Progressive Education Society's

Modern College of Engineering, Shivajinagar,Pune-05.

Department of Artificial Intelligence and Data Science

Curriculum Booklet

2019 Pattern

Semester: II

Class: SE (Artificial Intelligence and Data Science)

Vision of the Institute

- Creation of a collaborative academic environment to foster professional excellence and ethical values.

Mission of the Institute

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

Objectives of the Institute

- To develop infrastructure appropriate for delivering quality education
- To develop the overall personality of students who will be innovators and future leaders capable of prospering in their work environment.
- To inculcate ethical standards and make students aware of their social responsibilities.
- Promote close interaction among industry, faculty and students to enrich the learning process and enhance career opportunities.
- Encourage faculty in continuous professional growth through quality enhancement programs and research and development activities.
- Foster a healthy work environment which allows for freedom of expression and protection of the rights of all stakeholders through open channels of communication

Vision of the Department

To create a collaborative academic environment in the field of Artificial Intelligence and Data Science by imparting required skill sets and interactive industry interface for students and inculcate into them social and ethical values

Mission of the Department

M1: To nurture students with latest technologies in the field of Artificial Intelligence and Data Science.

M2: To build industry academia interface to update the recent trends in field of Artificial Intelligence and Data Science.

M3: To prepare students with professional approach, strong ethical values and research spirit along with leadership skills.

M4: To mentor students in the field of Artificial Intelligence and Data Science research to serve the needs of the society.

Program Educational Objectives (PEOs)

Program Educational Objectives (PEO's)	
A graduate of the Artificial Intelligence and Data Science Program will able to-	
PEO1	Work in the area of Artificial Intelligence and Data Science to design ability of a computer system.
PEO2	Apply analytical skills ,decision making skills, leadership skills and critical thinking skills to solve multidisciplinary problems for the betterment of the society
PEO3	Demonstrate professionalism as a means of lifelong learning in the area of Artificial Intelligence and Data Science with emerging tools and technologies like IoT , Big Data, Cloud Services , Artificial Neural Network.

Program Specific Outcomes (PSOs)

Program Specific Outcomes (PSO's)	
A graduate of the Artificial Intelligence and Data Science Program will demonstrate	
PSO1	**Professional Skills-**The ability to understand, analyze and develop computer programs in the areas of Artificial Intelligence and Data Science for efficient design of computer based systems.
PSO2	**Problem-Solving Skills-** The ability to apply the knowledge of Artificial Intelligence and Data Science to cater the need of industry, academia and society.
PSO3	**Successful Career and Entrepreneurship-** The ability to employ modern computer languages, environments and platforms to become an entrepreneur and to have a zest for higher studies.

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 Skills : 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													
	Second Year of Artificial Intelligence and Data Science (2020 Course)													
	(With effect from Academic Year 2021-22)													
	Semester-IV													
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
217528	Statistics	03	-	-	30	70	-	-	-	100	03	--	-	03
217529	Internet of Things	03	-	-	30	70	-	-	-	100	03	-	-	03
210252	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
210253	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
217530	Management Information System	03	-	-	30	70	-	-	-	100	03	-	-	03
217531	Internet of Things Laboratory	-	04	-	-	-	50	25	-	75	-	02	-	02
217532	Data Structures and Algorithms Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
217533	Project Based Learning II	-	04	-	-	-	50	-	-	50	-	02	-	02
217534	Code of Conduct	-	-	01	-	-	25	-	-	25	-	-	01	01
217535	Audit Course 4	Grade												
	Total	15	12	01	150	350	150	50	-	700	-	-	-	-
	Total Credit										15	06	01	22

217535: Options for Audit Course 4	
Audit Course Code	**Audit Course Title**
217535-I	Water Management
217535-II	Intellectual Property Rights and Patents
217535-III	The Science of Happiness
217535-IV	Stress Relief: Yoga and Meditation
217535-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

Subject 1: Statistics

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	03	**-**	**-**

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives

Demonstrate knowledge of probability & standard statistical distributions.

Course Outcomes

At the end of the Course, Students will be able to,

- Identify the use of appropriate statistical terms to describe data.
- Use appropriate statistical method to collect, organize, display and analyze relevant data.
- Use distribution functions and apply to functions of random variable.
- Distinguish between correlation coefficient and regression.
- Understand tests for hypothesis and its significance.

Syllabus

Unit	Topic	Hours
I	**Introduction To Statistics And Sampling Theory**	06
	Statistics: Introduction**,** Origin and Development of Statistics, Definition, Importance and Scope, Limitations, Distrust of Statistics **Population and Sample**: Sampling –Introduction, Types of Sampling, Purposive Sampling, Random Sampling, Simple Sampling, Stratified Sampling, Parameter and Statistic, Sampling Distribution, Statistical Inference, Sampling With and Without Replacement, Random Samples: Random Numbers, Population Parameters, Sample Statistics, Sampling Distributions	
II	**Descriptive Statistics: Measures Of Central Tendency**	06
	Frequency Distributions and Measures of central Tendency: Frequency Distribution, Continuous Frequency Distribution, Graphic Representation of a Frequency Distribution, Histogram, Frequency Polygon, Averages or Measures of Central Tendency or Measures of Location, Requisites for an Ideal Measure of Central Tendency, Arithmetic Mean, Properties of Arithmetic Mean, Merits and Demerits of Arithmetic Mean, Weighted Mean, Median, Merits and Demerits of Median, Mode, Merits and Demerits of Mode, Geometric Mean, Merits and Demerits of Geometric Mean, Harmonic Mean, Merits and Demerits of Harmonic Mean, Selection of an Average	
III	**Descriptive Statistics: Measures of Dispersion**	06
	Measures of Dispersion, Skewness and Kurtosis: Dispersion, Characteristics for an Ideal Measure of Dispersion, Measures of Dispersion, Range, Quartile Deviation, Mean Deviation, Standard Deviation and Root Mean Square Deviation, Coefficient of Dispersion, Coefficient of Variation, Skewness, Kurtosis Correlation and Regression : Bivariate Distribution, Scatter diagrams, Correlation, Karl Pearson's coefficient of correlation, Rank correlation, Regression, Lines of Regression, Regression Coefficients, Binomial and multinomial distributions, Poisson distribution, Uniform distribution, Exponential distribution, Gaussian distribution, Log-normal distribution, Chi-square distribution	
IV	**Random Variables And Probability Distributions**	08
	Random Variables and Distribution Functions: Random Variable, Distribution Function, Properties of Distribution Function, Discrete Random Variable, Probability Mass Function, Discrete Distribution Function, Continuous Random Variable, Probability Density Function	

