5 d. Aperiodic

- Determine whether the following signals are Energy/Power. Find the value.

5. $x[n] = (1/2)^n u[n]$

   a. Energy, 3/4 b. Power, 4/3 c. Energy, 4/3 d. Zero Signal

6. $x(t) = 2 , -1 \le t \le 1$

   $= 0 , otherwise$

   a. Energy, 6 b. Power, 4 c. Energy, 8 d. Energy, 2

7. $x(t) = t\, u(t)$

   a. Power, ½ b. Energy, ½ c. Power, 1 d. Neither Energy nor Power

8. $x(t) = 1, 0 \le t \le 1$

   $= -1, 1 \le t \le 2$

   a. Energy, 2 b. Energy, 4 c. Power, 2 d. Power, 4

9. Determine even and odd parts of the givensignal.

   $x(t) = 1 + t\cos(t) + t^2 \sin(t) + t^3 \sin(t)\cos(t)$

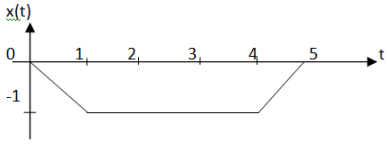
   a. Even: $1 + t^3 \sin(t)\cos(t)$
      Odd: $t\cos(t) + t^2 \sin(t)$

   b. Even: $t\cos(t) + t^2 \sin(t)$
      Odd: $1 + t^3 \sin(t)\cos(t)$

   c. Even: $t\cos(t) - t^2 \sin(t)$
      Odd: $1 - t^3 \sin(t)\cos(t)$

   d. Even: $-t\cos(t) - t^2 \sin(t)$
      Odd: $-1 - t^3 \sin(t)\cos(t)$

10. Write down the equation for the signal x(t) shown in the figure.



   a. $y(t) = -r(t) + r(t-1) + r(t-4) + r(t-5)$

   b. $y(t) = -r(t) + r(t-1) + r(t-4) - r(t-5)$

   c. $y(t) = r(t) - r(t-1) + r(t-4) + r(t-5)$

   d. $y(t) = r(t) + r(t-1) + r(t-4) + r(t-5)$

- Test the following systems for Memory(M/WM), Time Invariance (TI/TV), Linearity (L/NL), Causality (C/NC), Stability (S/US)

11. $y(t) = 2 \cos [x(t)]$

    a. WM, TI, L, C, US
    b. WM, TI, NL, NC, US
    c. M, TV, NL, C, US
    d. WM, TI, L, C, S

12. $y(t) = d/dt \{e^{-t} x(t)\}$

    a. WM, TV, L, C, US
    b. WM, TI, NL, NC, US
    c. M, TV, NL, NC, S
    d. WM, TI, L, C, S

13. $y(t) = x(t^3/3)$

    a. WM, TI, L, NC, US
    b. M, TV, NL, C, US
    c. M, TV, L, NC, S
    d. WM, TI, NL, C, S

14. $y[n] = 2\, x[2^n]$

    a. M, TV, L, NC, US
    b. WM, TI, NL, NC, S
    c. WM, TV, NL, NC, US
    d. M, TV, L, NC, S

15. $y[n] = x^2 [n^2 - 1]$

    a. M, TV, L, NC, US
    b. M, TV, NL, NC, S
    c. WM, TV, NL, NC, S
    d. M, TV, L, NC, S

16. Given, $x[n] = \{-1, -1, \underline{0}, 1, 1\}$. Determine – $x[2n+3]$

    a. $\{1, \underline{-1}, 1\}$
    b. $\{-1, 1, \underline{0}\}$
    c. $\{1, \underline{-1}, 0\}$
    d. $\{\underline{0}, -1, 1,\}$

17. Given, $x[n] = \{1, 1, \underline{1}, 1, 1\}$. Determine – $x[3n-2]$

    a. $\{\underline{1}, 1\}$
    b. $\{1, \underline{-1}\}$
    c. $\{1, \underline{1}\}$
    d. $\{-1, \underline{-1}\}$

18 The system $y(t) = x(t) + 2x(t + 3)$ is

a. causal system
b. non-causal system
c. partly (a) and partly (b)
d. none of these

19 The system $y(t) = x(t) + \frac{1}{3}x(t-1)$ is

a. causal system
b. non-causal system
c. partly (a) and partly (b)
d. none of these

20 The system $\frac{dy(t)}{dt} + t^2 y(t) = 2x(t)$ is

a. time invariant system
b. time-variant system
c. partly (a) and partly (b)
d. none of these

21 The system $\frac{dy(t)}{dt} + 3y(t) = x(t)$ is a

a. time invariant system
b. time-variant system
c. partly (a) and partly (b)
d. none of these

HOT* (Higher Order Thinking) Questions

CO Mapped – CO1,CO2

22. **Y_1 : It is not mandatory for every signal to be even or odd**

Y_2 : : Any signal which is neither even nor odd can be expressed as the difference of even and odd signals

a. Y_1 only

b. Y_2 only

c. Both Y_1 & Y_2 are correct but Y_2 is not a reason for Y_1

d. Both Y_1 & Y_2 are correct but Y_2 is definitely a reason of Y_1

2. **What is the obligatory sequence that need to be performed or executed in time shiftin, scaling and time reversal operational processes under the category of continuous time signals?**

a. Time Shifting, Time Scaling & Time Reversal

b. Time Scaling, Time Reversal & Time Shifting

c. Time Shifting, Time Reversal & Time Scaling

d. Time Reversal, Time Scaling & Time Shifting

3. **The signal energy of the continuous-time signal**

$$x(t)=[(t-1)u(t-1)]-[(t-2)u(t-2)]-[(t-3)u(t-3)]+[(t-4)u(t-4)]$$

is

a. 11/3
b. 7/3
c. 1/3
d. 5/3

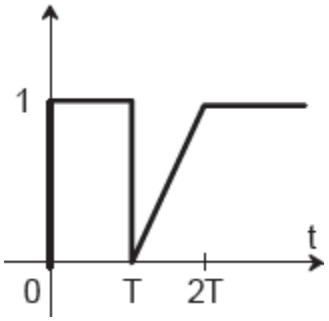
1. **Consider a continuous-time system with input $x(t)$ and output $y(t)$ given by**

$$y(t)=x(t)\cos(t)$$

This system is

a. linear and time-invariant
b. non-linear and time-invariant
c. linear and time-varying
d. non-linear and time-varying

2. **The function shown in the figure can be represented as**



a. $u(t)-u(t-T)+_{(t-T)T}u(t-T)-_{(t-2T)T}u(t-2T)$
b. $u(t)+_{tT}u(t-T)-_{tT}u(t-2T)$
c. $u(t)-u(t-T)+_{(t-T)T}u(t)-_{(t-2T)T}u(t)$
d. $u(t)+_{(t-T)T}u(t-T)-2_{(t-2T)T}u(t-2T)$

1.8 a. Unit No.-II

Time Domain Representation of LTI System

Pre-requisites:- Basics of integration and summation

Objectives:- 1.To Introduce the concept of Impulse response.

2. Analyze and classify the Linear Time Invariant system with the help of convolution Integral and Sum.

Outcomes:- at the end of the unit, students will be able to:

1. Develop input output relationship for linear shift invariant system using convolution.

2. Determine Step response of the systemusing given Impulse response

Lecture covered	Details of the Topic to be	Reference	CO Mappe	PI Mappe
1.	System modeling: Input-output relation, Definition of impulse response	T1, R3,	CO3	1.1.1 -2 1.4.1 - 2
2.	Necessity of convolution and convolution sum	T1, R3, E1		
3.	unit step to rectangular and rectangular to rectangular and few more problems	T1, R3, E1		
4.	Computation of convolution sum			
5.	Properties of convolution	T1, R3,		
6.	system interconnection and problems	E1 T1,		
7.	system properties	R3, E1		
	in terms of impulse response and problems			
8.	step response in terms of impulse	T1, R3,		

Question Bank Theory

Tutorial 4

CO Mapped – CO3

A. Express any two system mathematical expressions in impulse response form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time in variant, Invertible.

1. h[n]=[1/5]^n .u[n]
2. h[n]=(0.8)^n .u[n+2]
3. h[n]=[1/n]^n .u[-n]
4. h[n]=5^n.u[3-n]
5. h[n]=[-1/2]^n.u[n]+(1.01)^n. u[1-n]
6. h[n]=n[1/3]^n.u[n-1]
7. h(t)=e^(-4t).u(t-2)
8. h(t)=e^(-6t).u[3-t]
10. h(t)=e^(-2t).u(t+50)
11. h(t)=e^(2t).u(-1-t)
12. h(t)=e^(6|t|)
13. h(t)=t.e^(-t).u(t)

14. h(t)=[2e^(-t)-e(t-100)/100].u(t)
15. h(t)=cos(∏t)
16. h(t)=e^(-2t).u(t-1)
17. h(t)=3δ(t)
18. h(t)=cos(∏t).u(t)
19. h[n}=(-1)^n.u[-n]
20. h[n]=(1/n)^|n|
21. h[n]=cos(∏n/8){u[n]-u[n-10]}
22. h[n]=2.u[n]-2u[n-5]
23. h[n]=sin[∏n/2]

B. Evaluate step response of the given LTI system:

1. h[n]=(-1/2)^n.u[n]
2. h[n]=δ[n]-δ[n-2]
3. h[n]=(-1)^n{u[n+2]-u[n-3]}
4. h[n]=n.u[n]
5. h(t)=e^(-|t|)
6. h(t)=δ^2(t)
7. h(t)=(1/4)(u(t)-u(t-4))
8. h(t)=u(t)

Tutorial 5

CO Mapped – CO3

A. Perform Convolution Integral of Two Continuous time Signals.

1. x(t)=u(t), h(t)=u(t)
2. x(t)=u(t), h(t)=e^(-at).u(t)
3. x(t)=e^(-at).u(t), h(t)=e^(-bt).u(t)
4. x(t)=u(t)-u(t-2), h(t)=u(t)

5. x(t)=u(t)-u(t-2), h(t)=e^(-2t).u(t)

6. x(t)=u(t)-u(t-2), h(t)=u(t)-u(t-3)

7. x(t)=[u(t)-u(t-2)].e^(-2t), h(t)=e^(-t).u(t)

8. x(t)=u(t)-u(t-2), h(t)=u(t)-u(t-2)

B.

Q. 1 **Evaluate**

(a) $y[n] = u[n+3] * u[n-3]$

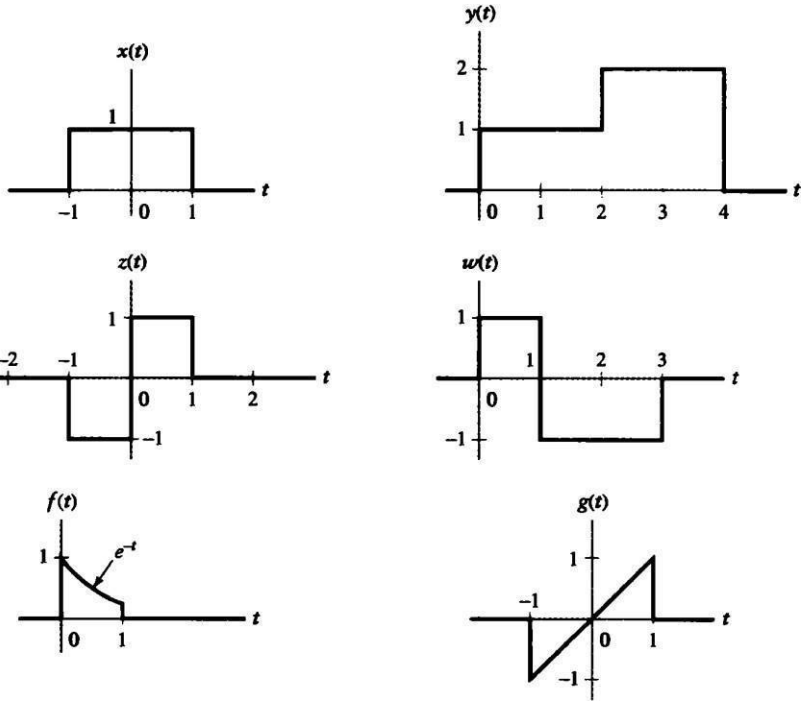
(b) $y[n] = 3^n u[-n+3] * u[n-2]$

(c) $y[n] = \left(\frac{1}{4}\right)^n u[n] * u[n+2]$

(d) $y[n] = \cos\left(\frac{\pi}{2}n\right) u[n] * u[n-1]$

(e) $y[n] = (-1)^n * 2^n u[-n+2]$

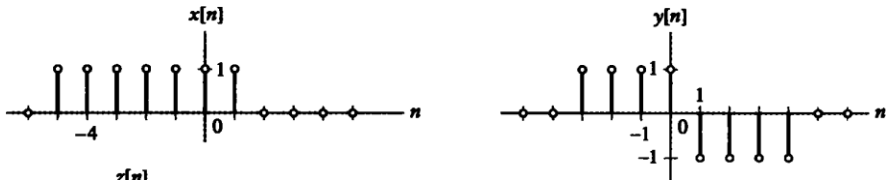
Q.2 **Given -**



Evaluate-

	*i. m(t) = x(t) * y(t)* *ii. m(t) = x(t) * z(t)* *iii. m(t) = x(t) * w(t)* *iv. m(t) = x(t) * f(t)* *v. m(t) = x(t) * g(t)* *vi. m(t) = z(t) * y(t)* *vii. m(t) = g(t) * y(t)* *viii. m(t) = w(t) * y(t)* *ix. m(t) = f(t) * y(t)* *x. m(t) = g(t) * f(t)*

Q.3 **Given –**



Evaluate – ***m[n] = x[n] * y[n]***

Question Bank: Multiple Choice Questions (MCQs)

CO Mapped – CO3

Test for Causality and Stability of the Impulse response given below.

1. ***h[n] = (1/5)^n u[n]***

a. NC, US
b. C, US
c. NC, S
d. C, S

2. ***h[n] = (0.8)^n u[n+2]***

a. NC, US
b. C, US

c. NC, S

d. C, S

3. $h(t) = e^{2t}\, u(-t-1)$

a. NC, US

b. C, US

c. NC, S

c. C, S

4. $h(t) = e^{-6t}\, u(3-t)$

a. NC, US

b. C, US

c. NC, S

c. C, S

5. **Evaluate -** $u(t) * u(t)$

a. t

b. $t\, u(-t)$

c. $-t\, u(-t)$

d. $t\, u(t)$

6. **Evaluate -** $u(t) * [\, e^{-at}\, u(t)]$

a. $a\,(1-e^{at})\, u(t)$

b. $1/a\,(1-e^{at})\, u(t)$

c. $1/a\,(1-e^{-at})\, u(t)$

d. $a\,(1-e^{-at})\, u(t)$

7. **Evaluate -** $[\, e^{-2t}\, u(t)] * [\, e^{-3t}\, u(t)]$

a. $(e^{-3t} - e^{-2t})/5$

b. $(e^{-3t} - e^{-2t})$

c. $(e^{-2t} - e^{-3t})$

d. $(-e^{-3t} + e^{-2t})/5$

8. **Evaluate -** $u(t) * [\, u(t) - u(t-2)\,]$

a. $y(t) = t\,; \quad 0 \le t \le 2$

$= 2; \quad t > 2$

b. $y(t) = 2\, u(t-2)$

c. $y(t) = t-2\,; \quad 0 \le t \le 2$

$= 2; \quad t > 4$

d. $y(t) = t\, u(t)$

9. Evaluate - $[\, u(t) - u(t-2)\,] * [\, u(t) - u(t-2)\,]$

10. **Evaluate convolution –** $x[n] = \{1, \underline{2}, 3, 4\}$ **and** $y[n] = \{4, 3, \underline{2}, 1\}$

a. {4, 11, <u>20</u>, 30, 25, 8, 4}

b. {4, 8, <u>25</u>, 30, 20, 11, 4}

c. {<u>4</u>, 11, 20, 30, 20, 11, 4}

d. {4, 11, 20, <u>30</u>, 20, 11, 4}

11. **Evaluate convolution –** $x[n] = \{\underline{1}, 2, 1, 2\}$ **and** $y[n] = \{\underline{2}, 1, 2, 1\}$

a. {2, <u>5</u>, 6, 10, 6, 5, 2}

b. {<u>2</u>, 5, 6, 10, 6, 5, 2}

c. {2, 5, 6, 10, 6, <u>5</u>, 2}

d. {2, 5, 6, <u>10</u>, 6, 5, 2}

12. **Evaluate convolution –** $x[n] = \{\underline{2}, 1, 1, 1\}$ **and** $y[n] = \{2, \underline{1}, 1, 1\}$

a. {4, <u>4</u>, 5, 6, 3, 2, 1}

b. {4, 4, 5, <u>6</u>, 3, 2, 1}

c. {4, 4, 5, 6, 4, <u>4</u>, 5}

d. {4, <u>5</u>, 4, 6, 5, 2, 1}

13. **Determine step response from the Impulse Response given –> h(t) = *δ(t) - δ(t-2)***

a. *u(t) - u(t-2)*

b. ∞

c. *- u(t) - u(t-2)*

d. *0*

14. **Determine step response from the Impulse Response given –> h(t) =$e^{-|t|}$**

a. *2*

b. (2 - e^{-t}) *u(t)*

c. 2 (1 - e^{-t}) *u(t)*

d. (2 - e^{-t})

15. **Mark the correct statement**

a. *x(t) * δ(t – t_0) = x(t_0)*

b. *x(t) * δ(t – t_0) = x(t - t_0)*

c. *x(t) * δ(t – t_0) = 1*

d. *x(t) * δ(t – t_0) = x(t + t_0)*

16. **Mark the wrong statement**

a. *x(t) * δ(t) = x(t)*

b. *x(t) * δ(t – t0) = x(t - t0)*

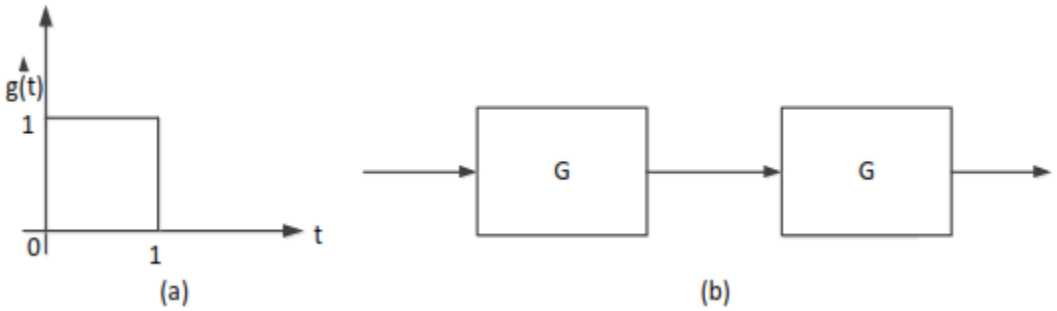
c. *x(t – t_{01}) * δ(t – t_{02}) = x(t – t_{01} – t_{02})*

d. *δ(t – t_{01}) * δ(t – t_{02}) = δ(t_{01} – t_{02})*

HOT* (Higher Order Thinking) Questions

CO Mapped – CO3

1. The impulse response g(t) of a system, *G*, is as shown in Figure (a). What is the maximum value attained by the impulse response of two cascaded blocks of *G* as shown in Figure(b)?