	Theoretical Discrete Distributions : Bernoulli Distribution, Binomial Distribution, Mean Deviation about Mean of Binomial Distribution, Mode of Binomial Distribution, Additive Property of Binomial Distribution, , Characteristic Function of Binomial Distribution, Cumulants of Binomial Distribution , Poisson Distribution, The Poisson Process, Geometric Distribution…	
V	**Inferential Statistics: Hypothesis**	**06**
	Statistical Inference - Testing of Hypothesis, Non-parametric Methods and Sequential Analysis: Introduction, Statistical Hypothesis (Simple and-Composite), Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two Types of Errors, level of Significance, Power of the Test	
VI	**Inferential Statistics: Tests For Hypothesis**	**08**
	Steps in Solving Testing of Hypothesis Problem, Optimum Tests Under Different Situations, Most Powerful Test (MP Test), Uniformly Most Powerful Test, likelihood Ratio Test, Properties of Likelihood Ratio Test, Test for the Mean of a Normal Population, Test for the Equality of Means of Two Normal Populations, Test for the Equality of -Means of Several Normal Populations, Test for the Variance of a Normal Population, Test for Equality of Variances of two Normal Populations, Non-parametric Methods, Advantages and Disadvantages of Non-parametric Methods	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction To Statistics And Sampling Theory	T1,R1	6 Hours
2	II	Descriptive Statistics: Measures Of Central Tendency	T1,R2	6 Hours
3	III	Descriptive Statistics: Measures of Dispersion	T1,R2	6 Hours
4	IV	Random Variables And Probability Distributions	T1,R1	8 Hours
5	V	Inferential Statistics: Hypothesis	T1,R1	6 Hours
6	VI	Inferential Statistics: Tests For Hypothesis	T1,R1	8 Hours

Text Books :

T1 : S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics (A ModernApproach)", Sultan Chand & Sons Educational Publishers, Tenth revised edition, ISBN:81-7014-791-3

T2 : J. Medhi, "Statistical Methods: An Introductory Text", Second Edition, New Age International Ltd, ISBN: 8122419577

Reference Books :

R1 : Glen Cowan, " Statistical Data Analysis" , University Of Siegen, Clarendon Press,Oxford, 1998, ISBN: 0198501552

R2 : Ken Black, "Applied Business Statistics", Wiley, 7th Edition, ISBN: 9788126537075

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

- *https://www.itl.nist.gov/div898/handbook/*

- *https://web.stanford.edu/~hastie/ElemStatLearn/index.html*

Unit No. I: Introduction To Statistics And Sampling Theory(6 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Statistics: Introduction, Origin and Development of Statistics, Definition, Importance and Scope	T1,R1
2	Limitations, Distrust of Statistics Population and Sample	T1,R1
3	Sampling –Introduction, Types of Sampling, Purposive Sampling, Random Sampling	T1,R1
4	Simple Sampling, Stratified Sampling, Parameter and Statistic, Sampling Distribution	T1,R1
5	Statistical Inference, Sampling With and Without Replacement, Random Samples: Random Numbers	T1,R1
6	Population Parameters, Sample Statistics, Sampling Distributions	T1,R1

Unit No.-II- Descriptive Statistics: Measures Of Central Tendency (6 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Frequency Distribution, Continuous Frequency Distribution, Graphic Representation of a Frequency Distribution,	T1,R2
2	Histogram, Frequency Polygon, Averages or Measures of Central Tendency or Measures of Location, Requisites for an Ideal Measure of Central Tendency	T1,R2
3	Arithmetic Mean, Properties of Arithmetic Mean, Merits and Demerits of Arithmetic Mean, Weighted Mean,	T1,R2
4	Median, Merits and Demerits of Median, Mode, Merits and Demerits of Mode,	T1,R2
5	Geometric Mean, Merits and Demerits of Geometric Mean, Harmonic Mean, Merits and Demerits of Harmonic Mean,	T1,R2
6	Selection of an Average and examples	T1,R2

Unit No.-III- Descriptive Statistics: Measures of Dispersion(6 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Characteristics for an Ideal Measure of Dispersion, Measures of Dispersion, Range, Quartile Deviation,	T1,R2
2	Mean Deviation, Standard Deviation and Root Mean Square Deviation	T1,R2
3	Coefficient of Dispersion, Coefficient of Variation, Skewness, Kurtosis	T1,R2
4	Bivariate Distribution, Scatter diagrams, Correlation, Karl Pearson's coefficient of correlation	T1,R2
5	Rank correlation, Regression, Lines of Regression, Regression Coefficients, Binomial and multinomial distributions	T1,R2
6	Poisson distribution, Uniform distribution, Exponential distribution, Gaussian distribution, Log-normal distribution, Chi-square distribution	T1,R2

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Calculate ：i. Quartile deviation(Q.D) ii. Mean Deviation(M.D) from mean, for the following data ：

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	6	5	8	15	7	6	8

Q. 2 An analysis of monthly wages paid to the workers of two firms A and B belonging to the same industry give the following results ：

	Firm *A*	Firm *B*
Number of workers	500	600
Average daily wage	Rs. 186.00	Rs. 175.00
Variance of distribution of eages	81	100

  i. Which firm, A and B has a larger wage bill ?
  ii. In which firm, A or B is there greater variability in individual wages?
  iii. Calculate ：(a) The average daily wage and (b) The variance of the distribution of wages of all the workers in the firm is A and B taken together.

Q. 3 In a partially destroyed laboratory, record of an analysis of correlation data, the following result only are legible ：

Cariance of $X = 9$. Regression equations : $8X - 10Y + 66 = 0$, $40X - 18Y = 214$. What are :
i)   The mean values of X and Y.
ii) The correlation coefficient between X and Y.
iii) The standard deviation of Y.

Q. 4	The variables X and Y are connected by the equation $aX + bY + c = 0$. Show that the correlation between them is $- 1$ if the signs of a and b are alike and $+ 1$ if they are different.

Q. 5 For 10 randomly selected observations the following data were recorded

Observation no.	1	2	3	4	5	6	7	8	9	10
Observation hrs(X)	1	1	2	2	3	3	4	5	6	7
Additional units(Y)	2	7	7	10	8	12	10	14	11	14

Determine the coefficient of regression and regression equation using the non linear form $Y = a + b_1X + b_2X^2$

Q. 6 Variables X and Y have the joint p. d. f given by :
$F(x, y) = \dfrac{1}{3}(x + y); 0 \le x \le 1, 0 \le y \le 2$. Find
i) $r(X, Y)$.
ii) The two lines of regression.
iii) The two regression curves for the means.