(a) (b)

a 23

b 34

c 45

d 1

2. Consider an LTI system with impulse response $h(t)=e^{-5t}u(t)$.

If the output of the system is $y(t)=e^{-3t}u(t)-e^{-5t}u(t)$.

then the input, $x(t)$, is given by

a. $e^{-3t}u(t)$
b. $2e^{-3t}u(t)$
c. $e^{-5t}u(t)$
d. $2e^{-5t}u(t)$

3. The impulse response of a system is *h(t) = t u(t)* . For an input *u(t -1)* , the output is

a. $t^2/2\ u(t)$

b. $t(t-1)/2\ u(t-1)$

c. $t(t-1)/2\ u(t-1)$

d. $(t^2-1)/2\ u(t-1)$

1.8 a. Unit No.-III

Fourier Series

Pre-requisites:- Convolution, properties of signals and systems, Integration and Summation Operation

Objectives:-

1. To Introduce CT and DT systems in the Time & Frequencydomain using Analysis tools
2. To represent the signals in terms of its Fourier coefficients and analyze them using CT and DT Fourier Series.
3. To Understand and apply the Dirichlet's conditions to obtain the Fourier series.

Outcomes:-

1. Describe and analyze signals in the Time & frequency domain using Fourier series.
2. Determine Amplitude and Frequency spectrum using Fourier series

Lecture No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Fourier series (FS) representation of periodic CT signals	T1, R3, E1	CO4	1.1.1 -2 1.1.2 - 1 1.4.1 -2 2.1.3 – 2 2.4.1 - 2
2	Dirichlet's condition for existence of Fourier series, orthogonality, basis functions	T1, R3, E1		
3	amplitude and phase response, FS representation of CT signals using trigonometric Fourier series.	T1, R3, E1		
4	Exponential Fourier series.	T1, R3, E1		
5	Applications of Fourier series, properties of Fourier series and their physical significance	T1, R3, E1		
6	Gibbs phenomenon, Discrete Time Fourier Series	T1, R3, E1		
7	Discrete Time Fourier Series properties convergence of DTFS	T1, R3, E1		

Question Bank Theory

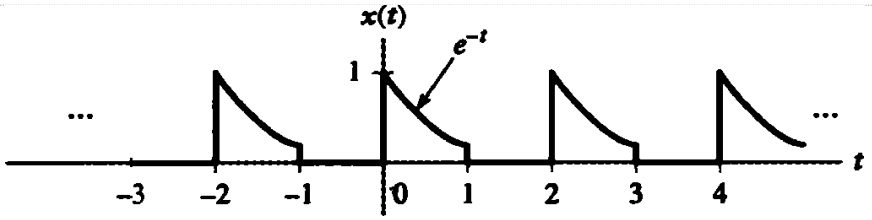
Tutorial 6

CO Mapped – CO4

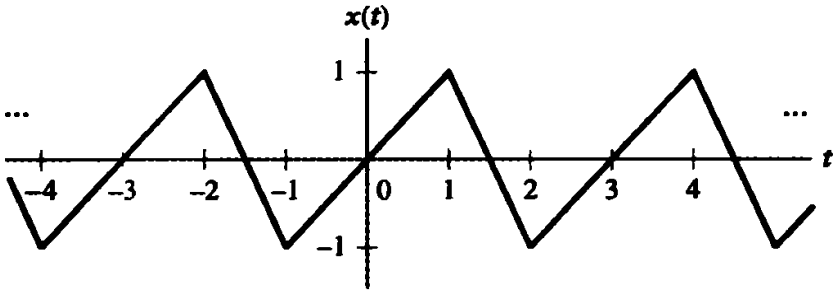
- **Find EFS and TFS expansion for the following signals**

Q. 1	Half wave rectified signal
Q.2	Full wave rectified signal
Q.3	Saw tooth wave
Q. 4	**Triangular wave**
Q. 5	**Square wave**

Q. 6



Q.7



Question Bank: Multiple Choice Questions (MCQs)

CO Mapped – CO4

1. **Determine Exponential Fourier Series Coefficients of – *x(t) = cos ωt***

a. -½, -½ b. ½, ½

c. ½, -½ d. -½, ½

2. **Determine Exponential Fourier Series Coefficients of – *x(t) = cos 4t + sin 6t***

a. *1/2j, ½, ½, 1/2j* b. *-1/2j, ½, ½, -1/2j*

c. *1/2j, -½, -½, 1/2j* d. *-1/2j, ½, ½, 1/2j*

3. **Duality property is -**

a. $X(t) \leftrightarrow 2\pi\, x(-\omega)$ b. $x(at) \leftrightarrow (1/|a|)\, X(\omega/a)$

c. $x(-t) \leftrightarrow X(-\omega)$ d. $(-jt)\, x(t) \leftrightarrow d[x(-\omega)]/d\omega$

4. **Fourier Series of any signal *x(t) can only be obtained if -***

a $\int_0^{\square} |(\square)| \square\square < \infty$ b. Finite number of discontinuities within finite interval T

c. both a and b c. infinite no. of discontinuities

5. **Magnitude spectrum *|X(ω)|* is an -**

a. even function b. odd function

c. Neither even nor odd d. even and odd both

6. Phase spectrum of $X(\omega)$ is an -

a. even function b. odd function

c. Neither even nor odd d. even and odd both

7. F.T. of x(t) = sgn(t) is -

a. $(2/j\omega) + \pi\,\delta(\omega)$ b. $2/j\omega$

c. $-2/j\omega$ d. $1/j\omega$

8. F.T. of 1 is -

a. $\pi\,\delta(\omega)$ b. $(\pi/2)\,\delta(\omega)$

c. $2\pi\,\delta(\omega)$ d. $2\pi\,\delta(-\omega)$

9. If $X(\omega) = \delta(\omega - \omega_0)$ the x(t) is -

a. $e^{-j\omega 0t}$ b. $\delta(t)$

c. $(1/2\pi)\,e^{j\omega 0t}$ d. 1

10. Expression for *DTFT* is -

a. $\sum_{n=-\infty}^{n=\infty} [n]\, n^{-j n_0 n}$ b. $n[n]$

c. $\sum_{n=-\infty}^{n=\infty} \sum_{n=-\infty}^{n=\infty} [n]\, n^{-j n_0 n}$ d. $\sum_{n=-\infty}^{n=\infty} n^{-j n_0 n}$

11. F.T. of u(t) is -

a. $(1/j\omega)$ b. $(-1/j\omega) - \pi\,\delta(\omega)$

c. $(1/j\omega) + 2\pi\,\delta(\omega)$ d. $(1/j\omega) + \pi\,\delta(\omega)$

12. *x(t) = cos (πt) has following FS coefficients*

a. a_0, a_k, b_k b. b_k only

c. a_0, a_k d. a_k only

13. F.T. of $e^{-|t|}$ is -

a. $2/(1 + \omega^2)$ b. $2/(1 - \omega^2)$

c. $1/(1 + \omega^2)$ d. $1/(1 - \omega^2)$

14. Match the following pairs.

1. $n^{-j n_0 n}$ I. a constant

2. $\frac{\sin(n\omega)}{n}$ II. '*t*' multiplied with exponential function

3. $k\,\delta(\omega)$ III. Rectangular Pulse

4. $\frac{1}{(3+\square)^2}$ IV. Shifted Impulse function

a. 1-IV, 2-III, 3-II, 4-I b. 1-I, 2-II, 3-III, 4-IV

c. 1-IV, 2-III, 3-I, 4-II d. 1-I, 2-II, 3-IV, 4-III

1.8 a. Unit No.-IV

Fourier Transform

Pre-requisites:- Fourier series

Objectives:-

1. To understand the Properties of Fourier Transform.
2. To analyze signals using CT and DT Fourier Transform.

Outcomes:-

1. Describe and analyze signals in the Time & Transform domain using Fourier Transform.
2. Determine Magnitude and Phase response using Fourier Transform.

Lecture No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Fourier Transform (FT) representation of aperiodic CT signals	T1, R3, E1	CO4	1.1.1 -2 1.1.2 - 1 1.4.1 -2 2.1.3 – 2 2.4.1 - 2
2	Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response	T1, R3, E1		
3	FT of standard CT signals, FT of standard periodic CT signals	T1, R3, E1		
4	Properties and their significance	T1, R3, E1		
5	Interplay between time and frequency domain using sinc and rectangular signals	T1, R3, E1		

6	Fourier Transform for periodic signals	T1, R3, E1		
7	Introduction to Discrete Time Fourier Transform	T1, R3, E1		

Question Bank Theory

Tutorial 7

CO Mapped – CO4

A. State and prove the various properties of CT Fourier Transform. Take rectangular and sinc Signal as examples and demonstrate the applications of CTFT properties. And also demonstrate the interplay between the time and frequency domain.

State and Prove the properties of Fourier transform

a	**Linearity**
b	**Time shifting**
c	**Frequency shifting**
d	**Time scaling**
e	**frequency scaling**
f	**Convolution in time**
g	**Convolution in frequency**
h	**Parseval's theorem**
h	**Differentiation in time**

i	**Differentiation in frequency**
j	**integration in time**

B. Obtain the Fouriertransform of Following Signals

Q1) x(t) = rect ($\frac{\square}{2\square}$) |t|<=T

Q2) x(t) = $\frac{1}{2\square}\int_{-\infty}^{\infty} \square(\square\square)\square^{\square\square}\,\square\square$

Q3) x(t) = { $\square$, $|\square| \leq 1$
0 , $|\square| \geq 1$

Q4) x($\square\square$) = $2\cos\square$ $|\square| \leq \square$
{ $|\square| \geq \square$

Q5) x(t) = {$\square^{\square\square}$ $|\square| \leq \square$
0

$\square\square h\ \square\square\square\square$

$\square\square$ Q6) x(t) = $e^{-at}\cos\omega_0 t\ u(t)$

Q7) x(t) = $e^{-at}\ u(t)$

Q8) Show that u(t) $\leftrightarrow \frac{1}{\square\square} + \square(\square)$

Q9) Show that $(\square) \leftrightarrow 1$

Q10) Show that $1 \leftrightarrow 2\pi\ \delta(\omega)$

Q11) State that Sig(t) $\leftrightarrow \frac{2}{\square\square}$

Find-i) $|x(j\omega)| < x(j\omega)$

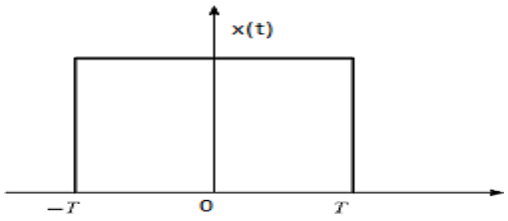
ii) $x(j\omega) = \int_{-\infty}^{\infty} \square(\square)\ \square^{-\square\square}\ \square\square$

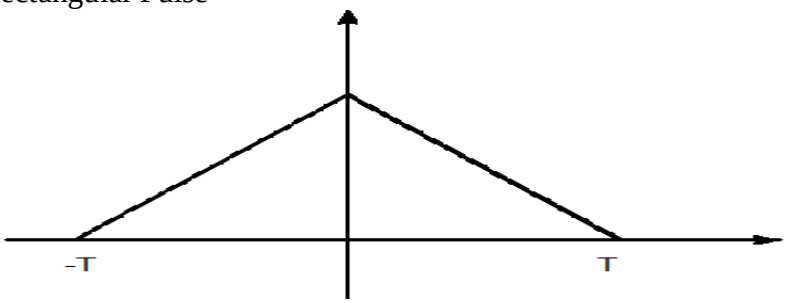
Q12) $x(j\omega) = -\frac{\square\square}{\square\square^2+3\square\square+2}$

Q13) $x(j\omega) = \frac{(-j\omega+1)}{(j\omega)^2+5j\omega+6}$

Q14) $x(j\omega) = \frac{j\omega}{(2+j\omega)^2}$

Q15) Obtain F.T. of Rectangular Pulse





Q16) Obtain F.T. of

Q17) $x(j\omega) = (j\omega)/(2 + j\omega)^2$

Q18) $x(j\omega) = \frac{4}{\omega^2} \sin^2\omega$

Q19) $x(t) = \frac{4}{\omega^2 t^2} \sin^2(t^2)$

Q20) Parseval's: $x(t) = e^{-2t}u(t)$

Q21) $x(t) = 2\int_{-\infty}^{\infty} \frac{1}{(2+j\omega)^2}\, d\omega$

C. Obtain the Discrete Time Fourier transform of Following Signals

Q1) $x(n) = u(n) - u(n-6)$

Q2) $x(n) = 2^n [u(n) - u(n - 4)$

Q3) $x(n) = \left(\frac{1}{2}\right)^{n}$

Q4) $x(n) = \left(\frac{1}{4}\right)^{n+3} u(n)$

Q5) $x(n) = (\frac{1}{2})^{n}$ $(n - 4)$

Q6) $x(n) = a^{n} u(-n)$ $a > 1$

HOT* (Higher Order Thinking) Questions

CO Mapped – CO4

1. Consider a signal defined by

$$x(t) = \{ e^{j10t} \quad \text{for } |t| \leq 1$$

$$= 0 \quad \text{for } |t| > 1$$

Its Fourier Transform is

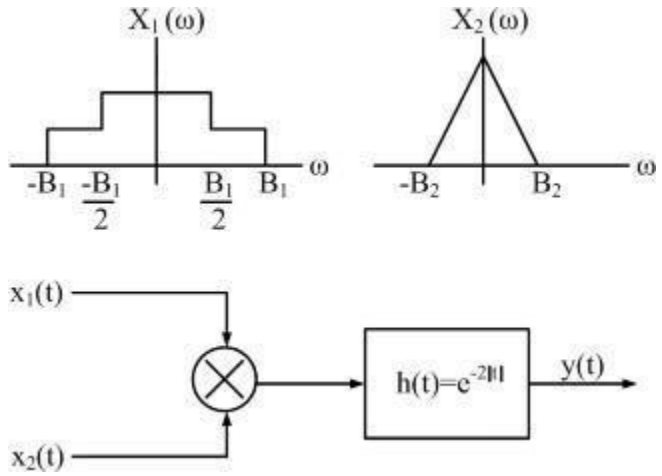
a. $2\sin(\omega - 10)/\omega - 10$

b. $2e^{j10}\sin(\omega - 10)/\omega - 10$

c. $2\sin\omega/\omega - 10$

d. $e^{j10\omega}\, 2\sin\omega/\omega$

2. Let $x_1(t) \leftrightarrow X_1(\omega)$ and $x_2(t) \leftrightarrow X_2(\omega)$ be two signals whose Fourier Transforms are as shown in the figure below. In the figure, $h(t) = e^{-2|t|}$ denotes the impulse response.



For the system shown above, the minimum sampling rate required to sample y(t), so that y(t) can be uniquely reconstructed from its samples, is

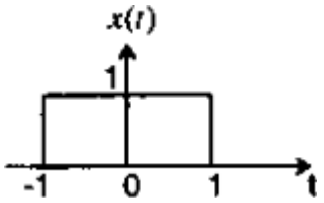
a. $2B_1$

b. $2(B_1+B_2)$

c. $4(B_1+B_2)$

d. ∞

3. ***x(t)*** **is a positive rectangular pulse from t = -1 to t = +1 with unit height as shown in the figure. The value of** $\int_{-\infty}^{\infty}|X(\omega)|^2 d\omega$, **{where** $X(\omega)$ **is the Fourier transform of** $x(t)$**} is:**



a. 2
b. 2π
c. 4
d. 4π

4. The value of the integral $2\int_{\infty}^{-\infty}(sin2\pi t/\pi t)dt$ **is equalto:**

a. 0
b. 0.5
c. 1
d. 2

1.8 a. Unit No.-V

Laplace Transform and its Applications

Pre-requisites:- Signals and Systems – unit 1&2

Objectives:-

1. To understand the need and properties of Laplace Transform.
2. To understand the concept of ROC of Laplace Transform.
3. To Apply Laplace Transform to analyze thesystems.

Outcomes:-

1. Describe and analyze signals in the Time & Transform domain using Laplace Transform.

2. Implement the concept and properties of Laplace Transform to analyze and synthesize the systems.

Lecture No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, Region of convergence	T1, R3, E1	CO4	1.1.1 -2 1.1.2 - 1 1.4.1 -2 2.1.3 – 2 2.4.1 - 2
2	Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their Significance	T1, R3, E1		
3	Properties of Laplace transform and their significance	T1, R3, E1		
4	Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion	T1, R3, E1		
5	Stability considerations in S domain, concept of poles and zeros.	T1, R3, E1		
6	Application of Laplace transforms to the LTI system analysis.	T1, R3, E1		
7	Application of Laplace transforms in signal analysis.	T1, R3, E1		
8	Application of Laplace transforms to analyze electrical circuits.	T1, R3, E1		

Question Bank Theory

Tutorial 8

CO Mapped – CO4

A. State and prove the properties of CT Laplace Transform. Take any example of a system in time domain and demonstrate the application of LT in system analysis.