Q. 7 In a partially distroyed laboratory, record of a analysis of correlation data, the following results only are legible : variance of $x = 9$.
Regression equations : $8X - 10Y + 66 = 0, 40X - 18Y = 214$. What are
i)   The mean values of X and Y.
ii) The correlation coefficient between X and Y.
iii) The standard deviation of Y.

Unit No.-IV : Random Variables And Probability Distributions(8 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Random Variable, Distribution Function, Properties of Distribution Function, Discrete Random Variable	T1,R1
2	Probability Mass Function, Discrete Distribution Function	T1,R1
3	Continuous Random Variable, Probability Density Function	T1,R1
4	Bernoulli Distribution, Binomial Distribution	T1,R1
5	Mean Deviation about Mean of Binomial Distribution, Mode of Binomial Distribution	T1,R1
6	Additive Property of Binomial Distribution, Characteristic Function of Binomial Distribution,	T1,R1
7	Cumulant's of Binomial Distribution	T1,R1
8	Poisson Distribution, The Poisson Process, Geometric Distribution.	T1,R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	A random variable X with following probability distribution：

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

Find： i) k.   ii) P($x > 5$)   iii) P($1 \leq x \leq 5$)

Q. 2	In a continuous distribution density function： $f(x) = kx^2(1 - x^3),\ 0 \leq x \leq 1.$ Find the value of： i) k. ii) Mean iii) Variance

Q. 3	A dice is thrown 10 times. If getting an odd number is a success. What is the probability of getting： i) 8 successes. ii) Atleast 6 success.

Q. 4	Fit Poisson's distribution to following data and calculate theoretical frequencies.

x	0	1	2	3	4
f	122	60	15	2	1

Q. 5	In a sample of 1000 cases, the means of certain test is 14 and standard deviation is 2.5. Assuming the distribution to be normal find i) Howmany students scored between 12 & 15. ii) Howmay scored below 8 [Given : $A(z = 0.8) = 0.2881, A(z = 0.4) = 0.1554, A(z = 2.4) = 0.4918$]

Q. 6	MNC company conducted 1000 candidates aptitude test. The average score is 45 and standard deviation of score is 25. Assuming normal distribution for the result. Find i) The number of candidate whose score exceed 60. ii) The number of candidates whose score lies between 30 & 60. [Given : $A(z = 0.6) = 0.2257$]

Q. 7	Assume that on an average number out of 15 called between 2 pm to 3 pm on week days is busy. What id the probability that 6 randomly selected telephone numbers called i) Not more than 3 busy. ii) Atleast 3 busy.

Q. 8	If the probability that an individual suffers a bad reaction from certain injection is 0.001. Determine the probability out of 2000 people, by using Poisson's distribution. i) Exactly 3 will suffer a bad reaction. ii) More than 1 will suffer a bad reaction.

Q. 9	In a sample of 1000 cases, the means of certain test is 14 and standard deviation is 2.5. Assuming the distribution to be normal find i) Howmany students scored between 12 & 15. ii) Howmay scored below 8. [Given : $A(z = 0.8) = 0.2881, A(z = 0.4) = 0.1554, A(z = 2.4) = 0.4918$]

Unit No.-V : Inferential Statistics: Hypothesis(6 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Testing of Hypothesis	T1,R1
2	Non-parametric Methods and Sequential Analysis	T1,R1
3	Introduction, Statistical Hypothesis (Simple and composite)	T1,R1
4	Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis	T1,R1
5	Critical Region, Two Types of Errors	T1,R1
6	level of Significance, Power of the Test	T1,R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	In an experiment of pea breeding, the following frequencies of seeds were obtained.

Round & green	Wrinkle & green	Round & yellow	Wrinkle & yellow	Total
222	120	32	150	524

Theory predicts that the frequencies should be in the proportion $8 : 2 : 2 : 1$. Examine the correspondance between theory and experiment. Given chi square$(0.05,3) = 7.815$.

Q. 2	The average marks in mathematics of a sample of 100 students was 51 with standard deviation of 6 marks. Could this have a random sample from the population with average marks 50 ? Given $z_\alpha = 1.96$ at 5% level of significance.

Q. 3	A random sample of 16 newcomers gave a mean of 1.67 m and standard deviation of 0.16 m. Is the mean height of newcomers significantly different from the mean height of students population of the previous year ? Given $t_{0.05,15} = 2.13$.

Q. 4	Following table shows number of books issued on the various days of week from a certain library at 5% level of significance. Test the null hypothesis that number of books issued in department of the day.

Days	Mon.	Tue.	Wed.	Thurs.	Fri.	Sat
No. of books issued	120	130	110	115	135	110

Given Chi square value at 5% level of significance for degrees of freedom 5 is 11.071.

Q. 5	A random sample of 900 members has mean 3.4 cms. Can it be reasonable regarded as a sample from a large population of mean 3.2 cms and standard deviation 2.3 cms.

Q. 6	Find the F statistics from the following data :			
	Sample	size(n)	Total observations $\sum x$	Sum of squares of observations
	1	8	9.6	61.52
	2	11	16.5	73.26

Q. 7	The following table gives the number of accidents that took place in an industry during various days of the week. Test if accidents are uniformly distributed over the week

Days	Mon	Tue	Wed	Thur	Fri	Sat
Number of accidents	14	18	12	11	15	14

Given $\chi^2_{0.05,5} = 11.09$.

Q. 8	A normal population has mean 6.8 and standard deviation 1.5. A sample of 400 member s gave a mean of 6.75. Is the difference significant? Given $z_\alpha = 1.96$ at 5% level of significance.

Q. 9	Suppose that sweets are sold in packges of fixed weight of contents. The procedure of the packges is interested in testing the average weight of contents in packages in 1 kg. Sum of squares of deviation from mean of 12 samples is 0.011967. Using above data should we conclude the average. Given $\bar{X} = 0.9883, t_{0.05,11} = 2.201$

Unit No.-VI : Inferential Statistics: Tests For Hypothesis(8 Lectures)

Lecture No.	Details of the Topic to be covered	References
1	Steps in Solving Testing of Hypothesis Problem, Optimum Tests Under Different Situations,	T1,R1
2	Most Powerful Test (MP Test), Uniformly Most Powerful Test	T1,R1
3	likelihood Ratio Test, Properties of Likelihood Ratio Test	T1,R1
4	Test for the Mean of a Normal Population	T1,R1
5	Test for the Equality of Means of Two Normal Populations	T1,R1
6	Test for the Equality of -Means of Several Normal Populations, Test for the Variance of a Normal Population	T1,R1
7	Test for Equality of Variances of two Normal Populations	T1,R1
8	Non-parametric Methods, Advantages and Disadvantages of Non-parametric Methods.	T1,R1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1 State and prove Neymann Pearson Fundamental lemma.