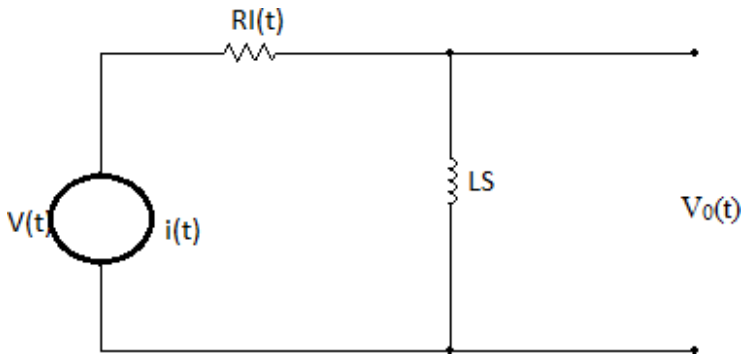
State and Prove the properties of Laplace Transform

a	**Linearity**

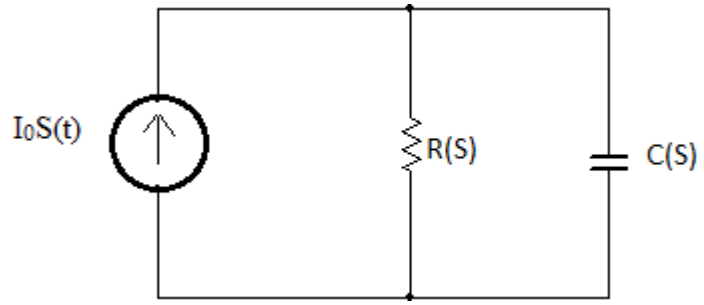
b	**Time shifting**
c	**Frequency shifting**
d	**Time scaling**
e	**frequency scaling**
f	**Convolution in time**
g	**Convolution in frequency**
h	**Parseval's theorem**
i	**Differentiation in time**
j	**Differentiation in frequency**
k	**integration in time**

Use Laplace transform to analyze following LTI Systems

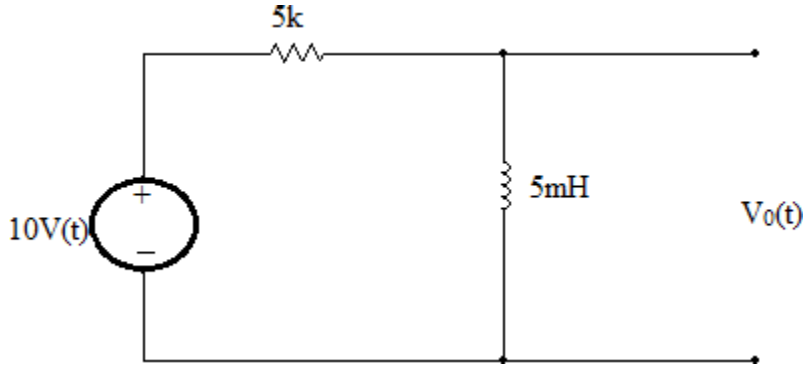
Q1) Find transfer function of current i(t) for the given circuit



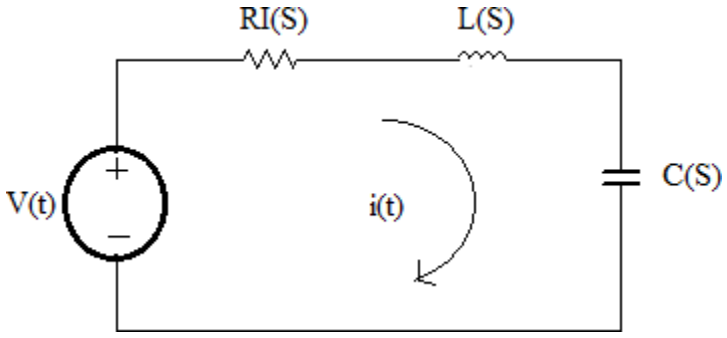
Q2) Find $V_0(t)$. Consider $(0^-) = 0$



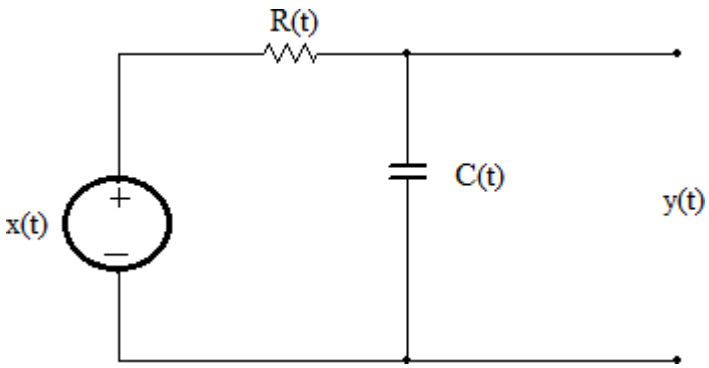
Q3) Find $V_0(t)$, if $i(0^-) = -2mH$



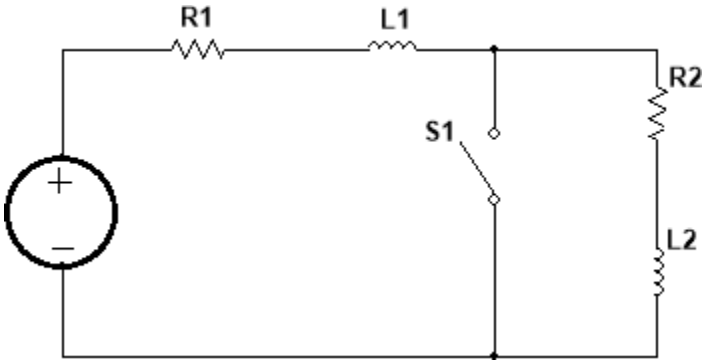
Q4) Obtain H(S)



Q5) □ = 1□Ω,□ = 200□□. Obtain y(t)



Q6) R1 = 10Ω, R2 = 15Ω, L1 = 3H, L2 = 2H. determine y(t).



Question Bank: Multiple Choice Questions (MCQs)

CO Mapped – CO4

1. **Evaluate L.T. of $x(t) = e^{-2t} u(t)$**

a. 1/s+2, σ < -2
b. 1/s+2, σ >-2
c. 1/s-2, σ < -2
d. 1/s+2, σ > 2

2. **Evaluate L.T. of $x(t) = e^{-a|t|}$**

a. $\frac{-2}{\square^2-\square^2}$, σ > -a
b. $\frac{-2\square}{\square^2-\square^2}$, σ < a
c. $\frac{-2}{\square^2-\square^2}$, -a ≤ σ ≤ a
d. $\frac{2\square}{\square^2+\square^2}$, -a ≤ σ ≤ a

3. **Find $x(t)$ if $X(s)=\frac{(\square+\square)}{(\square+\square)(\square+\square)}$ for the ROC σ < -3**

a. $[e^{-2t} – 2e^{-3t}] u(t)$
b. $[e^{-3t} + e^{2t}] u(t)$
c. $[e^{2t} – e^{-3t}] u(-t)$
d. $[e^{-2t} – 2e^{-3t}] u(-t)$

4. **Evaluate L.T. of $x(t) = u(t-a)$**

a. $1/s^2$
b. e^{at}/s
c. e^{-as}/s
d. e^{as}/s

5. **Evaluate L.T. of $x(t) = [e^{-at} \cos 5t\, u(t)]$**

a. $\frac{s-1}{(s-1)^2+25}$

b. $\frac{s+1}{s^2+5}$

c. $\frac{s-1}{s^2-s^2+25}$

d. $\frac{s}{(s-1)^2+5}$

6. Evaluate *I.L.T.* of $X(s) = \frac{s}{s^3+3s^2+3s+1}$

a. $6\,e^{2t}$

b. $8\,e^{-8t}$

c. $6\,t\,e^{-3t}$

d. $9\,t\,e^{-4t}$

***7.* Evaluate L.T. of $x(t) = [e^{-t}\,u(t)] * [\cos(t-2)u(t-2)]$**

a. $(s) = \frac{s^{-2s}}{(s+1)(s^2+1)}$

b. $(s) = \frac{s\,s^{-2s}}{(s+1)(s^2+1)_{2s}}$

c. $(s) = \frac{s}{(s-1)(s^2-1)}$

d. $(s) = \frac{s}{(s-1)(s^2-1)}$

8. Evaluate initial and Final Value of $s(s)$ $\frac{(2s+3)}{s^2+5s+6}$ =

a. $x(0) = 2, x(\infty) = 0$

b. $x(0) = 0, x(\infty) = 2$

c. $x(0) = -3, x(\infty) = 0$

d. $x(0) = 2, x(\infty) = -4$

9. Match the following.

a.	T	I.	$\omega/(s^2 + \omega^2)$
b.	$u(t)$	*II.*	$1/s^2$
c.	e^{at}	III.	$1/s$
d.	$\sin \omega t$	IV.	$1/(s-a)$

a. A – II, B – III, C – IV, D – I
b. A – III, B – II, C – IV, D – I
c. A – I, B – II, C – III, D – IV
d. A – IV, B – III, C – II, D – I

***10.* If $x(t) \leftrightarrow X(s)$,**
t x(t)* ↔ *?

a. $-\frac{(s)}{(s)}$

b. $\frac{(s)}{s}$

c. $s\,\frac{}{s}$

d. $-s\,\frac{(s)}{s}$

11. A Laplace Transform exists when _____

A. The function is piece-wise continuous
B. The function is of exponential order
C. The function is piecewise discrete
D. The function is of differential order

a. A & B

b. C & D

c. A & D

d. B & C

***12.* Evaluate the L.T. of - $e^{2t}\,X(t)$**

a. $x(s+2)$

b. $2\,x(s)$

c. $x(s-2)$

d. $x(s)/2$

13. Region of convergence of *X(s)* contain

a. zeros

b. poles

c. no zero

d. no pole

HOT* (Higher Order Thinking) Questions

CO Mapped – CO4

1. The Laplace Transform of

$$f(t)=e^{2t}\sin(5t)u(t)$$

is

a. $5/s^2-4s+29$

b. $5/s^2+5$

c. $S-2/s^2-4s+29$

d. $5/s+5$

2. The transfer function of a system is $Y(S)/R(S) = S/S+2$. The steady state output $y(t)$ is $A\ cos(2t+\varphi)$ for the input $\cos(2t)$ The values of A and φ respectvely are:

a. $12\sqrt{},-45^\circ$

b. $12\sqrt{},+45^\circ$

c. $2\sqrt{},-45^\circ$

d. $2\sqrt{},+45^\circ$

1.8 a. Unit No.-VI

Probability and Random Signals

Pre-requisites:- Probability theory

Objectives:-

1. To use the concept of probability to understand various probability models.
2. To Introduce the concept of Random variable to understand and analyze CDF and PDF.
3. To Introduce the Concept of Correlation ofsignals.

Outcomes:-

1. Perform Statistical analysis of signals using probability theory
2. Implement the properties of CDF and PDF for systemanalysis.
3. Use the properties of correlation to design and analyze the systems.

Lecture No.	Details of the Topics to be covered	References	CO Mapped	PI Mapped
1	**Probability:** Experiment, sample space, event, probability	R2, E2	**5**	1.1.1 – 2 2.1.3 – 2 2.4.1 - 2
2	Conditional probability and statistical independence, Bayes theorem	R2, E2		
3	Uniform and Gaussian probability models.	R2, E2		
4	**Random variables:** Continuous and Discrete random variables, cumulative distributive function, Probability density function	R2, E2		
5	properties of CDF and PDF	R2, E2		
6	Statistical averages, mean, moments and expectations, standard deviation and variance	R2, E2		
7	Probability Distribution models, CDF/PDF and their statistical parameters	R2, E2		

Question Bank Theory

Tutorial 9

CO Mapped – CO5

Q1) Determine the auto correlation function energy spectral density of

$x(t)=\cos \pi t(t+2)$ and sketch the auto correlation.

Q2) Find auto correlation PSD and power of given signal

$x(t)=2 \cos t +3 \cos 3t + 5 \sin 4t$.

Q3) Prove that auto correlation and Energy Spectral Density form a FT pair. Verify the same for the given signal:

$x(t)=e^{-at}$.

Q4) Obtain the cross correlation of following discrete time signal

$x[n]=\{\underline{1},2,3,4\}$

$y[n]=\{\underline{3},2,1,0\}$

using graphical and analytical expression method.

Q5) Find the following for given energy signal $x(t)= e^{-4t} u(t)$.

Find- i) auto correlation

ii) Energy

iii) Energy from definition

iv) ESD using autocorrelation

v) ESD from definition

Q6) For a given power signal $x(t)= 6 \sin(2t)$

Find- i) Auto correlation

ii) Power from autocorrelation

iii) Power from definition

iv) PSD from autocorrelation

v) PSD from definition

Tutorial No. 10

CO Mapped – CO5

Q1) The PDF of RV of 'x' is defined as $f_x(x)=\begin{cases} \square\square^{-4\square}, & \square > 0 \\ 0, & \square \leq 0 \end{cases}$

Find- i) constant k

ii) p(1<x<2)

iii) p(x >= 3)

iv) p(x<1)

Q2) A random variable x is defined by CDF $F_x(x)= \begin{cases} 0, & \square < 0 \\ \frac{\square}{2}, & 0 \leq \square \leq 1 \\ \square, & \square \geq 1 \end{cases}$

Find- i) constant k

ii) sketch PDF

iii) P(x>=2)

Q3) PDF of a random variable 'x' is given as $F_x(X)= e^{-x}$ for x>=0 Find-i) Mean f(x)

ii) mean square $f(x^2)$

iii) Variance

iv) Step deviation

Q4) Explain Gaussian probability model w.r.t its density & distribution function. Derive its expression for CDF.

Q5) List and explain the properties of CDF and PDF.

Q6) Explain uniform distribution model and obtain its CDF, means, square value and variance.

Q7) Suppose that a certain RV bias CDF $f_x(x)=\begin{cases} 0, & \square \leq 0 \\ \square\square^2, & 0 \leq \square \leq 10 \\ 100\square, & \square > 10 \end{cases}$

Find-i) constant k

ii) P(x<=5)

iii) Calculate P(5<=x<=7)

iv) Sketch PDF

Q8) Find mean, second moment and standard deviation of 'x' when

$F_x(x)=Ae^{-A\alpha}\,u(\alpha)$.

Q9)If the PDF of RV is given by $F_x(x)=(1-x)^2$, 0 <= x <= 1

Then find mean, mean square value, variance, standard Deviation.

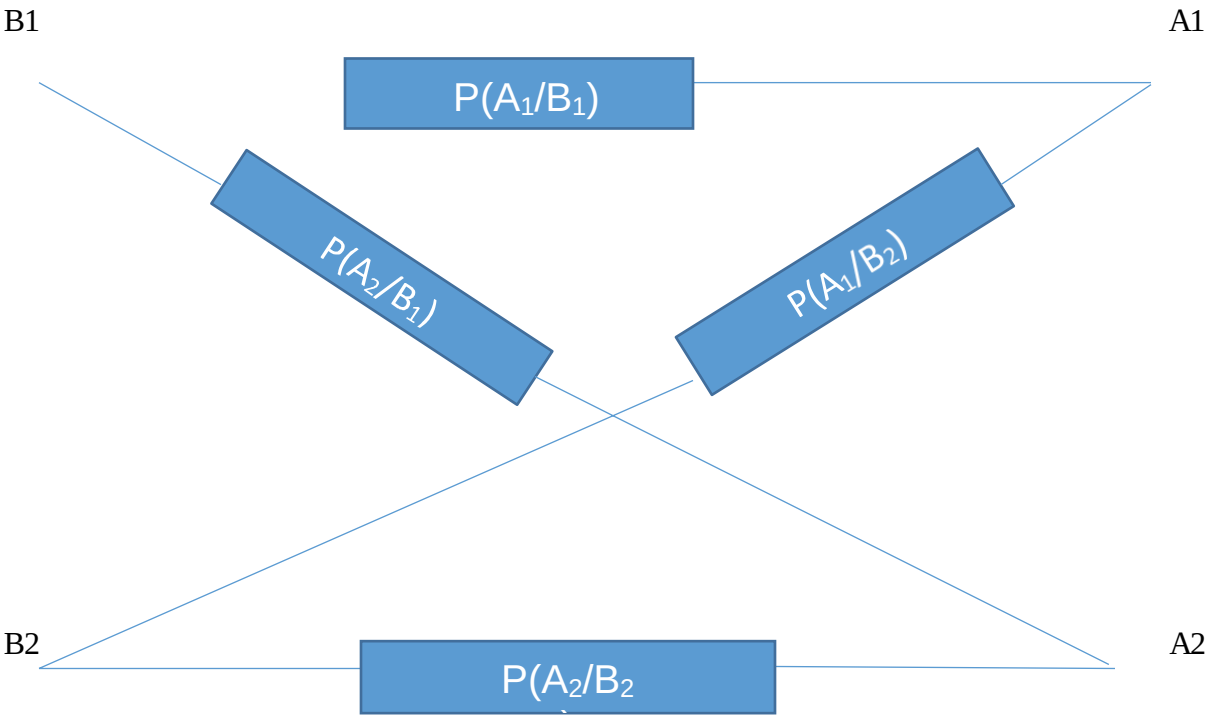
Q10) For the binary symmetric channel obtain probability for

Find-i) Correct Transmission

ii) Transmission with Error

where i) $P(B_1)= 0.6$

ii) $P(B_2)= 0.4$



Question Bank: Multiple Choice Questions (MCQs)

CO Mapped – CO5

1.	Three unbiased coins are tossed, what is the probability of getting at least 2 tails ?	
	a. 1/3	b. 1/6
	c. 1/8	d. 1/2
2.	*In a throw of dice what is the probability of getting number greater than 5?*	
	a. 1/3	b. 1/2
	c. 1/5	d. 1/6
3.	*What is the probability of getting a sum 9 from two throws of dice.*	
	a. 1/3	b. 1/9
	c. 1/12	d. 2/9
4.	A numerical description of the outcome of an experiment is called a - a. descriptive statistic b. probability function c. variance d. random variable	
5.	The probability associated with the reduced sample space is called:	
	a. Conditional probability	b. Statistical probability
	c. mathematical probability	d. Subjective probability
6.	Five cards are selected at random from a pack of 52 cards with replacement The possible combinations are:	
	a. *52*	b. 52^5
	c. *52X52*	d. 5^{52}
7.	If P(B/A)= 0.50 and P(A∩B) = 0.40, then p(A) will be equal to:	
	a. 0.4	b. 0.8
	c. 0.5	d. 1
8.	If P(A/B) = P(A) and P(B/A)=P(B), then A and B are:	
	a. Mutually exclusive	b. Dependent

	c. Equally likely	d. Independent
9.	If A and B are any two events, then P(A'/B) is equal to:	
	a. P(A/B)	
	b. 1-P(A/B)	
	c. 1+P(A/B)	
	d. None of these	
	a.	
10.	**A fair six-sided die is rolled 6 times. What is the probability of getting all outcomes as unique?**	
	a. 0.01543	*b. 0.024569*
	c. 0.04562	*d. 0.03562*

HOT* (Higher Order Thinking) Questions

CO Mapped – CO5

1. **Probability density function of a random variable *X* is givenbelow**

$f(x)=\{0.25 , \quad 1\leq x\leq 5$

$= 0 \quad$ otherwise

P(X≤4) is

a. 3/4
b. 1/2
c. 1/4
d. 1/8

2. **The probability density function of a random variable, $ x $ is**

$f(x) = x/4(4-x^2) \quad$ for $0\leq x\leq 2$

$=0 \quad$ otherwise

The mean, μ_x of the random variable is _____

3. **If f(x) and g(x) are two probability density functions,**

$$f(x) = x/a+1 \quad :-a \leq x<0$$

$$-x/a+1 \quad :0 \leq x<a$$

$$0 \quad : \text{otherwise}$$

$$g(x) = -x/a \quad :-a \leq x<0$$

$$x/a \quad :0 \leq x<a$$

$$0 \quad : \text{otherwise}$$

Which one of the following statements is true ?

a. Mean of $f(x)$ and $g(x)$ are same; Variance of $f(x)$ and $g(x)$ are same
b. Mean of $f(x)$ and $g(x)$ are same; Variance of $f(x)$ and $g(x)$ are different
c. Mean of $f(x)$ and $g(x)$ are different; Variance of $f(x)$ and $g(x)$ are same
d. Mean of $f(x)$ and $g(x)$ are different; Variance of $f(x)$ and $g(x)$ are different

4. A two-faced fair coin has its faced designated as head (H) and tail(T). This coin is tossed three times in succession to record the following outcomes. H, H, H. If the coin is tossed one more time. the probability (up to one decimal place) of obtaining H again, given the previous realizations of H, H and H would be _____

1. Name of the Course – Principles of Communication Systems

Weekly Work Load(in Hrs)	**Lecture**	**Tutorial**	**Practical**
	3 Hrs/ Week	--	2 Hrs/Week

In-sem (Theory)	**End-sem (Theory)**	**Practical**	**Total Marks**	**Credit**
30 marks	**70 marks**	**50 marks**	**150 marks**	**3 + 1**

1.1 Syllabus

Unit I: Signals & spectra (8 L)

Introduction to Communication System, Analog and Digital messages, regenerative repeaters, Signal Bandwidth & Power. Size & classification of signal, exponential Fourier series, concept of negative frequencies. Fourier transform and properties, Frequency shifting, Concept of baseband and bandpass signals, Signal transmission through LTI system. Signal energy & Energy Spectral density. Signal power & Power Spectral Density, Input and output PSD, PSD of modulated signal.

Unit II: AM transmission & reception for signal tone (8 L)

Need for frequency translation, Amplitude modulation (DSB-C), Double sideband Suppressed carrier (DSB-SC) modulation, Single sideband modulation (SSB), Vestigial Sideband modulation (VSB),Spectrum and Bandwidth of AM, DSB-SC, SSB & VSB, Calculation of modulation index for AM wave, Modulation index for more than one modulating signals, Power and power efficiency, AM reception.

Unit III: FM transmission & reception for signal tone (8 L)

Phase Modulation (PM) and Frequency Modulation (FM), Relationship between Phase and Frequency Modulation, Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient, Power of FM signal, Bandwidth of tone modulated FM signal, modulation index: AM vs. FM, Spectrum of constant Bandwidth‟ FM, Narrowband and Wideband FM.

FM Modulators and Demodulators: FM generation by Armstrong's Indirect method, frequency multiplication and application to FM, FM demodulator.

Unit IV: Pulse Modulation (6 L)

Need of analog to digital conversion, sampling theorem for low pass signal in time domain, and Nyquist criteria, Types of sampling- natural and flat top. Pulse amplitude modulation & concept of TDM: Channel

bandwidth for PAM, equalization, Signal Recovery through holding. Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation & Detection.

Unit V: Digital Representation of Analog Signals (6 L)
Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Mid-rise & Mid-tread Quantizer. **Companding:** A-law & μ-law. **Pulse Code Modulation system**: Generation & Reconstruction, Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation.

Unit VI: Baseband Digital Transmission (6 L)
Line codes: Properties and spectrum. **Digital Multiplexing and hierarchies:** T1, AT&T, E1, CCITT, Scrambling & Unscrambling. **Synchronization:** Carrier Synchronization, Bit Synchronization and Frame Synchronization. Intersymbol Interference, Equalization.

1.2 Course Objectives

- To familiarize with basic mathematical tools for time and frequency domain analysis of signals.
- To acquaint with the fundamental principles of modulation process and different amplitude and frequency modulation systems.
- To introduce with the concept of Sampling theorem and pulse modulation techniques like PAM, PWM, PPM.
- To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.
- To explain the techniques of waveform coding, multiplexing and synchronization in baseband digital transmission.

1.3 Course Outcomes

At the end of the course the Student will be able to:

- Describe various parameters (power, BW, energy, PSD) of signals in communication systems. (U1) (BTL – 2, Understand)
- Describe the AM and FM systems with mathematical analysis. (U2, U3) (BTL – 2, Understand)
- Explain the sampling theorem and various pulse modulation techniques. (U4) (BTL – 2, Understand)
- Explain the various Digital Modulation techniques. (PCM, DPCM, DM, ADM). (U5) (BTL – 2, Understand)
- Illustrate Describe the techniques of waveform coding, multiplexing and synchronization in baseband digital transmission. (U6) (BTL – 2, Understand)

1.4 Text Books

T1. Taub, Schilling and Saha, “Principles of Communication Systems”, McGraw-Hill, 4th Edition.

T2. B P Lathi, Zhi Ding, “Modern Analog and Digital Communication System”, Oxford University Press, 4th Edition.

1.5 Reference Books

R1. Bernard Sklar and Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Pearson Education 2nd Edition.
R2. Wayne Tomasi, "Electronic Communications System", Pearson Education, 5th Edition.
R3. A. B. Carlson, P B Crully and J C Rutledge, "Communication Systems", Tata McGraw Hill Publication, 5th Edition.
R4. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition.

1.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus

1. MIT OPENCOURSEWARE (ocw.mit.edu/courses/electrical-engineering)
2. https://ocw.mit.edu/courses/find-by-topic/#cat=engineering&subcat=electricalengineering&spec=telecommunications
3. nptel.ac.in/courses/108104091/

1.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned	CO Mapped
1	1	Introduction to Communication System, Analog and Digital messages, regenerative repeaters	T2	1	
2		Signal Bandwidth & Power. Size & classification of signal		2	
3		exponential Fourier series, concept of negative frequencies		3	
4		Fourier transform and properties, Frequency shifting		4	
5		Concept of baseband and bandpass signals, Signal transmission through LTI system		5	
6		Signal energy & Energy Spectral density		6	
7		Signal power & Power Spectral Density		7	
8		Input and output PSD, PSD of modulated signal		8	
9	2	Need for frequency translation, Amplitude modulation (DSB-C)	T1, T2	9	
10		Double sideband Suppressed carrier (DSB-SC) modulation		10	
11		Single sideband modulation (SSB)		11	
12		Vestigial Sideband modulation (VSB)		12	
13		Spectrum and Bandwidth of AM, DSB-SC, SSB & VSB		13	

14		Calculation of modulation index for AM wave		14	
15		Modulation index for more than one modulating signals, Power and power efficiency		15	
16		Problems		16	
17		AM reception		17	
18	3	Phase Modulation (PM) and Frequency Modulation (FM), Relationship between Phase and Frequency Modulation	T1, T2	18	
19		Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient		19	
20		Power of FM signal, Bandwidth of tone modulated FM signal		20	
21		Modulation index: AM vs. FM, Spectrum of constant Bandwidth FM		21	
22		Narrowband and Wideband FM		22	
23		FM Modulators and Demodulators: FM generation by Armstrong's Indirect method		23	
24		Frequency multiplication and application to FM		24	
25		FM demodulator		25	
26	4	Need of analog to digital conversion, sampling theorem for low pass signal in time domain	R2	26	
27		Nyquist criteria, Types of sampling- natural and flat top		27	
28		Pulse amplitude modulation, Channel bandwidth for PAM		28	
29		Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation & Detection		29	
30		Concept of TDM		30	
31		Equalization, Signal Recovery through holding		31	
32	5	Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization	R1, R2, R3	32	
33		Mid-rise & Mid-tread Quantizer, Companding: A-law & μ-law		33	
34		Pulse Code Modulation system: Generation & Reconstruction		34	
35		Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation		35	
36	6	Line codes: Properties and spectrum		36	

		Digital Multiplexing and hierarchies: T1, AT&T, E1, CCITT	R1, R2		
37		Scrambling & Unscrambling, Synchronization: Carrier Synchronization, Bit Synchronization and Frame Synchronization		37	
38		Intersymbol Interference, Equalization		38	

1.8 Unit wise Lecture Plan

3.8 a. Unit No - I

Pre-requisites: -

- Fourier Transform and its properties

Objectives: -

- To introduce Communication System, types of messages
- To describe various parameters of signals
- To equip/ familiarize students with basic mathematical tools for time and frequency domain analysis of communication signal and systems

Outcomes: - Describe various parameters (power, BW, energy, PSD) of signals in communication systems.

PI Mapped: - 1.3.1, 1.4.1, 2.1.2, 2.1.3

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Introduction to Communication System, Analog and Digital messages, regenerative repeaters	**T2**	
2	Signal Bandwidth & Power. Size & classification of signal		
3	Exponential Fourier series, concept of negative frequencies		
4	Fourier transform and properties, Frequency shifting		
5	Concept of baseband and bandpass signals, Signal transmission through LTI system		
6	Signal energy & Energy Spectral density		
7	Signal power & Power Spectral Density		
8	Input and output PSD, PSD of modulated signal		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
	Unit I		
1	Explain the block diagram of Communication System.	6	

2	Differentiate between Analog and Digital messages.	6	
3	Explain the role of regenerative repeaters.	6	
4	Explain signal bandwidth and its power.	4	
5	What is the concept of negative frequencies? Explain its significance.	4	
6	Describe the properties of Fourier Transform.	6	
7	Explain the concept of baseband and bandpass signals.	4	
8	How is the transmission of signal through LTI system? Explain.	6	
9	Compare and contrast between the signal energy and signal power.	6	
10	Compare and contrast between the energy spectral density and power spectral density.	6	

Oral Questions
(CO Mapped –)

Q 1. What are Analog and Digital messages?
Q 2. Why Regenerative repeaters are required? Are they feasible for both analog and digital systems?
Q 3. Define Signal Bandwidth.
Q 4. What is a signal? Classify them.
Q 5. What is the concept of negative frequencies?
Q 6. What are Fourier transform properties?
Q 7. What are baseband and bandpass signals?
Q 8. What is an LTI system?
Q 9. Define Signal energy & Energy Spectral density.
Q 10. Define Signal power & Power Spectral Density.
Q 11.Draw and explain differences in Continuous time and Discrete time signal.
Q 12.Draw and explain differences in Analog and Digital signal.
Q 13.Draw and explain differences in Periodic and Non-periodic signal.
Q 14.Draw and explain differences in Energy and Power Signals.
Q 15. Differentiate between Energy and Power Signals.
Q 16.Draw and explain differences in Deterministic and Random signal.
Q 17. Differentiate between Deterministic and Random signal

3.8 b. Unit No – II

Pre-requisites: -

- Fourier Transform and its properties

Objectives:-

- To acquaint with the fundamental principles of modulation process and different amplitude modulation systems
- Comparison and analysis of Amplitude modulation techniques

Outcomes: - Describe the AM and FM systems with mathematical analysis.

PI Mapped: - 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Need for frequency translation, Amplitude modulation (DSB-C)	**T1, T2**	
2	Double sideband Suppressed carrier (DSB-SC) modulation		
3	Single sideband modulation (SSB)		
4	Vestigial Sideband modulation (VSB)		
5	Spectrum and Bandwidth of AM, DSB-SC, SSB & VSB		
6	Calculation of modulation index for AM wave		
7	Modulation index for more than one modulating signals, Power and power efficiency		
8	Problems		
9	AM reception		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
	Unit I		
1	For a baseband signal m(t)cos(wmt), find the DSBSC signal and sketch its spectrum. Identify the USB and LSB.	6	
2	What do you mean by ISB and VSB? Also explain their generation methods.	6	
3	Derive the expression for AM, Sketch the waveform and explain power relations for DSB-FC.	6	
4	A carrier wave Vc = 4 Sin (2□ x 500 x 103t) is AM modulated by audio wave Vm = 0.2 Sin 3[(2□ x 500t) + 0.1 Sin 5(2□ x 500t)]. Determine the upper and lower sidebands and sketch the complete spectrum of the modulated wave. Estimate total power in sidebands.	5	
5	Explain Independent sideband system with help of block diagram.	5	
6	Define modulation. State various types of modulation schemes along with their waveforms.	4	
7	State and compare different SSB generation methods.	6	
8	With neat diagram explain ring modulator for DSBSC generation. Draw waveform and spectrum for DSBSC.	6	
9	An AM transmitter has carrier of 500 W which is modulated upto a depth of 40%. Find the total power in the transmitted wave.	5	
10	What is baseband transmission? What are its limitations?	6	
11	Compare between AM, FM and PM.	10	
12	Explain AM broadcast technical standards.	5	
13	Explain the phase shift method for generating SSB-SC. State its advantages and disadvantages.	6	
14	Compare between DSB-FC, DSB-SC and SSB-SC.	6	

15	What is carrier communication? Explain the types of the same.	6	

Oral Questions
(CO Mapped)

Q 1. What is modulation? Its types. Need for modulation.
Q 2. Explain block diagram of basic communication systems
Q 3. What is AM? Draw the waveforms for DSB-FC, DSB-SC and SSB signals in time and frequency domain.
Q 4. Write equation for AM.
Q 5. Give the broadcast range for AM.
Q 6. Give the audio range.
Q 7. Give the voice range.
Q 8. Give the need for modulation.
Q 9. Types of AM system.
Q 10. BW required for AM.
Q 11. Use of balanced modulator in case of AM
Q 12. Draw 100% modulated waveform and DSB-SC waveform and differentiates.
Q 13. Define modulation index. Its equation. Formula. How practically m is measured? Why do we use trapezoidal method?
Q 14. What is the maximum power transmitted by AM?
Q 15. Prove power saving is 66.66% if the sidebands are suppressed. Derive.
Q 16. What if carrier and side-bands are suppressed?
Q 17. Differentiate between AM transmitter and modulator.
Q 18. What is DSB-SC? Advantages. It's BW.
Q 19. What is SSB? Advantages. It's BW.
Q 20. What is VSB? Its applications. It's BW.
Q 21. Types of generation of SSB? Advantages. It's BW.
Q 22. Block diagram of SSB generation methods.
Q 23. Give the types of balanced modulators.

MCQs

Question	Choose the correct statement in AM
A	Sideband power is always constant
B	Transmitted power is always constant
C	Carrier power is constant
D	Bandwidth is infinite
Answer	C
Marks	1
CO mapped	II

Question	The amplitude modulator works on the principle of
A	Multiplication
B	Addition
C	Subtraction

D	division
Answer	A
Marks	1
CO mapped	II

Question	Let m(t) be band limited to fm Hz. The bandwidth requirement of the signal m(t)cos2Πfct
A	fm
B	fm/2
C	2fm
D	fc
Answer	C
Marks	1
CO mapped	II

Question	Video signal in TV are
A	Amplitude modulated
B	Frequency Modulated
C	Demodulated
D	Unmodulated
Answer	A
Marks	1
CO mapped	II

Question	The carrier power of an AM wave is 6 KW,with modulation index of 0.5, the total transmitted power is
A	8 KW
B	6.75 KW
C	8.75 KW
D	9 KW
Answer	B
Marks	1
CO mapped	II

Question	Why Class C amplifier is used in AM Generation
A	High efficiency
B	Low efficiency
C	Low fidelity
D	High response
Answer	A
Marks	1
CO mapped	II

Question	SSB-SC modulation is not used for audio broadcasting because
A	It is difficult to generate SSB-SC signal
B	It makes the receiver circuit quiet complex and expensive
C	SSB-SC modulation cannot be used for speech signal
D	None of the above
Answer	B
Marks	1
CO mapped	II

Question	A carrier wave of 10 MHz frequency and peak value of 10 V is amplitude modulated by a 5 KHz sine wave of 6V amplitude. Its modulation index is
A	1.66
B	0.6
C	4
D	0.6 V
Answer	B
Marks	1
CO mapped	II

Question	For a 100%, AM modulated wave with carrier suppressed, the percentage power saving will be
A	100
B	50
C	150
D	66.66
Answer	D
Marks	1
CO mapped	II

Question	Given an AM radio signal with a bandwidth of 10 KHz and the highest-frequency component at 705 KHz, what is the frequency ofthe carrier signal?
A	700 kHz
B	705 kHz
C	710 kHz
D	Cannot be determined
Answer	A
Marks	1
CO mapped	II

Question	Which of the following is not an advantage of the phase method over the filter method in producing SSB?

A	The design of the 90º phase-shift network for the intelligence frequencies is simple
B	Lower intelligence frequencies can be economically used, because a high-Q filter is not necessary.
C	Intermediate balanced modulators are not necessary, because high-Q filters are not needed
D	It is easier to switch from one sideband to the other.
Answer	A
Marks	1
CO mapped	II

Question	What is the difference between a balanced modulator and a regular modulator?
A	There is no carrier produced in the output of a balanced modulator
B	In a balanced modulator, there is 180º phase shift between the upper and lower sidebands
C	In a balanced modulator, only one sideband is produced
D	In a balanced modulator, harmonics of the sidebands are suppressed
Answer	A
Marks	1
CO mapped	II

Q. No.	Question	Marks	CO Mapped
	Unit 2		
1	Explain the tracking methods in Super heterodyne radio receiver.	6	
2	In a broadcast super heterodyne radio receiver, the loaded Q of the aerial coupling circuit at input of mixer is 125. If intermediate frequency 465 KHz. Calculate, i) Image Frequency and its rejection at 1 MHz and 30MHz ii) The IF required to make the Image rejection ratio as good at 30MHz as it is at 1MHz.	6	
3	The frequency span to be received is from 525 - 1650KHz. If Cmin of tuning circuit is limited to 50pf by a trimmer of 25pf. Calculate the value of padder capacitor. The max value of variable capacitor is 450pf, IF is 465KHz.	6	
4	Explain the characteristics of radio receivers.	6	
5	What are the different types of distortions that occur in a typical diode detector circuit? Explain with proper waveforms.	4	
6	Explain how a diode can be used to detect an AM signal. What are the different types of distortions that occur in a typical diode detector circuit?	4	
7	For tone modulation derive the equation for upper limit of RC to ensure the capacitor follows the envelope of an AM DSBFC wave.	6	
8	Explain with waveforms and block diagram AM super heterodyne receiver.	6	
9	Compare TRF and super heterodyne receivers.	6	

10	Explain with waveforms and block diagram Dual conversion super heterodyne receiver.	8	

Oral Questions
(CO Mapped)

Q 1. State the different AM detection techniques. Draw simple practical diode detector.
Q 2. Explain distortions observed in diode detector with reason.
Q 3. Why envelope detector is named so?
Q 4. Define selectivity.
Q 5. Define sensitivity.
Q 6. Define image rejection ratio.
Q 7. Define fidelity.
Q 8. Draw curves for receiver characteristics.
Q 9. List drawbacks of TRF receiver.
Q 10. How are the shortcomings of TRF receiver overcome?