Q. 2

Given the frequency function $f(x, \theta) = \begin{cases} \dfrac{1}{\theta} & ; \quad 0 \le x \le \theta \\ 0 & ; \quad \text{elsewhere} \end{cases}$

And that you are testing the null alternative $H_0 : \theta = 1$ virsus $\theta = 2$ by means of a single observed value of x. What would be the size of type I and type II error. If you choose the interval　i.　$0.5 \le x$.　　ii.　$1 \le x \le 1.5$
Also obtain the power function of the test.

Q. 3 Write short notes on :
i)　Most powerful test.
ii)　Uniformly most powerful test.
iii)　Advantages and disadvantages of non parametric tests.
iv)　Level of significance.

Q. 4 Explain in detail about test for the equality of means of several normal populations.

Q. 5 If $x \ge 1$ is the critical region for testing $\Theta_0 : \theta = 2$ against the alternative $\theta = 1$ on the basis of the single observation from the population. $f(x, \theta) = \theta e^{-\theta x}, 0 \le x < \infty$,

	obtain the values of type I, type II error. Also find power of function.
Q. 6	State and prove Neymann Pearson lemma for testing a simple hypothesis against a simple alternative hypothesis.
Q. 7	Write short notes on : i) Population and sample. ii) Type I and Type II error. iii) Critical region. iv) Power of test.
Q. 8	State and prove Neymann Pearson lemma for testing a simple hypothesis against a simple alternative hypothesis.
Q. 9	Let $X_1, X_2, X_3, \cdots\cdots\cdots, X_n$ be random sample of size n from a normal distribution $N(\mu, \sigma^2)$, where μ and σ^2 both are unknown. Show that likelihood ratio test(LRT) used to test $H_0 : \mu = \mu_0$ virsus $H_1 : \mu \neq \mu_0, 0 < \sigma^2 < \infty$ is used t test. OR Explain in detail the **test for the mean of normal population**

Subject 2: Internet of Things

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

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:
- Understand the Basic Digital Electronics and microprocessors.
- To introduce students with the architecture and operation of typical microprocessors and microcontrollers and its interfacing
- Understand the definition and significance of the Internet of Things.
- Interface and deploy analog and digital sensors.
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies.

Course Outcomes:
On completion of the course, learner will be able to–
- Have a thorough understanding of the structure, function and characteristics of computer systems and Understand the structure of various number systems and its application in digital design.
- Develop the skill set to build IoT systems and sensor interfacing.
- Explain the concept of Internet of Things and identify the technologies that make up the internet of things
- Analyze trade-offs in interconnected wireless embedded device networks. Select Appropriate Protocols for IoT Solutions
- Design a simple IoT system comprising sensors by analyzing the requirements of IoT Application
- Identify the Application of IoT in automation of Commercial and Real World examples

Syllabus

Unit	Topic	Hours
I	**Fundamentals of Computer Organization & Digital Electronics**	**09**
	Basic Organization of Computers, Classification Micro, Mini, Mainframe and Super Computer. System Bus and Interconnection, PCI, Computer Function, I-Cycle, Interrupt and Class of Interrupts. Number systems, Decimal Number system, Binary number system, Octal & Hexadecimal number system, 1's & 2's complement, Binary Fixed Point Representation.	
II	**Communication Interface**	**06**
	Basic Peripherals & their interfacing with 8086/8088, Semiconductor Memory Interfacing-Dynamic RAM Interfacing-Interfacing I/O ports-PIO-8255, Modes of operation-interfacing Analog-Digital Data converter- stepper motor interfacing.	
III	**Introduction & IOT Technologies behind smart and intelligent devices**	**09**
	IoT Concepts, Introduction to IOT Communications, Telemetry vs IOT, Applications of IOT Communications, People, Processes and Devices. Automation, asset management, telemetry, transportation, telematics. Telemetry and Telemetric; Report location, logistics, tracking and remote assistance; Next generation kiosks, self-service technology; Cellular IOT connectivity services.	
IV	**IoT Systems, Network and Protocols**	**07**
	Study of RF Wireless Sensors; Wireless networks; Wireless Sensor Networking (WSN); Cellular Machine-to- Machine (M2M) application networks; Computer Connected to Internet; Network Devices; Device configuration and management; Exchange information in real time without human intervention; IoT Protocols.	
V	**IOT Design and System Engineering**	**06**
	Discuss IOT Requirements; Hardware & Software; Study of IOT Sensors; Tagging and Tracking; Embedded Products; IOT Design; SIM Card Technology; IOT Connectivity and Management; IOT Security & IOT Communication.	
VI	**IOT Applications**	**07**
	IOT Verticals; IOT Hosted Services; IOT Application development, IOT Connectivity; IOT Software providers; Review of various IoT application domains including agriculture, healthcare, manufacturing, device	

management, and vehicle to vehicle communication and wearable computing devices.	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Basic Organization of Computers, Classification Micro, Mini, Mainframe and Super Computer. System Bus and Interconnection, PCI, Computer Function, I-Cycle, Interrupt and Class of Interrupts. Number systems, Decimal Number system, Binary number system, Octal & Hexadecimal number system, 1's & 2's complement, Binary Fixed Point Representation.	Computer Organization and Architecture By Willam Stallings	9
2	II	Basic Peripherals & their interfacing with 8086/8088, Semiconductor Memory Interfacing-Dynamic RAM Interfacing-Interfacing I/O ports-PIO-8255, Modes of operation-interfacing Analog-Digital Data converter-stepper motor interfacing.	Digital Logic and Computer Design By Morris Mano	6
3	III	IoT Concepts, Introduction to IOT Communications, Telemetry vs IOT, Applications of IOT Communications, People, Processes and Devices. Automation, asset management, telemetry, transportation, telematics. Telemetry and Telemetric; Report location, logistics, tracking and remote assistance; Next generation kiosks, self-service technology; Cellular IOT connectivity services.	1.1 , 1.2 , 2.2	9
4	IV	Study of RF Wireless Sensors; Wireless networks; Wireless Sensor Networking (WSN); Cellular Machine-to- Machine (M2M) application networks; Computer Connected to Internet; Network Devices; Device configuration and management; Exchange information in real time without human intervention;	2.1	7

		IoT Protocols.		
5	V	Discuss IOT Requirements; Hardware & Software; Study of IOT Sensors; Tagging and Tracking; Embedded Products; IOT Design; SIM Card Technology; IOT Connectivity and Management; IOT Security & IOT Communication.	2.3	6
6	VI	IOT Verticals; IOT Hosted Services; IOT Application development, IOT Connectivity; IOT Software providers; Review of various IoT application domains including agriculture, healthcare, manufacturing, device management, and vehicle to vehicle communication and wearable computing devices.	1.2 , 2.2	7

1. Text Books:

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.