MCQs

Question	A high value of IF for a Super heterodyne receiver
A	Improve image frequency rejection ratio
B	Improves the selectivity
C	Improves the sensitivity
D	Improves the fidelity
Answer	A
Marks	2
CO mapped	2

Question	F1 and F2 are the inputs of Mixer what is the o/p of mixer
A	F1 and F2
B	F1+F2
C	F1-F2
D	All of these
Answer	D
Marks	2
CO mapped	2

Question	The key difference between IF and audio amplifier is
A	The use of filtration component
B	Voltage requirements
C	Audio amplifiers usually are in IC form
D	Frequency of operation
Answer	D
Marks	1

CO mapped	2

Question	The frequency of input signal of a Superheterodyne AM receiver is 1000KHz, the local frequency required to tune the signal is.....
A	1455KHz
B	550KHz
C	570KHz
D	530KHz
Answer	A
Marks	2
CO mapped	2

Question	A Superheterodyne AM broadcast receiver has an IF of 455 KHz. If it is tuned to a frequency of 700 KHz, the image frequency is
A	1610KHz
B	1155KHz
C	245KHz
D	210KHz
Answer	A
Marks	1
CO mapped	2

Question	The negative tracking error is present in
A	Trimmer tracking
B	Padder tracking
C	Two point Tracking
D	None of these
Answer	A
Marks	1
CO mapped	2

Question	If the sensitivity for three receivers is 10µV, 12µV, 6µV respectively at 1000KHz which one is the most sensitive.
A	10µV
B	12µV
C	6µV
D	None of these
Answer	C
Marks	2

CO mapped	2

Question	AM receivers operate in which bands of frequencies?
A	Medium wave
B	Short wave
C	High frequency wave
D	both A and B
Answer	D
Marks	1
CO mapped	2

Question	RF carrier range for Medium wave band signal is
A	bellow 455k
B	455 to 1000k
C	535k to 1650k
D	above 1650k
Answer	C
Marks	1
CO mapped	2

3.8 c. Unit No.-III

Pre-requisites: -

- Fourier Transform and its properties
- Amplitude modulation and its advantages-disadvantages

Objectives: -

- To acquaint with the fundamental principles of modulation process and different frequency modulation systems

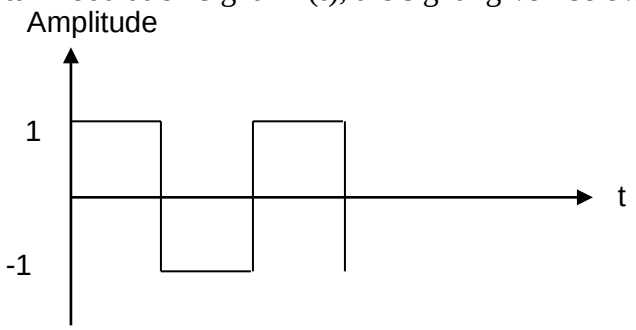
Outcomes: - Describe the AM and FM systems with mathematical analysis.

PI Mapped: - 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Phase Modulation (PM) and Frequency Modulation (FM), Relationship between Phase and Frequency Modulation	**T1, T2**	
2	Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient		
3	Power of FM signal, Bandwidth of tone modulated FM signal		

4	Modulation index: AM vs. FM, Spectrum of constant Bandwidth FM		
5	Narrowband and Wideband FM		
6	FM Modulators and Demodulators: FM generation by Armstrong's Indirect method		
7	Frequency multiplication and application to FM		
8	FM demodulator		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
	Unit III		
1	Sketch Frequency Modulation (FM) and Phase Modulation (PM) waveform for the digital modulation signal m(t), the signal given below:  Figure 1 The constants kf and kp are ($2\pi * 10^5$) and ($\pi/2$) respectively and fc = 100 MHz. Calculate the frequencies present in the FM and PM waves. What is the limitation on the product kpm(t)?	6	
2	Design and draw the block diagram of Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency of 98.1 MHz and Δf = 75 KHz. A narrowband FM generator is available at a carrier frequency of 1000 KHz and Δf = 10 Hz with the oscillator having an adjustable frequency in the range of 10-11 MHz. Frequency doublers, triplers are available.	8	
3	Derive an expression for frequency and phase modulated wave. Sketch the Waveforms.	8	
4	An angle modulated signal is described by the equation □EM(t) = 10 Cos (2□ $\mathbf{f_m}$ t + 4 sin 2 □ fm t) where fc = 10 MHz and fm = 1000Hz. i) Determine the Modulation Index. Estimate the transmitted signal bandwidth ii) Repeat (i) fm is doubled.	5	
5	Explain the Direct method for FM generation with block diagram.	8	
6	Explain the Armstrong method of FM generation with suitable block diagram.	8	
7	Why is FM known as constant bandwidth system? Compare between NBFM and WBFM.	5	

8	A carrier $E_c cos\omega_c t$ is modulated by a signal $f(t) = 2cos2\pi t + 6cos10^3 2\pi t + 7cos10^3 4\pi t$. Find the bandwidth of FM using Carson's rule. Assume $K = 10 \times 10^3$ *Hz per volt*. Also find the 'deviation ratio'.	8	
9	A carrier is frequency modulated with a sinusoidal signal of 2 kHz resulting in frequency deviation of 5 kHz : (i) Find bandwidth of modulated signal. (ii) The amplitude of modulating sinusoid is increased by a factor of 3 and its frequency is halved. Find the maximum frequency deviation and bandwidth of new modulated signal.	8	
10	Describe threshold in angle modulation.	8	
11	With the help of mathematical expression explain which is superior PM/FM.	6	
12	Give the equation for FM and PM. Give the difference in bandwidth when: (i) Amplitude of modulating signal is doubled (ii) Frequency of modulating signal is halved.	6	
13.	An angle modulated signal with carrier frequency wc = $(2 * \pi * 10^6)$ is described by the equation $\Phi_{EM}(t) = 10 \cos(w_c t + 0.2 \sin 1000\pi t)$ (i) Find the power of modulated signal, (ii) Find the modulation index, (iii) Find the frequency deviation, (iv) Estimate the bandwidth.	6	
14.	Explain with block diagram FM stereo transmitter.	6	

Oral Questions
(CO Mapped)

Q 1. Give the FM Broadcast range. How many sidebands are there? It's BW. Q
2. Differentiate between high level modulation and low level modulation. Q 3.
Differentiate between Narrow band FM and wideband FM.
Q 4. Draw the waveforms for FM and PM. Explain the difference.
Q 5. Give the mathematical representation of FM. It's modulation index. Frequency deviation.
Q 6. Define the significant bands. What is the significant band in FM?
Q 7. Give the frequency spectrum of FM.
Q 8. What is pre-emphasis and de-emphasis?
Q 9. Draw the block diagram of Armstrong method
Q 10. Draw the diagram for varactor diode method
Q 11. State the radio channel ranges in Pune.
Q 12. If information signal is absent, what is the output of modulator?

MCQs

Question	In FM broadcasting, the peak frequency deviation and the maximum audio frequency handled, are respectively
A	75KHz, 10 KHz
B	75KHz, 15 KHz

C	200KHz, 10 KHz
D	75KHz, 5KHz
Answer	B
Marks	1
CO mapped	2

Question	Range of FM is
A	91.1MHz to 101MHz above 93.1 MHz
B	88Mhz to 108MHz
C	Above 93.1 MHz
D	None of these
Ans	B
Marks	1
CO mapped	2

Question	The amount of frequency deviation from the carrier center frequency in an FM transmitter is proportional to what characteristic of the modulating signal?
A	Amplitude
B	Frequency
C	Phase
D	shape
Answer	A
Marks	1
CO mapped	2

Question	Both FM and PM are types of what kind of modulation?
A	Duty Cycle
B	Amplitude
C	Phase
D	Angle
Answer	D
Marks	1
CO mapped	2

Question	The phenomenon of a strong FM signal dominating a weaker signal on a common frequency is referred to as the
A	Quieting factor
B	Blot out
C	Capture effect

D	Domination syndrome
Answer	C
Marks	1
CO mapped	2

Question	The maximum deviation of an FM carrier is 2KHz by a maximum modulating signal of 400Hz. The deviation ratio is
A	5
B	0.2
C	8
D	40
Answer	A
Marks	1
CO mapped	2

Question	A 100 MHz carrier is deviated 50 KHz by a 4KHz signal. The modulation index is
A	12.5
B	5
C	8
D	20
Answer	A
Marks	1
CO mapped	2
Question	The FM produced by PM is called
A	Indirect PM
B	Indirect FM
C	PM
D	FM
Answer	B
Marks	1
CO mapped	2

Question	Advantages of angle modulation over amplitude modulation are ---------
A	Noise reduction
B	More efficient use of power
C	Improved system fidelity
D	All of these
Answer	D
Marks	1
CO mapped	2

Question	Angle modulation is used for --------
A	Radio broadcasting
B	Cellular radio

C	Microwave communication
D	All of the above
Answer	D
Marks	1
CO mapped	2

Question	The only way to solve the expression for FM wave is to use----------
A	Fourier transform
B	Bessel's function
C	Laplace transform
D	Both A and C
Answer	B
Marks	1
CO mapped	2

Question	To produce frequency modulation using a phase modulator
A	The message signal must be integrated and then used for modulation
B	The message signal must be differentiated and then used for modulation
C	The phase modulated signal must be integrated
D	The phase modulated signal must be differentiated
Answer	A
Marks	1
CO mapped	2

Question	How many sidebands are present in spectrum of FM
A	Infinite
B	two
C	four
D	three
Answer	A
Marks	1
CO mapped	2

Question	The transmitted power in FM is

A	Dependent on number of sidebands
B	Always Constant
C	Dependent on carrier power
D	None of these
Answer	B
Marks	1
CO mapped	2

Question	Modulation Index of wide band FM system is …..
A	m=1
B	m>1
C	m<1
D	None of these
Answer	B
Marks	1
CO mapped	2

Question	For the broad casting application ..... used
A	Narrowband FM
B	Wideband FM
C	PM
D	AM
Answer	B
Marks	1
CO mapped	2

Question	Armstrong method is …..
A	Direct method to generate a FM
B	Direct method to generate a PM
C	Indirect method to generate a PM
D	Indirect method to generate a FM
Ans	D
Marks	1
CO mapped	2

Question	Standard FM broadcast stations use a maximum bandwidth of
A	150 kHz
B	200 kHz
C	75 kHz
D	15 kH
Answer	B
Marks	1
CO mapped	2

Question	In FM modulation, when the modulation index increases, transmitted power is
A	Constant
B	Increased
C	Decreased
D	None of the above
Answer	A
Marks	1
CO mapped	2

Question	The number of significant sideband in FM depend upon
A	Frequency
B	Modulation index
C	Phase
D	Amplitude
Answer	B
Marks	1
CO mapped	2

Question	Amplitude of PM wave
A	Remains constant
B	Change in proportion to the modulating voltage.
C	Change in proportion to the modulating frequency.
D	Phase
Answer	A
Marks	1
CO mapped	2

Question Bank: Theory

Q.No.	Question	Marks	CO Mapped

1	Draw the block diagram of FM super heterodyne radio receiver. Explain working of each block mentioning the typical frequencies at different points.	8	
2	Explanation the need of Pre-Emphasis and De-Emphasis with their respective frequency response in FM.	8	
3	Discuss the importance of Pre-emphasis and De-emphasis network in the performance of FM system.	8	
4	Explain FM detection using PLL.	8	
5	Explain with block diagram FM stereo receiver.	8	
6	Explain with block diagram two way FM radio receiver.	8	
7.	Describe working of slope detector and balanced slope detector.	8	

Oral Questions
(CO Mapped – CO2)

Q 1. Give the detection methods for FM
Q 2. Draw S-curve. Explain.
Q 3. Draw the diagram of balanced slope detector
Q 4. Draw the diagram of phase discriminator and ratio detector.
Q 5. What is amplitude limiter? Need of amplitude limiting in AM or FM. Why?
Q 6. Draw the TRF radio receiver.
Q 7. Draw the super heterodyne receiver.
Q 8. Explain the super heterodyne principle.
Q 9. Draw the waveform at each and every block of the receiver.
Q 10. Give the IF, FM and AM value.
Q 11. What are the selection criteria for IF?
Q 12. What is adjacent channel rejection? What is Image frequency rejection?
Q 13. Define sensitivity, selectivity and fidelity
Q 14. Give the methods of measurement and what is measured first.
Q 15. What is AFC, AGC and delayed AGC?
Q 16. Give the block diagram of FM communication receiver.
Q 17. Draw the graph of sensitivity, selectivity, and fidelity. Q
18. What is meant by tracking?
Q 19. Why the oscillator is called Local oscillator in case of receiver?
Q 20. What are the other types of oscillators?
Q 21. What is the function of RF?
Q 22. Which range is responsible for sensitivity, and selectivity?
Q 23. What is meant by double conversion?
Q 24. What is the use of scquelch circuit?
Q 25. What is pilot carrier?
Q 26. What is ISB? Spectrum. BW. Diagram for ISB receiver.

MCQs

Question	The standard intermediate frequency used in super heterodyne FM receivers is

A	88KHz
B	455KHz
C	15KHz
D	10.7KHz
Answer	D
Marks	1
CO mapped	2

Question	Pre-emphasis is used to:
A	increase the signal to noise ratio for higher audio frequencies
B	increase the signal to noise ratio for lower audio frequencies
C	increase the signal to noise ratio for all audio frequencies
D	allow stereo audio to be carried by FM stations
Answer	A
Marks	1
CO mapped	2

Question	A high value of IF for a Super heterodyne receiver
A	Improve image frequency rejection ratio
B	Improves the selectivity
C	Improves the sensitivity
D	Improves the fidelity
Answer	A
Marks	2
CO mapped	2

Question	A occurrence of double spotting indicates.....
A	that the selectivity is too poor
B	That the IF is too high
C	That image frequency rejection capability of the receiver is inadequate
D	That the local oscillator frequency is less than incoming signal
Answer	C
Marks	2
CO mapped	2

Question	IF = 455KHz,radio reviver is tuned to 855 KHz, the local oscillator frequency is
A	455 KHz

B	1310 KHz
C	1500 KHz
D	1520 KHz
Answer	B
Marks	2
CO mapped	2

Question	What is the standard value of Intermediate frequency?
A	450KHz
B	455KHz
C	500KHz
D	150KHz
Answer	B
Marks	2
CO mapped	2

3.8 d. Unit No.- IV

Pre-requisites: -

- FT, its properties and FT of periodic signals

Objectives:-

- To introduce with the concept of Sampling theorem and pulse modulation techniques like PAM, PWM, PPM

Outcomes:- Explain the sampling theorem and various pulse modulation techniques.

PI Mapped:- 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Need of analog to digital conversion, sampling theorem for low pass signal in time domain	R2	
2	Nyquist criteria, Types of sampling- natural and flat top		
3	Pulse amplitude modulation, Channel bandwidth for PAM		
4	Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation & Detection		
5	Concept of TDM		

6	Equalization, Signal Recovery through holding		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
	Unit IV		
1.	Compare Digital Pulse Modulation Methods.	10	
2	A 1KHz sine wave is sampled and transmitted using 12bit PCM and DM system. If 25 cycle of the signal are digitized find: i) Signaling rate ii) Bandwidth required iii) Total number of bits transmitted.	8	
3	Explain band limited and time limited signals.	10	
4	What is Nyquist criterion? State sampling theorem in time domain. Draw the spectrum showing aliasing and guard band.	8	
5	With the help of block diagram, explain transmitter and receiver of pulse code modulation.	16	
6	State and prove sampling theorem in time domain.	7	
7	With the help of waveforms explain how PWM and PPM can be generated.	6	
8	Give the circuit for flat top sampling. Explain its working.	6	
9	Explain the types of sampling with waveforms.	6	
10	With the help of neat diagram, explain PWM.	7	

Oral Questions
(CO Mapped)

Q 1. Explain band limited and time limited signals.
Q 2. What is Nyquist criterion?
Q 3. State sampling theorem in time domain.
Q 4. Draw the spectrum showing aliasing and guard band.
Q 5. Explain transmitter and receiver of pulse code modulation.
Q 6. With the help of waveforms explain how PWM and PPM can be generated.
Q 7. Give the circuit for natural sampling. Explain its working.
Q 8. Give the circuit for flat top sampling. Explain its working.
Q 9. Explain the types of sampling with waveforms.
Q 10. Explain Aperture effect.

3.8 e. Unit No.- V

Pre-requisites: -

- FT, its properties and FT of periodic signals

Objectives: -

- To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM

Outcomes: - Explain the various Digital Modulation techniques. (PCM, DPCM, DM, ADM).

PI Mapped: - 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization	**R1, R2, R3**	**CO4**
2	Mid-rise & Mid-tread Quantizer, Companding: A-law & μ-law		
3	Pulse Code Modulation system: Generation & Reconstruction		
4	Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
	Unit V		
1.	Compare Digital Pulse Modulation Methods.	10	
2	A 1KHz sine wave is sampled and transmitted using 12bit PCM and DM system. If 25 cycle of the signal are digitized find: i) Signaling rate ii) Bandwidth required iii) Total number of bits transmitted.	8	
3	Explain band limited and time limited signals.	10	
4	What is Nyquist criterion? State sampling theorem in time domain. Draw the spectrum showing aliasing and guard band.	8	
5	With the help of block diagram, explain transmitter and receiver of pulse code modulation.	16	
6	State and prove sampling theorem in time domain.	7	
7	With the help of waveforms explain how PWM and PPM can be generated.	6	
8	Give the circuit for flat top sampling. Explain its working.	6	
9	Explain the types of sampling with waveforms.	6	
10	With the help of neat diagram, explain PWM.	7	

Oral Questions
(CO Mapped – CO4)

Q 1.What is a quantization process?

Q 2.What is quantization error?
Q 3.What are types of quantization techniques?
Q 4. What is Companding?
Q 5.What is A-law and μ-law Companding?
Q 6. What is PCM?
Q 7. What Differential Pulse code modulation and its advantages and disadvantages?
Q 8.What is Delta Modulation and its advantages and disadvantages?
Q 9.What is Adaptive Delta Modulation and its advantages and disadvantages?
Q 10. Which modulation requires less bandwidth?

3.8 f. Unit No.- VI

Pre-requisites: -

- FT, its properties and FT of periodic signals

Objectives: -

- To explain the techniques of waveform coding, multiplexing and synchronization in baseband digital transmission

Outcomes: - Illustrate Describe the techniques of waveform coding, multiplexing and synchronization in baseband digital transmission.

PI Mapped: - 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
1	Line codes: Properties and spectrum	**R1, R2**	
2	Digital Multiplexing and hierarchies: T1, AT&T, E1, CCITT		
3	Scrambling & Unscrambling, Synchronization: Carrier Synchronization, Bit Synchronization and Frame Synchronization		
4	Intersymbol Interference, Equalization		

Question Bank: Theory

Q. No.	Question	Marks	CO Mapped
Unit VI			
1.	Compare Digital Pulse Modulation Methods.	10	

2	A 1KHz sine wave is sampled and transmitted using 12bit PCM and DM system. If 25 cycle of the signal are digitized find: i) Signaling rate ii) Bandwidth required iii) Total number of bits transmitted.	8	
3	Explain band limited and time limited signals.	10	
4	What is Nyquist criterion? State sampling theorem in time domain. Draw the spectrum showing aliasing and guard band.	8	
5	With the help of block diagram, explain transmitter and receiver of pulse code modulation.	16	
6	State and prove sampling theorem in time domain.	7	
7	With the help of waveforms explain how PWM and PPM can be generated.	6	
8	Give the circuit for flat top sampling. Explain its working.	6	
9	Explain the types of sampling with waveforms.	6	
10	With the help of neat diagram, explain PWM.	7	

Oral Questions
(CO Mapped –)

Q 1. What are lines codes?
Q 2. What is Scrambling and Descrambling?
Q 3. Explain Carrier Synchronization,
Q 4. Explain Bit Synchronization and Frame Synchronization.
Q 5. Explain Intersymbol Interference, Equalization.

3.9 List of Practicals

Course Objectives:

1. To demonstrate different modulation techniques. (Group A: 1, 2, 4, 5, 6, 7, 8).
2. To explain the sampling theorem and aliasing effect. (Group A: 3)
3. To illustrate different line coding techniques and their spectral analysis. (Group A: 9)
4. To simulate PCM, DM system, sampling of a signal, scrambling and descrambling operation using any simulation tool (Group B: 12, 13, 14).