2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things: Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0

2. Reference Books:

1. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017

2. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345 3.

3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1-

118-43063-7

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

e-Books: Internet of Things and Access Control: Sensing, Monitoring and Controlling Access in IoT-Enabled Healthcare Systems (Smart Sensors, Measurement and Instrumentation Book 37), 1st Edition, Kindle Edition
MOOC Courses: Introduction to IoT (NPTEL) by Prof. Sudip Mishra, IITKGP.

Unit No.-I

Name of the Unit : Fundamentals of Computer Organization & Digital Electronics

Lecture No.	Details of the Topic to be covered	References
1	Basic Organization of Computers	
2	Classification Micro, Mini, Mainframe and Super Computer.	
3	System Bus and Interconnection, PCI,	
4	Computer Function, I-Cycle, Interrupt and Class of Interrupts.	Computer Organization and Architecture
5	Number systems, Decimal Number system	By William Stallings
6	Binary number system, Octal	
7	Hexadecimal number system, 1's & 2's complement,	
8	Binary Fixed Point Representation.	

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1   (ii)   Convert the following numbers in Decimal Number System.
  i. $(2A)_{16}$
  ii. $(37)_8$

(iii)   Perform the following binary subtractions using the 2's complement method:
  i. $1011110 - 1001010$
  ii. $1000100 - 0100101$

Q. 2   ii)   What is the binary equvalent of decimal 22?

Q. 3   Convert decimal 3521 to binary & octal form.

| Q. 4 | Draw and explain the block diagram of computer. |

| Q. 5 | Write short note on Interrupts |

Unit No.-II

Name of the Unit : Communication Interface

Lecture No.	Details of the Topic to be covered	References
1	Basic Peripherals & their interfacing with 8086/8088	
2	Semiconductor Memory Interfacing	
3	Dynamic RAM Interfacing	Digital Logic and Computer Design
4	Interfacing I/O ports-PIO-8255	
5	Modes of operation	By Morris Mano
6	interfacing Analog-Digital Data converter	
7	Stepper motor interfacing.	

Question Bank: Theory & Numerical
Mapped to Course Outcome:

| Q. 1 | With the help of block diagram explain the internal architecture of IC 8255 and describe its working in IO mode. |

| Q. 2 | Explain the block diagram of 8259 Programmable interrupt controller. What are its features? Explain the interrupt operation of 8259 in the simplest format. |

| Q. 3 | Explain the block diagram of 8251A programmable communication interface. What are its features? Explain the various modes 8251 in the simplest format |

| Q. 4 | Write short note on Different working modes of IC 8254 |

| Q. 5 | Define Stepper motor. Explain the interfacing of a stepper motor to 8085 microprocessor with necessary circuit diagram. Write an ALP to rotate the stepper |

	motor clockwise direction	

Unit No.-III

Name of the Unit : Introduction & IOT Technologies behind smart and intelligent devices

Lecture No.	Details of the Topic to be covered	References
1	IoT Concepts, Introduction to IOT Communications,	1.1 , 1.2 , 2.2
2	Telemetry vs IOT, Applications of IOT	1.1 , 1.2 , 2.2
3	Communications, People, Processes and Devices.	1.1 , 1.2 , 2.2
4	Automation, asset management, telemetry,	1.1 , 1.2 , 2.2
5	Transportation, telematics. Telemetry and Telemetric;	1.1 , 1.2 , 2.2
6	Report location, logistics, tracking and remote assistance; Next generation kiosks,	1.1 , 1.2 , 2.2
7	Self-Service technology; Cellular IOT connectivity services.	1.1 , 1.2 , 2.2

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Illustrate the various IoT Communication APIs

Q. 2	With the help of following sectors explain how IoT technology is impacting on the end-to-end value chain in the logistics sector:
	i) Route generation & scheduling
	ii) Fleet tracking
	iii) Shipment monitoring
	iv) Remote vehicle diagnostics

Q. 3	Demonstrate the IoT component with a neat diagram.

Q. 4	What is piggybacking ? What is the necessity of security and privacy of IoT ?

Unit No.-IV

Name of the Unit: IoT Systems, Network and Protocols

Lecture No.	Details of the Topic to be covered	References
1	Study of RF Wireless Sensors	2.1
2	Wireless networks; Wireless Sensor Networking (WSN);	2.1
3	Cellular Machine-to-Machine (M2M) application networks	2.1
4	Computer Connected to Internet	2.1
5	Network Devices; Device configuration and management	2.1
6	Exchange information in real time without human intervention	2.1
7	IoT Protocols.	2.1

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Draw and Explain WSN architecture?

Q. 2	Explain any four IoT network protocols?

Q. 3	Explain Machine to Machine Architecture?

Q. 4	Explain any four applications of RFID?

Unit No-V

Name of the Unit : IOT Design and System Engineering

Lecture No.	Details of the Topic to be covered	References
1	Discuss IOT Requirements; Hardware & Software	2.3
2	Study of IOT Sensors	2.3
3	Tagging and Tracking	2.3
4	Embedded Products	2.3
5	IOT Design; SIM Card Technology; IOT Connectivity and Management	2.3
6	IOT Security & IOT Communication.	2.3

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Explain IoT Information model specification.

Q. 2	Explain Various IoT sim card Technologies

Q. 3	What are the criterias for selection of controllers in Embedded Products?

Q. 4	What are different security parameters considered while designing any IoT system?

Unit No.-VI

Name of the Unit : IOT Applications

Lecture No.	Details of the Topic to be covered	References
1	IOT Verticals; IOT Hosted Services	1.2 , 2.2
2	IOT Application development,	1.2 , 2.2
3	IOT Connectivity; IOT Software providers	1.2 , 2.2
4	Review of various IoT application domains including agriculture, healthcare	1.2 , 2.2
5	Review of various IoT application domains including , manufacturing, device management	1.2 , 2.2
6	Vehicle to vehicle communication and wearable computing devices.	1.2 , 2.2

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Discuss various IoT applications in the Agriculture domain

Q. 2	What is the E-Healthcare system? How IOT is important in E-Health Monitoring application.

Q. 3	Discuss various IoT applications in Automotive applications.

Q. 4	Write a short note on IoT vertical Applications.

Q.5	Explain Voice Application for IoT Device.

Q.6	Explain Vehicle to Vehicle communication

Subject 3: Data Structure and Algorithms

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

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

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

- Identify and articulate the complexity goals and benefits of a good hashing scheme for real- world applications.
- Apply non-linear data structures for solving problems of various domain.
- Design and specify the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.
- Analyze the algorithmic solutions for resource requirements and optimization
- Use efficient indexing methods and multiway search techniques to store and maintain data.
- Use appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Unit	Topic	Hours
I	**Hashing**	**07**
	Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining. **Skip List-** representation, searching and operations- insertion, removal	
II	**Trees**	**08**
	Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in- order threaded binary search tree, in order traversal of in-order threaded binary search tree.	
III	**Graphs**	**07**
	Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. **Traversals**-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.	
IV	**Search Trees**	**08**
	Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree.	
V	**Indexing and Multiway Trees**	**07**
	Discuss IOT Requirements; Hardware & Software; Study of IOT Sensors; Tagging and Tracking; Embedded Products; IOT Design; SIM Card Technology; IOT Connectivity and Management; IOT Security & IOT Communication.	

VI	File Organization	07
	Files: concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining. Skip List- representation, searching and operations- insertion, removal	1.1,1.2, 1.3, ,2.1,2.2	7
2	II	Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in inorder threaded binary search tree, in order traversal of in-order threaded binary search tree	1.1,1.2,1.3 2.1,2.2,2.5	8
3	III	Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Minimum spanning	1.1,1.2,1.3 2.1,2.2,2.4	7

		Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering	,2.5	
4	IV	Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree.	1.1, 1.2, 1.3,2.1,2.2 ,2.3,2.4	8
5	V	Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion, B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree	1.1,1.2,1.3 2.1, 2.2,2.3,2.4,2.5	7
6	VI	Files: concept, need, primitive operations. Sequential file organization- concept and primitive operations, Direct Access File- Concepts and Primitive operations, Indexed sequential file organization-concept, types of indices, structure of index sequential file, Linked Organizationmulti list files, coral rings, inverted files and cellular partitions.	1.2,2.1, 2.2,2.3,2.4	7

1. Text Books:

1. 1. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. 2. M Folk, B Zoellick, G. Riccardi, "File Structures", Pearson Education", ISBN:81-7758-37-5
3. 3. Peter Brass, "Advanced Data Structures", Cambridge University Press, ISBN: 978-1-107-43982-5

2. Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms", Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, "File Structures an Object Oriented Approach with C++", Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, "Data Structures, Algorithms and Applications in C++", Second Edition, University Press, ISBN: 81-7371522 X.
4. G A V Pai, "Data Structures and Algorithms", McGraw-Hill Companies, ISBN - 9780070667266.
5. Goodrich, Tamassia, Goldwasser, "Data Structures and Algorithms in Java", Wiley Publication, ISBN: 9788126551903

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

e-Books:
- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC/ Video Lectures available at:
- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

Unit No.-I-

Name of the Unit : Hashing

Lecture No.	Details of the Topic to be covered	References
1	Hash Table- Concepts-hash table, hash function, basic operations, bucket,	1.1,1.2
2	collision, probe, synonym,overflow, open hashing, closed hashing, perfect hash function, load density,	1.1,1.2,1.3
3	full table, load factor,rehashing, issues in hashing, hash functions- properties of good hash function, division,	1.1,1.2,1.3
4	multiplication,extraction, mid-square, folding and universal,	1.1,1.2,2.1
5	Collision resolution strategies- open addressing and chaining,	1.1,1.2,2.2
6	Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining.	1.1,1.2,1.3, 2.1
7	Skip List- representation, searching and operations- insertion, removal	1.1,1.2,1.3,2.1

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain hashing and any 3 types of hash function in detail .

Q. 2	Solve collision using linear probing techniques for the given set of values 35,36,25,47,2501,129,65,29,16,14, 99. Create a hash table with size 15

Q. 3	Explain Skip list and operation on skip list.

Unit No.-II-

Name of the Unit:

Lecture No.	Details of the Topic to be covered	References
1	Tree- basic terminology, General tree and its representation,	1.1,2.1
2	representation using sequential and linked organization,	1.1,2.1
3	Binary tree- properties, converting tree to binary tree,	1.1,2.1
4	binary tree traversals(recursive and non-recursive)- inorder, preorder, post order,	1.1,2.1
5	depth first and breadth first,Operations on binary tree.	1.1,2.1
6	Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations,	1.1,2.1
7	Threaded binary search tree- concepts, threading,	1.1,2.1
8	insertion and deletion of nodes in in- order threaded binary search tree, in order traversal of in-order threaded binary search tree.	1.1,2.1

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain following terms with diagram 1.Degree of the node 2. Level of the tree. 3.Ancestor node 4.Sibling

	5. Height of the Tree

Q. 2	Apply the concept of sequential representation on the following binary tree.
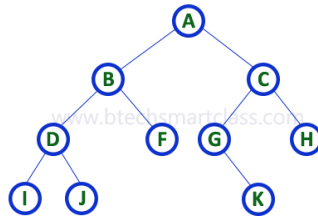
Q. 3	Prove that for binary tree maximum number of nodes at level L are 2^L

Unit No.-III

Name of the Unit :Graphs

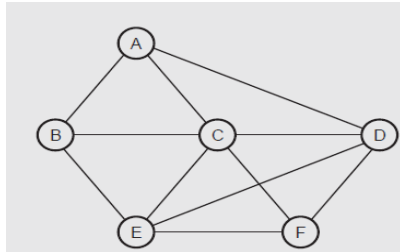| Lecture No.	Details of the Topic to be covered	References
1	Basic Concepts, Storage representation,	1.1,1.2,2.1,2.5
2	Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list.	1.1,1.2,2.5,2.1
3	Traversals-depth first and breadth first, Minimum spanning Tree,	1.1,1.2, 2.1,2.5
4	Greedy algorithms for computing minimum spanning tree-	1.1,1.2, 2.1,2.5
5	Prims and Kruskal Algorithms,	1.1,1.2, 2.1,2.5
6	Dikjtra's Single source shortest path,	1.1,1.2, 2.1,2.5
7	All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.	1.1,1.2, 2.1,2.5

Question Bank: Theory & Programs
Mapped to Course Outcome:

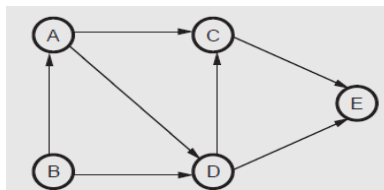| Q. 1	Explain the following terms
	I. Adjacency Matrix of graph
	II Adjacency List of graph