Course Outcomes: -

At the end of the course students will be able to –

CO1: Illustrate different modulation techniques. (Group A: 1, 2, 4, 5, 6, 7, 8).
CO2: Verify the Sampling Theorem and aliasing effect. (Group A: 3)
CO3: Demonstrate different line coding techniques and their spectral analysis. (Group A: 9)
CO4: Simulate PCM, DM system, sampling of a signal, scrambling and descrambling operation using any simulation tool (Group B: 12, 13, 14).

List of Practicals:

Sr. No.	Name of the Experiment
Group A: Hardware Practicals	
1	AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.
2	Frequency modulator & demodulator using Varicap / Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.
3	Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain.
4	Generation and Detection of PWM using IC 555
5	Study of PCM
6	Study of Companded PCM
7	Study of DM: Generation and detection
8	Study of ADM: Generation and detection
9	Study of line codes (NRZ, RZ, POLAR RZ, BIPOLAR (AMI), MANCHESTER) & their Spectral analysis
Group B: Simulation Practicals [Any 3 to be performed]	
10	Simulation of T1/E1 system using suitable software.
11	Simulation program to study effect of ISI and noise in baseband communication system
12	Simulation program to calculate Signal to noise ratio for PCM system & DM system
13	Verify Sampling Theorem using simulation
14	Demonstrate Scrambling and descrambling operation either using hardware or any simulation tool.

Sr. No.	Name of the Practical	CO Mapped
1	AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.	
2	Frequency modulator & demodulator using Varicap / Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.	
3	Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain.	
4	Generation and Detection of PWM using IC 555	
5	Study of PCM	
6	Study of Companded PCM	
7	Study of DM: Generation and detection	

8	Study of ADM: Generation and detection	
9	Study of line codes (NRZ, RZ, POLAR RZ, BIPOLAR (AMI), MANCHESTER) & their Spectral analysis	
10	Simulation program to study effect of ISI and noise in baseband communication system	
11	Simulation program to calculate Signal to noise ratio for PCM system & DM system	
12	Verify Sampling Theorem using simulation	
	AM Generation (DSB-FC): Calculation of modulation index by trapezoidal method, Power of AM Wave for different modulating signal.	

Experiment related questions

Q 1. How to measure modulation index using the AM experimental set up?
Q 2. What is the difference in waveform method and trapezoidal method?
Q 3. What is the formula for calculating modulation index using waveform and trapezoidal method?
Q 4. What is modulating signal and sampling signal frequency?
Q 5. How do observe aliasing effect?
Q 6. Which method is better, Natural sampling or flat top sampling? Why?
Q 7. How to measure frequency deviation, modulation index using the FM experimental set up?
Q 8. How does varactor modulator work?
Q 9. What is simulation?
Q 10. How to plot input signal waveform in Matlab?
Q 11. Which command is used to plot more than one graph in a plot?
Q 12. What is the function of stem command?
Q 13. How to study effect of ISI and noise in baseband communication system?
Q 14. What is the function of the eye pattern plot

Name of Course: Object Oriented Programming

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks
PR: 02 hrs. / week	01	ORAL: 25 Marks

UNIT I: Foundation of Object Oriented Programming

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline functions, Function overloading, call by valueand call by reference, return by reference, functions with default arguments, this pointer, illustrative Simple C++ Programs. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators, arrays

Unit II: Classes & Objects

Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (Complex Class & String Class).

UNIT III: Operator Overloading

Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions

UNIT IV: Inheritance & Polymorphism

Introduction to inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, pointers to objects, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding, container classes, Contained classes,Singleton class.

UNIT V: Templates, Namespaces and Exception handling

Templates: Introduction, Function template and class template, function overloading vs. function templates Namespaces: Introduction, Rules of namespaces Exception handling: Introduction, basics of exception handling, exception handling mechanism, throwing and catching mechanism,

specifying exceptions, Multiple Exceptions, Exceptions with arguments C++ streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators.

UNIT VI: Working with files

Introduction, classes for file Stream Operations, opening and closing files, detecting End_Of_File (EOF), modes f File Opening, file pointers and manipulators, updating file, error handling during fileoperations.

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in C++ To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
- Develop an ability to write programs in C++ for problem solving.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Describe the principles of object oriented programming.

CO2: Apply the concepts of data encapsulation, inheritance in C++.

CO3: Understand Operator overloading and friend functions in C++.

CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs C++.

CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs in C++.

CO6: Describe and use of File handling in C++.

Text Books:

1. E Balagurusamy, "Programming with C++", Tata McGraw Hill, 3rd Edition.

2. Herbert Schildt , "The Complete Reference C++", 4th Edition.

Reference Books:

1. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, 4th Edition.

2. Matt Weisfeld, "The Object-Oriented Thought Process", Pearson Education.

MOOC / NPTEL Courses:

1. NPTEL Course **"Prgramming in Java",** by Prof. Debasis Samanta (IIT Kharakpur)

https://nptel.ac.in/courses/106/105/106105191/

2. NPTEL Course **"Prgramming in C++",** by Prof. Pratha Pritam (IIT Kharakpur)

https://nptel.ac.in/courses/106/105/106105151/

Other Resources:

1. Bjarne Stroustrup, "A Tour of C++"

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline functions, Function overloading, call by value and call by reference, return by reference, functions with default arguments, this pointer, illustrative Simple C++ Programs. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators, arrays.	T1,R1	12
2	II	Defining class, Defining member functions, static data	T1 R1	6

		members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (Complex Class & String Class).		
3	III	Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions	T1 R1	6
4	IV	Introduction to inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, pointers to objects, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding, container classes, Contained classes, Singleton class.	T1 R1	6
5	V	Templates: Introduction, Function template and class template, function overloading vs. function templates Namespaces: Introduction, Rules of namespaces Exception handling: Introduction, basics of exception handling, exception handling mechanism, throwing and catching mechanism, specifying exceptions, Multiple Exceptions, Exceptions with arguments C++ streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators	T1 R1	6
6	VI	Introduction, classes for file Stream Operations, opening and closing files, detecting End_Of_File (EOF), modes f File Opening, file pointers and manipulators, updating file, error handling during file operations	T1 R1	6

Text Books:

1. E Balagurusamy, “Programming with C++”, Tata McGraw Hill, 3rd Edition.
2. Herbert Schildt , “The Complete Reference C++”, 4th Edition.

Reference Books:

1. Robert Lafore, “Object Oriented Programming in C++”, Sams Publishing, 4th Edition.
2. Matt Weisfeld, “The Object-Oriented Thought Process”, Pearson Education.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- NPTEL Course “Prgramming in Java”, by Prof. Debasis Samanta (IIT Kharakpur) https://nptel.ac.in/courses/106/105/106105191/
- NPTEL Course “Prgramming in C++”, by Prof. Pratha Pritam (IIT Kharakpur) https://nptel.ac.in/courses/106/105/106105151/
- Other Resources: 1. Bjarne Stroustrup, “A Tour of C++”

Unit No.-I

Foundation of Object Oriented Programming

Lecture No.	Details of the Topic to be covered	References
1	Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming	T1 R1
2	fundamentals of object-oriented programming: objects, classes, data members, methods, messages,	T1 R1
3	data encapsulation, data abstraction and information hiding, inheritance, polymorphism	T1 R1
4	Inline functions	T1 R1
5	Function overloading	T1 R1
6	call by value	T1 R1
7	call by reference	T1 R1
8	return by reference	T1 R1
9	functions with default arguments	T1 R1
10	Dynamic initialization of variables, memory management operators	T1 R1
11	Member dereferencing operators, operator precedence, typecast operators	T1 R1
12	Scope resolution operators, arrays.	T1 R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

1. What are the benefits of OOPs?
2. **Compare C & C++**
3. What are different object oriented paradigm?
4. **Describe the basic principle of OOps**
5. What are different applications of OOPs?
6. Differentiate between procedure oriented programming and object oriented programming.
7. State applications of C++
8. How to declare a variable in C++ programming languages?
9. Write a short notes on Functions in C++
10. What is inline functions? Explain with suitable program.
11. **What is called by reference, explain with example**
12. What do u mean by memory management operators?
13. What are different memory management operators?
14. **Explain function overloading**

Unit No.-II

Classes & Objects

Lecture No.	Details of the Topic to be covered	References
1	Defining class, member functions	T1 R1
2	static data members, static member functions	T1 R1
3	private data members, public member functions	T1 R1
4	arrays of objects	T1 R1
5	objects as function arguments.	T1 R1
6	types of constructors,	T1 R1
7	handling of multiple constructors, destructors	T1 R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1	Explain classes and objects?
Q. 2	What is constructor?
Q. 3	What is destructor? Explain with program.
Q. 4	How to define member function?
Q5	Write a class for student
Q6	How to nest member functions?
Q7	What is constructor overloading.
Q8	Write short notes on array of objects?

Unit No.-III

Operator Overloading

Lecture No.	Details of the Topic to be covered	References
1	Fundamentals of Operator Overloading	T1 R1
2	Operator Functions as Class Members vs. as Friend Functions	T1 R1
3	Overloading Unary Operators	T1 R1
4	Overloading Binary Operators,	T1 R1
5	Friend function concept	T1 R1
6	Overloading of operators using friend functions.	T1 R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

1. What is operator overloading?
2. Why it is necessary to over load an operator?
3. What are the rules for operator overloading?
4. What is an operator function ? describe syntax of operator function.
5. How do u overload unary operator? explain with program.
6. How to overload binary operator? Explain with program.
7. How to overload using friends. Explain with the help of suitable example
8. List out the operators that cannot be overloaded
9. Define derived class & give example

Unit No.-IV
Inheritance & Polymorphism

Lecture No.	Details of the Topic to be covered	References
1	Introduction to inheritance, base and derived classes, friend classes,	T1 R1
2	types of inheritance, hybrid inheritance, member access control	T1 R1
3	Static class, multiple inheritance, ambiguity, virtual base class,	T1 R1
4	Introduction to polymorphism,	T1 R1
5	pointers to objects, virtual functions	T1 R1
6	Pure virtual functions, abstract base class, Polymorphic class	T1 R1
7	Virtual destructors, early and late binding	T1 R1
8	Container classes, Contained classes, Singleton class.	T1 R1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

1. What is inheritance? How to implement inheritance **?**
2. Why is inheritance required?
3. What are a Base and derived class?
4. What are the advantages of inheritance?
5. What are different modes of inheritance?
6. What is diamond problem?
7. Write a short note with example on method overriding
8. What are the types of inheritance? Explain with program.
9. What is virtual function and why do we need virtual function?
10. What is pure virtual function and abstract class?
11. Differentiate between early binding and Late binding
12. Write a C++ program to illustrate multiple inheritance
13. Explain with the help of program use of 'this' operator

Unit No.-V

Templates, Namespaces and Exception handling

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Function template	T1 R1
2	Class template, function overloading vs. function templates	T1 R1
3	Introduction, Rules of namespaces	T1 R1
4	Introduction, basics of exception handling, exception handling mechanism	T1 R1
5	Throwing and catching mechanism, specifying exceptions, Multiple Exceptions	T1 R1
6	Exceptions with arguments C++ streams, stream classes, unformattedI/O, formatted I/O and I/O manipulators.	T1 R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

1. What is generic programming? How it is implemented in C++
2. Explain What is Function template and Class template using program
3. What Is exceptional handling ?
4. Write a program in C++ to handle "divide by zero" exception.
5. Explain try, catch and throw mechanism of C++ exception handling
6. Explain concept of multiple catch with suitable example.
7. What is a Stream? explain types of Streams available in C++
8. What is namespace? What is the use of Name space?

Unit No.-VI

Working with files

	Lecture No.	Details of the Topic to be covered	References
1		Introduction, classes for file Stream Operations	T1 R1
2		Opening and closing files, detecting End_Of_File (EOF)	T1 R1
3		Modes f File Opening,	T1 R1
4		File pointers and manipulators	T1 R1
5		Updating file, error handling during file operations	T1 R1
6		Updating file, error handling during file operations	T1 R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q1	Explain the classes associated with file handling
Q2	Expalin how to read and write a sentence in a file with the help of program
Q3	Explain different file opening modes in detail
Q4	Explain I/O manipulators.
Q5	Explain file open operation and various modes of file opening,
Q6	What are various file handling error flags along with their purpose? Explain
Q7	Explain get pointer and put pointer.
Q8	Write a short note on file pointer and explain the use of seek and tell functions.
Q9	Write syntax of seek and tell functions.
Q10	How can we detect end of file.

	Question Bank :
1	When would you choose to use C rather than C++.
2	List the features of Object oriented programming
3	What is Constructor and Destructor, explain using program
4	What is class and object. Differentiate between class and object
5	What is class abstraction
5	Write a program which uses default constructor, parameterized constructer and destructor
6	Compare 1) Procedure oriented programming Vs Object oriented programming
7	What is the use of *'this'* pointer
8	Compare and contrast dynamic memory allocation and deallocation operators new, new [], delete and delete [].
9	Explain Polymorphism
10	When do we overload the functions and when do we override

11	Explain Function overloading and operator overloading
12	Write a program to overload unary operator using friend functions
13	Explain what is type casting, Implicit type casting and explicit type casting
14	Explain information hiding in C++.
15	Explain public, private and protected keywords using program
16	What are type of inheritance
17	What is an abstract class, how it is different from concrete class
18	What are nested classes, how to access the members of nested classes. Explain using example
19	25What is generic programming? How it is implemented in C++
20	What Is exceptional handling
21	What is stack unwinding
22	Explain try, catch and throw mechanism of C++ exception al handling
23	Explain What is Function template and Class template using program
24	What are the different types of access specifier supported by C++
25	What are the differences between static binding and late binding
26	What are the different data types supported by C++
27	What are keywords? List keywords specific to C++
28	What is an expression? Is it different than statement?
29	What is copy constructors
30	List types of constructors
31	State difference between private access specifier and protected access specifier
32	What are the different types of inheritance
33	Can base class access derived class
34	When we declare member of a class as static
35	Compare overriding and overloading methods
36	what is virtual function
37	What is abstract class
38	Declare a pointer to object
39	Significance of this pointer
40	Define polymorphism
41	What is meant by early binding
42	List classes associated with file handling
43	Explain fopen and fclose methods in file handling
44	List different file opening modes in c++
45	What are the different flags associated with error in file handling

46	What is file pointer.
47	What are the functions associated with file pointer.
48	Write syntax of seekg() and tellg()
49	Explain functions getline and outline used in c++

List of Laboratory Experiments

Group A (Any Four)

1.	Write a program in C++ to sort the numbers in an array using separate functions for read, display, sort and swap. The objective of this assignment is to learn the concepts of input, output, functions, call by reference in C++.
2.	Write a C++ program that illustrates the concept of Function over loading.
3.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate. Design the class for complex number representation and the operations to be performed. The objective of this assignment is to learn the concepts classes and objects.
4.	Write a program in C++ to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors. The objective of this assignment is to learn the concepts classes and objects, constructors and destructors.
5.	Write a program in C++ to overload unary operators for complex class.

Group B (Any Seven)

6.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide. Use operator overloading for these operations. The objective of this assignment is to learn the concepts operator overloading.
7.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function.
8.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function. To overload = operator so as call copy constructor.
9.	Write a program in C++ to implement containment concept using Employee, B Date, & String Classes.

10.	Write a program in C++ to Read and Display the information of Employee Using Multiple Inheritance. Use Basic Info and Department Info as a base classes of Employee class.
11.	Write a C++ program that illustrates run time polymorphism by using virtual functions.
12.	Write a C++ program which use try and catch for exception handling.
13.	Write a C++ program which to implement class and function template.
14.	Write a C++ program which to demonstrate use of namespace in the program.
15.	Write a C++ program which copies the contents of one file to another.

1. Name of the Subject - System Programming & Operating System

Course Code-(210346)

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	03	-	-

In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	-	-	100	03

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Syllabus

Unit I: Introduction to Systems Programming (8 Hrs)

Introduction: Components of System Software, Language Processing Activities, Fundamentals

Assemblers: Elements of Assembly language programming. Simple assembler scheme, Structure of an assembler, Design of single and two pass assembler.

Macro Processors: Macro Definition and call, Macro expansion, Nested Macro Calls, Advanced Macro Facilities, Design of a two-pass macro-processor

Unit II : Compiler, Loaders and Linkers (8Hrs)

Compilers: Basic compilers function, Phases of compilation, memory allocation, compilation of expression, Compilation of expressions, compilation of control structures, Code of optimization.

Loaders: Loader Schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, Design of an absolute loader.

Linkers: Relocation and linking concepts, Design of linker, self relocating programs, Static and dynamic linker

Unit III : Introduction to OS and Process management (6 Hrs) Introduction to OS : Architecture, Goals & Structures of O.S, Basic functions, Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.

Process Management: Process Concept, Process states, Process control, Threads, Scheduling: Types of scheduling: Preemptive, Non preemptive, Scheduling algorithms: FCFS, SJF, RR.

Unit IV : Concurrency control (6Hrs) Concurrency: Inter process communication, Mutual Exclusion, Semaphores, Classical Problems of Synchronization: Readers-Writers, Producer Consumer, and Dining Philosopher problem. **Deadlock:** Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.

Unit V : Memory Management (8 Hrs) Basics of memory management, Swapping, Memory Allocation, Paging, Segmentation ,Virtual memory, Demand Paging, Page replacement, Page replacement algorithms – Optimal FIFO, LRU, LRU approximation, Allocation of frames

Unit VI : Input and Output, File System (8Hrs) I/O management & Disk scheduling: I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS), RAID, Disk Cache. **File Management:** Concepts, File Organization, File Directories, File Sharing, Record Blocking, Allocation methods, Free Space management.

Text Books:

1. 1 Dhamdhere D., "Systems Programming and Operating Systems", 2nd Edition, 'TMH

2. Siberschatz A; Galvin P.B; Gagne G, ―Operating System Concepts‖, John Wiley.

3. J. J. Donovan, ―Systems Programming‖, McGraw Hill

Reference Books:

1. Stalling William, "Operating Systems" , Pearson Education, fifth edition.
2. Adam Hoover, ―System Programming with C and UNIX‖, Pearson Education
3. Leland L. Beck, ―System Software,‖ Pearson Editions.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, Second Edition, PHI.
5. A. V. Aho, R. Sethi, J. D. Ullman. Compilers: Principles, Techniques, and Tools. Addison-Wesley

1.1 Course Objectives

Course Objectives:

- To Explain fundamentals of system programming and operating systems.
- To Develop comprehensive skills to design Assembler, Macro Processor, Compiler and Interpreters.
- To give overview of various memory allocation methods, input output devices and file system for different operating system.
- To teach implementation of various process scheduling techniques and dead lock avoidance schemes in operating system.
- To Improve written, oral, & presentation communication skills in **System Programming and Operating System** and engage in learning beyond the syllabus.
- To create awareness about the overall obligations with respect to **System Programming and Operating System** and help students understand their moral responsibilities while working in the field.

1.2 Course Outcomes

Course Outcomes:

After successfully completing the course students will be able to:

- **Demonstrate** the knowledge of Systems Programming and Fundamentals of Language Processing activities. (Unit 1)
- **Develop** comprehensive skills to design Assembler, Macro Processor, Compiler, Interpreters, Linker and Loader. (Unit2)
- **Compare and analyze** the different implementation approach of Operating System abstractions. (Unit 3 & 4)
- **Interpret** various OS functions used in Linux / Ubuntu and Windows (Unit 5 & 6)
- **Improve** written, oral, and presentation skills related to **System Programming and Operating System** and engage in life-long learning. (All Units)

1.3 Text Books:

1. D. M. Dhamdhare, "Systems Programming and Operating System", TMH.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, PHI.
3. Siberschatz A; Galvin P.B; Gagne G, ―Operating System Concepts‖, John Wiley.
4. J. J. Donovan, ―Systems Programming‖, McGraw Hill

1.4 Reference Books:

1. Stalling William, "Operating Systems", Pearson Education, fifth edition.
2. Adam Hoover, ―System Programming with C and UNIX‖, Pearson Education
3. Leland L. Beck, ―System Software, Pearson Editions.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, Second Edition, PHI.
5. A. V. Aho, R. Sethi, J. D. Ullman. Compilers: Principles, Techniques, and Tools. Addison-Wesley

1.5 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1. http://nptel.ac.in/courses/106108101/
2. *https://books.google.co.in/books/about/**Systems_Programming**.html*
3. *https://drive.google.com/file/d/0B_UhcJN7cX5vcWpjYjJ2dWdTZjA/*
4. *carment.ase.ro/so/**Modern_Operating_Systems.pdf***
5. http://www.cs.csubak.edu/~jcourtne/O'Reilly%20-%20Lex%20and%20Yacc.pdf
6. Lex & Yacc by John R. Levine and Tony Mason , O'Reilly Media

1.6 Teaching Plan

Sr.No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	Introduction of System Programming	7
2	II	Compiler, Loaders and Linkers	7
3	III	Introduction to OS and Process management	6
4	IV	Concurrency control (6Hrs	8
5	V	Memory Management	6
6	VI	Input & output File system	6

1.7 Unit wise Lecture Plan

1.8 a. Unit No.-I

Pre-requisites :- Basic concepts of microprocessor , microcontroller and C programming and assembly language programming.

Objectives :-

- To Explain fundamentals of system programming and operating systems.
- To Develop comprehensive skills to design Assembler, Macro Processor, Compiler and Interpreters.

Outcomes :

- **Demonstrate** the knowledge of Systems Programming and Fundamentals of Language Processing activities.(Unit 1)

Lecture No.	Details of the Topic to be covered	References
1	**Introduction:** Components of System Software, Language Processing Activities,	**T1,R1**
2	Fundamentals of Language Processing.	**T1,R1**
3	**Assemblers**: Elements of Assembly language programming. Simple assembler scheme,	
4	Structure of an assembler, Design of single and two pass assembler.	**T1,R1**
5	**Macro Processors**: Macro Definition and call, Macro expansion,.	**T1,R1**
6	Nested Macro Calls, Advanced Macro Facilities,	**T1,R1**
7	Design of a two-pass macro-processor	**T1,R1**

1.9 Question Bank Theory

Theory Paper

Unit 1: Introduction of system programming

Q. 1	What is language processor?
Q. 2	Describe language processors.
Q. 3	What do you mean by interpreters
Q. 4	State the different language processing activties.
Q. 5	What is language processor
Q. 6	Describe different phases of language processing.
Q. 7	Explain language processor development tools.
Q. 8	Explain data structures used for language processing.
Q. 9	What is scanning?
Q. 10	What is parsing
Q. 11	Explain different parsing techniques.
Q. 12	What is a aseembler?
Q. 13	Explain two PASS aseembler along with the schematic diagram.
Q. 14*	**Explain the processing of LTORG, ORIGIN statements by PASS-1 and PASS-2 of a two pass assembler.**
Q. 15	Explain EQU statement
Q. 16	Explain data structures used to design pass1 and pass2 assembler
Q. 17	Explain 2pass assembler with a neat diagram
Q. 18	State the algorithm for 2 PASS assembler
Q. 19	Write the algorithm of PASS 1 assembler nd explain the working
Q. 20	Explain design of 2 PASS assembler
Q. 21	Explain design of 1 pass assembler

Q. 22	Enlist the different types of errors that are handles by PASS1 and PASS2 of a two pass assembler
Q. 23	What do you mean by a literal? State its advantages
Q.24*	**Write a C program to implement PASS 1 of 2-PASS assembler**
Q.25*	**Write a C program to implement Lexical Analyzer**

1.8 **b. Unit No.-II**

Pre-requisites :-

Basic concepts of microprocessor, microcontroller and C programming and assembly language programming.

Objectives :-

To Develop comprehensive skills to design Assembler, Macro Processor, Compiler and Interpreters.

Outcomes:- After successfully completing this unit students will be able to:

- **Develop** comprehensive skills to design Assembler, Macro Processor, Compiler, Interpreters, Linker and Loader.(Unit2)

Lecture No.	Details of the Topic to be covered	References
1	**Compilers:** Basic compilers function, Phases of compilation,	T1,R1
2	memory allocation, compilation of expression, Compilation of expressions,	T1,R1
3	compilation of control structures, Code of optimization.	T1,R1
4	**Loaders:** Loader Schemes: Compile and go, General Loader Scheme, Absolute loaders,	T1,R1
5	subroutine linkages, relocating loaders, direct linking loaders, Design of an absolute loader.	T1,R1
6	**Linkers:** Relocation and linking concepts Static and dynamic linker.	T1,R1
7	Design of linker, self-relocating programs,	T1,R1

1.9 b Question Bank: Theory

Theory Paper

Unit 2: Compiler, Loaders and Linkers

Q. 1	Define macro.
Q. 2	Explain lexical expansion of macro
Q. 3	Difference between macros and functions
Q. 4	Explain process of macro expansion with data structures
Q. 5	What are different features of machine independent and machine dependent macros ?
Q. 6	Explain macro calls
Q. 7	Explain macro expansion
Q. 8	Draw a flowchart for macro processor to handle nested macro definition
Q. 9	Explain macro with example and describe nested macro calls with example
Q. 10	Explain the process of alteration of flow of control during macro expansion
Q. 11	Explain nested macro calls
Q. 12*	**Explain the advance macro facilities:1)alteration of flow of control during expansion 2)expanson time variables 3)attributes of parameters**
Q. 13	Explain advance macro facilities to alter flow of control during expansion and expansion time variables with examples
Q. 14	Explain 2pass macro processor
Q. 15	State the steps in designing the macro processor
Q. 16	What are the data structures used for design of macro processing?
Q. 17	Explain design of two pass MACRO processor in detail
Q. 18	How to handle macro cells in macros
Q. 19	What are the advantages and disadvantages of combining macro processor with pass-1 of an assembler
Q. 20	Explain compiler

Q. 21	Explain phases of compiler with examples
Q. 22	Explain lexical analysis, syntax analysis,semantic analysis
Q. 23	What are different phases of compiler, exlain in detail
Q. 24	Explain use of register descriptor
Q. 25	Explain use of operand descriptor
Q. 26	Explain compilation of control structure for if statement and while statement
Q. 27	Explain parameter passing mechanisms:1)call by value,2)call by result,3)call by name
Q. 28	Explain code optimization with suitable example
Q. 29	Enlist various code optimization techniques.
Q. 30	Explain code optimization techniques.
Q. 31	Compare compilers and interpreters
Q. 32	Explain interpreters
Q. 33	What is a loader?
Q. 34	Enlist functions of loader
Q. 35	Explain absolute loader
Q. 36	Explain function of compiler and go scheme.
Q. 37	What are the advantages and disadvantages of the scheme
Q. 38	Explain designing of direct linking loader. explain all required data structures
Q. 39	Compare absolute loader and compile-and-go loader
Q. 40	Explain subroutine linker
Q. 41	List and explain the different loader scheme in detail
Q. 42	Explain dynamic linking loader
Q. 43	Explain program execution with diagram
Q. 44	Explain:1)translated origin 2)link origin 3)load origin
Q. 45	What is a linker

Q. 46	Explain program relocation in detail
Q. 47	How program relocation is performed
Q. 48	Why program relocation is required
Q. 49	Explain nedd of a linker in program development
Q. 50	Explain MS-DOS linker in detail
Q. 51	Write a note on MS-DOS linker
Q. 52	Short answers:
Q. 53	What is bootstrap compiler?
Q. 54	Explain program execution
Q. 55	Explain:1)translated origin,2)link origin,3)load origin
Q. 56	Why lexical and syntax analyser are separated out
Q. 57	Explain forward reference explain DFA
Q. 58	Explain data structures used to define pass1 and pass2 assembler
Q. 59	Explain macro calls
Q. 60	Explain expansion time variables
Q. 61	Explain nested macro calls
Q. 62	Draw a flowchart for MACRO processor to handle nested macro definitions
Q. 63	Phases of compiler
Q. 64	Explain call by value
Q. 65	Explain call by result
Q. 66	Explain call by reference
Q. 67	Explain call by name
Q. 68	Compare absolute loader and compile and go loader
Q. 69	Direct linking loader: explain
Q. 70	Explain implementation of MS DOS linker in detail

Q. 71	Explain program relocation
Q.72*	**Write a C program to implement Macro Pass I preprocessor**

1.8 c. Unit No.-III

Pre-requisites :-

Basic concepts of microprocessor , microcontroller and C programming and assembly language programming.

Objectives :-

- To give overview of various memory allocation methods, and fundamentals of Linker and Loader.

Outcomes:- After successfully completing this unit students will be able to:

- **Compare and analyze** the different implementation approach of Operating System abstractions.

Lecture No.	Details of the Topic to be covered	References
1	**Introduction to OS :** Architecture, Goals & Structures of O.S, Basic functions,	R1
2	Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.	R1
3	**Process Management:** Process Concept, Process states, Process control,.	R1
4	Threads, Scheduling: Types of scheduling: Preemptive, Non preemptive,	R1
5	Scheduling algorithms: FCFS,	R1,R3
6	Scheduling algorithms: SJF, RR	R1,R3

1.9 c. Question Bank: Theory

Theory Paper

Unit3: Introduction to OS and Process management

Q. 1	Enlist different OS functions.
Q. 2	Write short note on OS structure
Q. 3	Explain the OS system call with example
Q. 4	Write short note on following • Processes • IPC

- Classical IPC

Q. 5 Explain following CPU scheduling techniques with example

- SJF
- FCFS
- LRU
- Advanced LRU

Q. 6 What is real time OS?

Q. 7 Write short note on following

- System Calls in LINUX
- System Calls in WINDOWS

Q. 8 What is Preemptive scheduling and non-preemptive scheduling

Q. 9 Explain following with examples

1. Round Robin Scheduling
2. Priority scheduling

Q. 10 Differentiate Process Versus Thread

Q. 11

Process	Arrival Time	Execute Time	Service Time
P0	0	5	0
P1	1	3	5
P2	2	8	8
P3	3	6	16

Calculate average waiting time and average turn around time using FCFS ,SJF,RR scheduling algorithm

Q. 12 Solve following with round robin algorithm(5marks)

Calculate turnaround time and average waiting time

Process	Arrival time	Burst time
P1	0	10
P2	1	4
P3	2	5
P4	3	3

Q. 13 Solve following with FIFO algorithm(5marks)

Calculate turnaround time and average waiting time

Process Arrival time Burst time

	P1	0	5
	P2	1	4
	P3	2	6
	P4	3	7
Q. 14	Explain various types of operating system		
Q15	Solve following with SJF algorithm(5marks) Calculate turnaround time and average waiting time		
	Process	Arrival time	Burst time
	P1	0	3
	P2	1	5
	P3	3	2
	P4	9	5
	P5	12	5
	Write a C program to implement FCFS algorithm		
	Write a C program to implement SJF algorithm		
	Write a C program to implement Round Robin algorithm		

1.8 d. Unit No.-IV

Pre-requisites:-

Basic concepts of microprocessor, microcontroller and C programming and assembly language programming.

Objectives:-

- To teach implementation of various process scheduling techniques and dead lock avoidance schemes in operating system.

Outcomes:- After successfully completing this unit students will be able to:
Compare and analyze the different implementation approach of Operating System abstractions.

Lecture No.	Details of the Topic to be covered	References
1	**Concurrency:** Interprocess communication, Mutual Exclusion,	T1,T2,R2
2	Semaphores, Classical Problems of Synchronization: Readers-Writers,	T1,T2,R2
3	Producer Consumer, and.	T1,T2,R2
4	Dining Philosopher problem.	T1,T2,R2
5	. **Deadlock:** Principles of deadlock, Deadlock Prevention.	T1,T2,R2
6	Deadlock Avoidance, Deadlock Detection.	T1,T2,R2

1.9.d. Question Bank: Theory

Theory Paper

Unit IV: Concurrency control

Q. 1	Concept of Deadlock with example
Q. 2	Explain deadlock avoidance techniques
Q. 3	Explain deadlock detection techniques
Q. 4	Explain bankers algorithm and solve following example to avoid deadlock

Process	Allocation			Maximum Requirement			Available		
	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	2	3	0
P1	3	0	2	3	2	2			
P2	3	0	2	9	0	2			
P3	2	1	1	2	2	2			
p4	0	0	2	4	3	3			

Q. 5	Explain Inter-process communication and its type
Q. 6	Explain inter process communication with their problems and solution
Q. 7	Write short note on: a) inter process communication b) Critical section
Q. 8	Compared inter process communication using shared memory and message passing
Q. 9	What is race condition and explain how to remove it?
Q. 10	Write short note on: a)Mutual Exclusion b)Semaphore
Q. 11	Explain software approach for mutual exclusion with examples
Q. 12	Explain hardware approach for mutual exclusion with examples
Q. 13	Explain Producer-Consumer problem with solution
Q. 14	What is Producer-Consumer problem and how to solve it using semaphore and mutex
Q. 15	Explain Dinning Philosophers problem with solution
Q. 16	Define deadlock and state conditions for deadlock
Q. 17	Explain Ostrich algorithm
Q. 18	Define deadlock and how deadlocks are avoided in operating systems. Explain it with suitable example
Q. 19	Find out the safe sequence for execution of three processes using Bankar's Algorithm. Maximum resources are R1=15,R2=8 Allocation Matrix Maximum Requirement Matrix
Q. 20	Find out the safe sequence for execution of three processes using Bankar's Algorithm. Maximum resources are R1=4,R2=4 Allocation Matrix Maximum Requirement Matrix

Process	R1	R2
P1	2	1
P2	3	2
P3	3	0

Process	R1	R2
P1	5	6
P2	8	5
P3	4	8

Process	R1	R2
P1	1	0
P2	1	1
P3	1	2

	Process	R1	R2
	P1	1	1
	P2	2	3
	P3	2	2
Q. 21*	Write a C program to implement Banker's algorithm **--*Higher Order Thinking Question**		
Q. 22*	Write a C program to implement Readers Writes problem solution using Mutex **--*Higher Order Thinking Question**		
Q. 23*	Write a C program to implement Readers Writes problem solution using Mutex **--*Higher Order Thinking Question**		

1.8 e. Unit No.-V

Pre-requisites :-

Basic concepts of microprocessor , microcontroller and C programming and assembly language programming.

Objectives :-

- To explain concept of memory management and Page replacement algorithms

Outcomes:- After successfully completing this unit students will be able to:

Interpret various OS functions used in Linux / Ubuntu and Windows

Lecture No.	Details of the Topic to be covered	References
1	Basics of memory management, Swapping, Memory Allocation,	T1,T2,R2
2	Paging ,Segmentation ,Virtual memory	T1,T2,R2
3	, Page replacement, Page replacement algorithms, Demand Paging,	T1,T2,R2
4	Page replacement Algorithm : Optimal,FIFO	T1,T2,R2
5	Page replacement Algorithm: LRU	T1,T2,R2
6	LRU Approximation, Allocation of frames	T1,T2,R2
7	Paging over segmentation	T1,T2,R2
8	Examples on Page Replacement Algorithm	T1,T2,R2

1.9.e. Question Bank: Theory

Theory Paper

Memory Management(CO4)

Q. 1	Explain the concept of memory management in detail.
Q. 2	Explain the concept of Swapping with suitable diagram.
Q. 3	Explain memory allocation with example.
Q. 4	What do you mean by page replacement algorithm? Enlist different page replacement algorithms in detail.
Q. 5	Write short note on Demand paging.

Q. 6	Compare different page replacement algorithms.
Q. 7	Write short note on segmentation of virtual memory.
Q. 8	Explain the concept of memory management in detail.
Q. 9	Explain page replacement algorithm LRU with example and calculate hit ratio. Reference string :2 3 2 1 5 2 4 5 3 2 5 2 Number of Page frames:3
Q. 10	Explain page replacement algorithm FIFO with example and calculate hit ratio. Reference string :2 3 2 1 5 2 4 5 3 2 5 2 Number of Page frames:3
Q. 11	Explain page replacement algorithm FIFO with example and calculate hit ratio. Reference string :0 3 4 7 6 9 5 6 8 3 9 Number of Page frames:3
Q. 12*	Write a C program to implement FIFO algorithm for page replacement **--*Higher Order Thinking Question**
Q. 13*	Write a C program to implement LRU algorithm for page replacement **--*Higher Order Thinking Question**
Q. 14*	Write a C program to implement OPT algorithm for page replacement **--*Higher Order Thinking Question**

1.8 Unit No.-VI

Pre-requisites:-

Basic concepts of microprocessor, microcontroller and C programming and assembly language programming.

- **Objectives :-** To explain Input output devices and file system for different operating System.
- **Outcomes:-** After successfully completing this unit students will be able to:

  Interpret various OS functions used in Linux / Ubuntu and Windows

Lecture No.	Details of the Topic to be covered	References
1	**I/O management & Disk scheduling:** I/O Devices, Organization of I/O functions,	T2
2	Operating System Design issues, I/O Buffering,	T2
3	Disk Scheduling (FCFS)	T2
4	RAID, Disk Cache	T2
5	**File Management:** Concepts, File Organization,	T2
6	File Directories, File Sharing,	T2
7	Record Blocking, Allocation methods,	T2
8	Free Space management	T2

1.10 Question Bank: Theory

Theory Paper (CO4)

Q. 1	Explain the principles of Input output hardware and software.
Q. 2	Explain disk scheduling algorithms.
Q. 3	Explain input output software layers.
Q. 4	Write short note on dick space management.
Q. 5	Advantages of file systems.
Q. 6	Explain in detail file systems and its implementation.
Q. 7	Write short note on directories.
Q. 8	Explain Program I/O with examples
Q. 9	Differentiate memory mapped I/O and I/O mapped I/O
Q. 10	Explain interrupt driven I/O

Q. 11	Explain I/O management using DMA with suitable diagram and example
Q. 12	Write Short note on Magnetic Disc
Q. 13	Write Short note on RAID
Q.14*	**Consider a typical disc with an average seek time of 10 ms ,rotational speed of 10000 rpm and 512 byte sectors with 320 sectors per track. Suppose that we wish to read a file consisting of 2560 sectors for a total of 1.3 m bytes.Estimate a total time for the transfer**
Q.15*	**Write a shell script program for arithmetic calculator on Linux**

Curriculum

Name of the Course: Principles of Programming Languages

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	03		04

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	25	-	25	150	05

Course Objectives:

- To learn basic principles of programming languages and programming paradigms.
- To learn structuring the data and manipulation of data, computation and program structure.
- To learn Object Oriented Programming (OOP) principles using Java Programming Language.
- To learn basic concepts of logical and functional programming language.