Q. 2	What is graph? Draw how the following graph can be represented using linked organization?

Q. 3	Sort the digraph for topological sort using source using removal algorithm.

Unit No.-IV

Name of the Unit: Search Trees

Lecture No.	Details of the Topic to be covered	References
1	Symbol Table-Representation of Symbol	1.1, 1.2, 2.1,2.2,2.3,2.5
2	Tables- Static tree table and Dynamic tree table,	1.1, 1.2, 2.1,2.2
3	Weight balanced tree	1.1, 1.2, 2.1,2.2,
4	Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming,	1.1, 1.2, 2.1,

5	Height Balanced Tree	1.1, 1.2,2.1,2.2,2.2,
6	AVL tree.	1.1, 1.2, 2.1,2.2,
7	Red-Black Tree, AA tree,	1.1, 1.2, 2.1,2.2,
8	K-dimensional tree, Splay Tree.	1.1, 1.2, 2.1,2.2,

Question Bank: Theory & Programs
Mapped to Course Outcome:

Q. 1	Explain height balance tree with example.
Q. 2	Construct AVL tree for the following data. 30,50,110,80.40,10,120,60,20,70, 100,90
Q. 3	Explain algorithm to insert node into AVL tree.

Unit No.-V

Name of the Unit: Indexing and Multiway Trees

Lecture No.	Details of the Topic to be covered	References
1	Indexing and Multiway Trees- Indexing,	2.1, 2.2,2.3,2.4,2.5
2	indexing techniques-primary, secondary, dense, sparse,	2.1, 2.2 ,2.3,2.4,2.5
3	Multiway search trees,	2.1, 2.2, ,2.3,2.4,2.5
4	B-Tree- insertion, deletion,	2.1, 2.2, ,2.3,2.4,2.5
5	B+Tree - insertion, deletion,	2.1, 2.2, ,2.3,2.4,2.5
6	use of B+ tree in Indexing,	2.1, 2.2,2.3,2.4,2.5
7	Trie Tree.	

Question Bank: Theory & Programs

Mapped to Course Outcome:

Q. 1	Create a B tree of order 3 for the following data: 20,10,30,15,12,40,50

Q. 2	What is B tree? Explain the delete operation in B tree with example.

Q. 3	Writer an algorithm to search an element in a B tree.

Q. 4	Construct a B+ tree for F,S,Q,K,C,L,H,T,V,W,M,R

Q. 5	Explain the concept of max heap and min heap

Unit No. VI

Name of the Unit: File Organization

Lecture No.	Details of the Topic to be covered	References
1	Files: concept, need, primitive operations.	2.1, 2.2
2	Sequential file organization- concept and primitive operations,	2.1, 2.2
3	Direct Access File- Concepts and Primitive operations,	2.1, 2.2
4	Indexed sequential file organization-concept, types of indices,	2.1, 2.2
5	structure of index sequential file,	2.1, 2.2
6	Linked Organization- multi list files, coral rings,	2.1, 2.2
7	inverted files and cellular partitions.	2.1, 2.2

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain the various modes of opening the file

| Q. 2 | Explain any three operations on sequential file organization with example. |

| Q. 3 | Explain the link organization with respect to the file handing. |

Subject 4: Software Engineering

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	03	**-**	**-**

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Unit	Topic	Hours
I	**Introduction to Software Engineering and Software Process Models**	**06**
	Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. **Software Process:** A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.	
II	**Software Requirements Engineering and Analysis**	**07**
	Modeling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements. **Suggested Free Open Source tools:** StarUML, Modelio, SmartDraw.	
III	**Estimation and Scheduling**	**07**
	Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based	

	Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix **Project Scheduling:** Project Scheduling, Defining a Task for the Software Project, Scheduling. **Suggested Free Open Source Tools:** Gantt Project, Agantty, Project Libre.	
IV	**Design Engineering**	**07**
	Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements. **Architectural Design:** Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles. **Suggested Free Open Source Tool:** Smart Draw	
V	**Risks and Configuration Management**	**07**
	Discuss IOT Requirements; Hardware & Software; Study of IOT Sensors; Tagging and Tracking; Embedded Products; IOT Design; SIM Card Technology; IOT Connectivity and Management; IOT Security & IOT Communication.	
VI	**Software Testing**	**07**
	A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies forWebApps, Validation Testing, Validation-Test Criteria, Configuration Review. **Suggested Free Open Source Tools:** Selenium, JUnit.	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. Software Process: A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development	1.1,1.2, 2.1	06
2	II	Modeling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements.	1.1, 2.2,2.3	07
3	III	Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix Project Scheduling: Project Scheduling, Defining a Task for the Software Project, Scheduling.	1.1,1.2,2.4	07

4	IV	Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements. Architectural Design: Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles.	1.1,1.2,2.5	07
5	V	Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan. Software Configuration Management: Software Configuration Management, The SCM Repository The SCM Process, Configuration Management for any suitable software system.	1.1,1.2,2.1,2.4	07
6	VI	A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies for WebApps, Validation Testing, Validation-Test Criteria, Configuration Review. Suggested Free Open Source Tools: Selenium, JUnit.	1.1, 1.2,2.5	07

1. Text Books:

4. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill, ISBN 0–07–337597–7
5. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

2. Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", PHI, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering", PHI, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering", World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. 5.Tom Halt, "Handbook of Software Engineering", Clanye International, ISBN- 10: 1632402939

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

e-Books:
- https://ebookpdf.com/roger-s-pressman-software-engineering
- Case study research in software engineering : guidelines and examples / Per Runeson [and others]. (unimelb.edu.au)
- Top Front End and Back End Programming Languages (simplilearn.com)

MOOC/ Video Lectures available at:
- https://nptel.ac.in/courses/106101061
- https://nptel.ac.in/courses/106105087
- https:// nptel.ac.in/courses/106105182

Unit No.-I-

Name of the Unit : Introduction to Software Engineering and Software Process Models

Lecture No.	Details of the Topic to be covered	References
1	Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software	1.1,1.2,2.1
2	Defining Software, Software Engineering Practice. What is Software Process.	1.1,1.2,2.1

3	A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement	1.1,1.2,2.1
4	Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models	1.1,1.2,2.1
5	The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models	1.1,1.2,2.1
6	A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development	1.1,1.2,2.1

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain Prescriptive Process Model.