Course Outcomes:

On completion of the course, learner will be able-

C216.1 Make use of basic principles of programming languages.

C216.2 Develop a program with Data representation and Computations.

C216.3 Develop programs using Object Oriented Programming language : Java.

C216.4Develop application using inheritance, encapsulation, and polymorphism.

C216.5 Demonstrate Multithreading for robust application development.

C216.6Develop a simple program using basic concepts of Functional and Logical programming paradigm.

University Syllabus

Savitribai Phule Pune University, Pune S.E. (Electronics & Computer Engineering) 2020 Course (With effect from Academic Year 2021-22)														
Semester-IV														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**			
		Theory	**Practical**	**Tutorial**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
	Signals & Systems	**03**	**-**	**01**	**30**	**70**	**25**	**-**	**-**	**125**	**03**	**--**	**01**	**04**
	Principles of Programming Language	**03**	**-**		**30**	**70**		**-**	**-**	**100**	**03**	**-**	**-**	**03**
	Principles of Communication System	**03**	**-**	**-**	**30**	**70**	**-**	**-**	**-**	**100**	**03**	**-**	**-**	**03**
	Object Oriented Programming	**03**	**-**	**-**	**30**	**70**	**-**	**-**	**-**	**100**	**03**	**-**	**-**	**03**
	System Programming & Operating Systems	**03**	**-**	**-**	**30**	**70**	**-**	**-**	**-**	**100**	**03**	**-**	**-**	**03**
	Signals & System Lab	**-**	**02**	**-**	**-**	**-**	**25**	**-**	**-**	**50**	**-**	**01**	**-**	**01**
	Communication Lab	**-**	**02**	**-**	**-**	**-**	**-**	**50**	**-**	**50**	**-**	**01**	**-**	**01**
	Object Oriented Programming Lab	**-**	**02**	**-**	**-**	**-**	**-**	**-**	**25**	**25**	**-**	**01**	**-**	**01**
	Employability Skill Development	**-**	**02**	**-**	**-**	**-**	**25**	**-**	**-**	**25**	**-**	**01**	**-**	**01**
	Project Based Learning η	**-**	**04**	**-**	**-**	**-**	**50**	**-**	**-**	**50**	**-**	**02**	**-**	**02**
	Mandatory Audit Course 4&	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Total	**15**	**14**	**01**	**150**	**350**	**125**	**50**	**25**	**700**	**-**	**-**	**-**	**-**
Total Credit											**15**	**06**	**01**	**22**

Abbreviations:

In-Sem: In semester End-sem: End semester TH : Theory TW : Term Work PR : Practical OR : Oral TUT : Tutorial

Note: Interested students of S.E. (Electronics/E&TC) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXX: Principles of Programming Language

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXX – Principles of Programming Language Lab

Course Objectives:

- To learn principles of programming language
- To understand structural, computational and logical implications regarding programming languages
- To explore main programming paradigms.
- To understand and apply Object Oriented Programming (OOP) principles using C++ and Java

Course Outcomes: On completion of the course, learner will be able to –

CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.

CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.

CO3: To grasp different programming paradigms

CO4: To use the programming paradigms effectively in application development.

Course Contents

Unit I	Programming Language Syntax & semantics	(07 Hrs)

Software development process, language and software development environments, language and software design methods, languages and computer architecture, programming language qualities, languages and reliability, languages and maintainability, languages and efficiency, a brief historical perspective and early high level languages, a bird's eye view of programming language concepts.

Syntax and semantics: Language definition, syntax, abstract syntax, concrete syntax, and pragmatics, semantics, an introduction to formal semantics, languages, language processing, interpretation, translation, the concept of binding, variables, name and scope, Type, l-value, r-value, reference and unnamed variables, routines, generic routines, aliasing and overloading, an abstract semantic processor, run time structure.

Mapping of Course Outcomes for Unit I	CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development. CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.

Unit II	Structuring Data, Computations and Programming	(07 Hrs)

Structuring of Data- Built in and primitive types, Data aggregates and type constructors, Cartesian product, Finite mapping User -defined types and abstract data types, Type systems, Static versus dynamic program checking, Strong typing and type checking, Type compatibility, Type conversions, Types and subtypes, Generic types, monomorphic versus polymorphic type systems,

Structuring of Computations: Structuring the computation, Expressions and statements, Conditional execution and iteration, Routines, Style issues: side effects and aliasing, Exceptions,

Mapping of Course Outcomes for Unit II	**CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.** **CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.**	
Unit III	**Structuring of a Program**	**(07 Hrs)**

Software design method, Concepts in support of modularity, Encapsulation, Interface and implementation, Separate and independent compilation, Libraries of modules, Language features for programming in the large, Program organization, Grouping of units, Encapsulation, Interface and implementation, Abstract data types, classes, and modules, Generic units, Generic data structures, Generic algorithms, Generic modules, Higher levels of genericity.

Programming paradigms: Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based.

Mapping of Course Outcomes for Unit III	**CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.** **CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.**	
Unit IV	**Java as Object Oriented Programming Language**	**(07 Hrs)**

Java History, Java Features, Java and Internet, Java and Word Wide Web, Web Browsers, Java Virtual Machine.

Data Types and Size: (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type).

Arrays: One dimensional array, multi-dimensional array, alternative array declaration statements.

Control Statements Revision of identical selection Statements in brief (if, else if, Nested if, Switch, Nested Switch), Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop, Using comma in for loop), Jump Statements (Labeled Break and Labeled Continue).

String Handling: String class methods.

Mapping of Course Outcomes for Unit IV	**CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.** **CO3: To grasp different programming paradigms**

Unit V	**Inheritance, Polymorphism and Encapsulation in Java**	**(07 Hrs)**

Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable -length arguments.

Inheritances: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class.

Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.

Mapping of Course Outcomes for Unit V	**CO3: To grasp different programming paradigms**

Unit VI	**Exception handling in Java**	**(07 Hrs)**

Fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes).

Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class,

Applet: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Difference between Applet and Application Program.

Mapping of Course Outcomes for Unit VI	**CO3: To grasp different programming paradigms.** **CO4: To use the programming paradigms effectively in application development.**

Learning Resources

Text Books:

T1 : Carlo Ghezzi, Mehdi Jazayeri, "Programming Language Concepts",3rd Ed, Wiley Publication.

T2 : Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,

Reference Books:

R1 : Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education.

R2 : Deugo, "Java Gems", Cambridge University Press.

R3 : T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation", 4th Ed, PHI

Teaching Plan

Lecture Number	Contents to be covered	Reference/Text Books
1	Software development process, language and software development environments	T1, R1, R3
2	language and software design methods, languages and computer architecture	T1, R1
3	programming language qualities, languages and reliability, languages and maintainability, languages and efficiency,	T1, R1
4	a brief historical perspective and early high level languages, a bird's eye view of programming language concepts.	T1, R1, R3
5	**Syntax and semantics:** Language definition, syntax, abstract syntax, concrete syntax, and pragmatics, semantics	T1, R1
6	introduction to formal semantics, languages, language processing, interpretation, translation, the concept of binding, variables, name and scope	T1, R1
7	Type, l-value, r-value, reference and unnamed variables, routines, generic routines,	T1, R1
8	aliasing and overloading, an abstract semantic processor, run time structure.	T1, R1
9	**Structuring of Data-** Built in and primitive types, Data aggregates and type constructors, Cartesian product, ,	T1, R1, R3
10	Finite mapping User -defined types and abstract data types, Type systems	T1, R1, R3
11	Static versus dynamic program checking, Strong typing and type checking, Type compatibility,	T1, R1, R3
12	Type conversions, Types and subtypes, Generic types, monomorphic versus polymorphic type systems,	T1, R1, R3
13	**Structuring of Computations:** Structuring the computation,	T1, R1, R3
14	Expressions and statements, ,	T1, R1, R3
15	Conditional execution and iteration,	T1, R1, R3
16	Routines, Style issues: side effects and aliasing,	T1, R1, R3
17	Exceptions	T1, R1, R3
18	**Structuring of a Program**, Software design method, Concepts in support of modularity, Encapsulation,	T1, R1, R3
19	Interface and implementation, .	T1, R1, R3
20	Separate and independent compilation, Libraries of modules	T1, R1, R3
21	Language features for programming in the large, Program organization, Grouping of units, Encapsulation, Interface and implementation	T1, R1, R3
22	, Abstract data types, classes, and modules, Generic units, Generic data structures, Generic algorithms	T1, R1, R3

23	Generic modules, Higher levels of genericity. **Programming paradigms:** Introduction to programming paradigms	**T1, R1, R3**
24	Introduction to four main Programming paradigms procedural,	**T1, R1, R3**
25	object oriented, functional, and logic & rule based	**T1, R1, R3**
26	**Unit IV: Java as Object Oriented Programming Language,** Java History, Java Features, Java and Internet	**T2, R2**
27	Java and Internet, Java and Word Wide Web, Web Browsers, Java Virtual Machine.	**T2, R2**
28	**Data Types and Size:** (Signed vs. Unsigned, User Defined vs. Primitive Data Types, ExplicitPointer type).	**T2, R2**
29	**Arrays:** One dimensional array, multi-dimensional array, alternative array declaration statements.	**T2, R2**
30	**Control Statements** Revision of identical selection Statements in brief (if, else if, Nested if, Switch,Nested Switch)	**T2, R2**
31	Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop, Using comma in for loop) Jump Statements (Labeled Break and Labeled Continue).	**T2, R2**
32	Unit IV: Java History, Java Features, Java and Internet, Java and Word Wide Web, ., Using comma in for loop), **String Handling:** String class methods.	**T2, R2**
33	Web Browsers, Java Virtual Machine. **Data Types and Size:** (Signed vs. Unsigned, User Defined vs. Primitive Data Types, ExplicitPointer type).	**T2, R2**
34	**Arrays:** One dimensional array, multi-dimensional array, alternative array declaration statements	**T2, R2**
35	**Control Statements** Revision of identical selection Statements in brief (if, else if, Nested if, Switch,Nested Switch),	**T2, R2**
36	Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop	**T2, R2**
37	Jump Statements (Labeled Break and Labeled Continue). String class methods, **String Handling:**	**T2, R2**
38	**Unit V : Classes and Methods:** class fundamentals, declaring objects, assigning object reference variables, ,. **Inheritances**: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. ,	**T2, R2**
39	adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize()method, overloading methods	**T2, R2**
40	argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable -	**T2, R2**

	length arguments	
41	**Packages and Interfaces:** defining a package, finding packages and CLASSPATH	**T2, R2**
42	access protection, importing packages, interfaces (defining, implementation, nesting, applying	**T2, R2**
43	variables ininterfaces, extending interfaces, instance of operator.	**T2, R2**
45	Fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally.	**T2, R2**
46	multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes).	**T2, R2**
47	**Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams	**T2, R2**
48	Reading console Input, Writing Console Output, Print Writer class,	**T2, R2**
49	**Applet**: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, status window,	**T2, R2**
50	HTML Applet tag, passing parameters to Applets,	**T2, R2**
51	Difference between Applet andApplication Program	**T2, R2**

MCQs

1. The following statement forces the next iteration of the loop to take place.

A. Break

B. Goto

C. Continue

D. None of the above

ANSWER: C

2. Java is called as platform independent language.

A. True

B. False

ANSWER: A

3. JVM will differ from platform to platform but still all understand the Same Java Bytecode.

A. True

B. False

ANSWER: A

4. Java is made useful for distributed system. It is possible due to _feature of java.

A. Inheritence

B. API

C. RMI

D. Polymorphism

ANSWER: C

5. Arrange the following statements in correct order.1. Running the java command Statement 2. Main method of that class is executed Statement.3.JRE is loaded along with the class you specify.

A. Statement: 2 1 3

B. Statement: 2 3 1

C. Statement: 1 2 3

D. Statement: 1 3 2

ANSWER: D

6. What is garbage collection in the context of Java?

A. The operating system periodically deletes all of the java files available on the system.

B. Any package imported in a program and not used is automatically deleted.

C. When all references to an object are gone, the memory used by the object is automatically reclaimed.

D. The JVM checks the output of any Java program and deletes anything that doesn't make sense.

ANSWER: C

7. Bytecode is given as input to ___

A. JRE

B. Linker

C. JVM

D. Assembler

ANSWER: C

8. A recursive function is said to be ___recursive if there are no pending operations to be performed on return from a recursive call.

A. Tail

B. Pass

C. linear

D. End

ANSWER: A

9. System.out.println(). What is System in the statement

A. Method

B. Constructor

C. Class

D. Package

ANSWER: D

10. The process of accessing and processing each element of an array A exactly once is called ____.

A. Deleting

B. Inserting

C. traversing

D. Searching

ANSWER: C

11. How many instances of an abstract class can be created?

A. 1

B. 2

C. 3

D. 0

ANSWER: D

12. How will the class protect the code inside it?

A. Using access specifiers

B. Using abstraction

C. Use of inheritance

D. All of the above

ANSWER: A

13. Which of the following concept is often expressed by the phrase,'One interface,multiple methods'?

A. Abstraction

B. Polymorphism

C. Inheritance

D. Encapsulation

ANSWER: B

14. _____diagram shows crossed flow paths with no clear path from beginning to end, which causes poor structure

A. Spaghetti

B. Class

C. Activity

D. Sequence

ANSWER: A

15. Largeness of program relates size and complexity of the problem being solved than to the final size of a program in terms of the __

A. Number of keywords.

B. Number of source lines.

C. Collection of primitive data types.

D. Collection of variables

ANSWER: B

16. _____allows us to design and build program from smaller pieces called modules.

A. Subprogramming

B. program divide method

C. Abstraction

D. Modularity

ANSWER: D

17. A good modular decomposition is one that is based on modules that are as independent from each other as possible.

A. True

B. False

ANSWER: A

18. JDK means ?

A. Java Development Kit

B. Just Designed key

C. Java Designer kit

D. Java decided key

ANSWER: A

19. _____statements allow the program to choose different parts of the execution based on the outcome of an expression.

A.Creation

B.Assignment

C.Iteration

D.Selection

ANSWER : D

20. ____statements enable program execution to repeat one or more statements.

A.Creation

B.Assignment

C.Iteration

D.Selection

ANSWER : C

21. ___statements enable your program to execute in a non-linear fashion

A.Selection

B.Assignment

C.Iteration

D.Jump

ANSWER: D

22. AWT and Swing are used in java for creating standalone applications

A. True

B. false

ANSWER: A

23. Which one of the following is not a built-in data type?

A. Integer

B. String

C. Boolean

D. Structure

ANSWER: C

24. Which one of the following is not the Dynamic Data Structure?

A. Array

B. Stack

C. Linked list

D. Queue

ANSWER: A

25. What will the output of following java statement? System.out.println(16/(int)5.0);

A. 3.0

B. 3.2

C. 3

D. syntax error

ANSWER: C

Question bank

Q.1 What is interpretation and translation process ? With neat diagram state the purpose of each activity in language processing with interpretation and translation.
Q.2 Explain with example the use of following data aggregates to construct compound data types: a) Sequencing b) Cartesian product.

[

Q.3 List out challenges for programming in large? How these are addressed in programming languages.
Q.4 What do you mean by Syntax? State and draw the EBNF definition for syntax rules.
Q.5 Explain any three of the following

a) Final keyword & Static keyword **b)** Static and dynamic binding **c)** Garbage collection
d) Finalize method.
Q.6 What is an Applet ? Write a generic skeleton of Java Applet and explain the use of each block.

Q.7 Differentiate between abstract class and interface in JAVA]

Q.8 What are advantages of Inheritance? show by example the simple inheritance in Java.

Q.9 Write a program in Java using switch case statement to perform addition, division, multiplication, subtraction of given two numbers and print the result. Does the program generate any exception ?

Q.10 Identify and write the use of PrintStream and PrintWriter classes? Which methods are supported by these classes ? Construct example of each.

Q.11 Write a program in Java to calculate the value of ((x+y)/(x-y)).Program should prevent the condition x-y=0.

Q.12 What is the use of CharacterArrayReader() and CharacterArrayWriter() methods in Java? Write a program which reads string of 10 characters from the user. Program extracts and prints the substring from the given string using above methods.

Q.13 What is Method Overriding in Java?
State with example the following in built exceptions in Java.

a)IndexOutOfBpoundException()
b)NullPointerException()
c)ArrayIndexOutOfBoundException()

Q.14 What is the importance of maintainability and reliability to programming languages? list the factors which ensures the reliability and maintainability.

Q.15 Why pointers are eliminated from JAVA?

Q.16 What is the difference between a method and a function?

Q.17 Which part of JVM allocates memory for a Java program?

Q.18 What is an API document?

Q.19 What is the difference between #include and import statement?

Q.20 What is the difference between >> and >>> ?

Q.21 What are control ststements?

Q.22 What is a collection?

Q.23 Write a program to come out of switch block, after executing a task.

Q.24 What is the difference between return and System.exit(0)?

Q.25 Write a program which accepts elements of a matrix and displays it's Transpose.

Q.26 Write a program to display Command Line Arguments?

Q.27 What is Object Reference?

Q.28 Write a program to search for a given string in an array of strings.

Q.29 What is Object oriented approach?

Q.30 What is encapsulation?

Q.31 What is abstraction?

Q.32 What is inheritance?

Q.33 What is an interface?

Q.34 What is polymorphism?

Q.35 What is a class?

Q.36 What is an object?

Q.37 What are constructors?

Q.38 What is constructor overloading?

Q.39 What are instance methods?

Q.40 How are objects passed to methods in Java?

Q.41 What are factory methods?

Q.42 What are inner classes?

Q.43 What are the types of inheritance?

Q.44 What is method signature?

Q.45 What is method overloading?

Q.46 What is final class?

Q.47 What is type casting?

Q.48 What is abstract method and abstract class?

Q.49 What is the difference between abstract class and an Interface?

Q.50 What are packages and their types?
Q.51 What is CLASSPATH?
Q.52 What is a JAR file?
Q.53 Hoe to create an API document?
Q.54 What are checked exceptions?
Q.55 What is Throwable?
Q.56 Explain exception handling in Java?
Q.57 What are Wrapper classes?
Q.58 What is try-catch block?
Q.59 What is Scanner class?
Q.60 What is an Applet and its architecture?
Q.61 Draw the skeleton of an Applet.
Q.62 What is the difference between an Applet and an Application program?
Q.63 What is the difference between System.out and System.err?
Q.64 What are streams?
Q.65 What is the default buffersize used by any buffered class?
Q.66 What is Zipping and Unzipping of files?
Q.67 What is serialization?
Q.68 Explain nested try statements.
Q.69 What are custom exceptions?
Q.70 What is the Life cycle of an applet?