Q. 2	Differentiate between Plan driven and Agile driven development method.

Q. 3	Define i) Software ii) Process Pattern iii) Software Process iv) Unified Process

Unit No.-II-

Name of the Unit: Software Requirement Engineering and Analysis

Lecture No.	Details of the Topic to be covered	References
1	Modeling: Requirements Engineering, Establishing the Groundwork	1.1, 2.2,2.3
2	Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration	1.1, 2.2,2.3
3	Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering	1.1, 2.2,2.3
4	Usage Scenarios, Elicitation Work Products, Developing Use Cases	1.1
5	Building the Requirements Model	1.1, 2.2,2.3

| 6 | Elements of the Requirements Model | 1.1, 2.2,2.3 |
| 7 | Negotiating Requirements, Validating Requirements | 1.1, 2.2,2.3 |

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain Eliciting the Requirements in Software Engineering.

Q. 2	Describe Modeling in Software Engineering.

Q. 3	Explain the following term i) Negotiating Requirements ii)Validating Requirements.

Unit No.-III

Name of the Unit : Estimation and Scheduling

Lecture No.	Details of the Topic to be covered	References
1	Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management	1.1,1.2,2.4
2	Reusable Software Resources, Environmental Resources, Software Project Estimation	1.1,1.2
3	Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation,	1.1,1.2,2.4
4	FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation	1.1,1.2
5	Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models	1.1,1.2,2.4
6	The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix	1.1,1.2,2.4
7	Project Scheduling: Project Scheduling, Defining a Task for the Software Project, Scheduling.	1.1,1.2

Question Bank: Theory & Programs
Mapped to Course Outcome:

Q. 1	Explain Project Scheduling in detail.

Q. 2	Describe in detail Software Decomposition technique.

Q. 3	Explain COCOMO II Model .

Unit No.-IV

Name of the Unit: Design Engineering

Lecture No.	Details of the Topic to be covered	References
1	Design Concepts: Design within the Context of Software Engineering, The Design Process	1.1,1.2,2.5
2	Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture	1.1,1.2,2.5
3	design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring	1.1,1.2,2.5
4	Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements	1.1,1.2,2.5
5	Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps	1.1,1.2,2.5,
6	Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements	1.1,1.2,2.5
7	Architectural Design: Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles.	1.1,1.2,2.5

Question Bank: Theory & Programs
Mapped to Course Outcome:

Q. 1	Explain following terms : i) Modularity ii) Information Hiding iii) Refinement iv)

	Refactoring

Q. 2	Why Architecture is important? Explain all Architectural Styles.

Q. 3	Describe Object Oriented Design for Software.

Unit No.-V

Name of the Unit: Risks and Configuration Management

Lecture No.	Details of the Topic to be covered	References
1	Risk Management: Software Risks, Risk Identification, Risk Projection	1.1,1.2,2.1,2.4
2	Risk Refinement, Risk Mitigation	1.1,1.2,2.1,2.4
3	Risk Monitoring, and Management	1.1,1.2,2.1,2.4
4	The RMMM Plan.	1.1,1.2,2.1,2.4
5	Software Configuration Management: Software Configuration Management	1.1,1.2,2.1,2.4
6	The SCM Repository The SCM Process	1.1,1.2,2.1,2.4
7	Configuration Management for any suitable software system	1.1,1.2,2.1,2.4

Question Bank: Theory & Programs
Mapped to Course Outcome:

Q. 1	Explain in detail RMMM plan.

Q. 2	What is Software Configuration Management? Explain Configuration Management for suitable system.

Q. 3	Describe term: i) Risk Identification ii) Risk Projection

Unit No. VI

Name of the Unit: Software Testing

Lecture No.	Details of the Topic to be covered	References
1	A Strategic Approach to Software Testing	1.1, 1.2,2.5
2	Verification and Validation, Organizing for Software Testing	1.1, 1.2,2.5
3	Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues	1.1, 1.2,2.5
4	Test Strategies for Conventional Software, Unit Testing	1.1, 1.2,2.5
5	Integration Testing, Test Strategies for Object-Oriented Software	1.1, 1.2,2.5
6	Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies for WebApps	1.1, 1.2,2.5
7	Validation Testing, Validation-Test Criteria, Configuration Review.	1.1, 1.2,2.5

Question Bank: Theory & Numericals
Mapped to Course Outcome:

Q. 1	Explain the Testing Strategies for Object Oriented System.

Q. 2	Explain Testing Strategies for Conventional Software.

Q. 3	Differentiate between Verification and Validation

Subject 5: Management Information Systems

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

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:
- To understand concepts of Management Information System and Business intelligence for MIS.
- To recognize the need of an information system in today's global business with tools and technologies.
- To identify IT infrastructure components and to study security in the Information System.
- To understand the importance of project management and the international information system.
- To understand the concepts of decision support systems for business applications. To understand artificial intelligence and data science for Management Information System

Course Outcomes:
On completion of the course, learner will be able to–
- **Explain** the concepts of Management Information System and Business intelligence
- **Illustrate** the need of information systems in global business and ethical issues.
- **List** the IT infrastructure components and **explain** security in the Information System.
- **Demonstrate** the importance of project management and **extend** its use in the international information system.
- **Illustrate** the concepts of decision support systems for business applications.
- **Relate** artificial intelligence and data science for Management Information System.

Syllabus

Unit	Topic	Hours
I	**An Overview of Management Information System**	**07**
	Management information system: Concept, MIS: Definition, Role of MIS, Impact of MIS, MIS & the User, Management as a Control System: The functions of Management, Managerial Roles, The Levels of Management[R3]. MIS: A Support to the Management, Management effectiveness and MIS, Organization as a System. Decision Making, Information, Knowledge and Business intelligence, Business intelligence for MIS.	
II	**Organization, Management and Network Enterprise**	**07**
	Information systems in today's global business: The Role of information system, Perspective's on Information System. Global E-business and collaboration: Business Processes, Types of Information Systems. System for Collaboration and Team Work: Tools and technologies for collaboration and team work, E-mail and Instant Messaging, Social Networking, Virtual worlds, Internet based Collaboration Environments. Information system organization and strategy, Ethical and social issues in information system.	
III	**Information Technology Infrastructure**	**07**
	IT infrastructure and Emerging Technologies: IT infrastructure and its components, Hardware and software platform trends, Management issues. Foundation of Business intelligence: Databases and information management. Telecommunication, The Internet and Wireless technology, Securing information systems: system vulnerability, Business value of security and control.	
IV	**Key System Applications for Digital Age**	**07**
	Achieving operational Excellence and customer intimacy : Enterprise Applications, **E-Commerce**: Digital Markets and Digital Goods , Managing knowledge, **Enhancing Decision Making**, Building information Systems, Managing project : The importance of project Management, the business value of information systems, Managing project risk, Managing Global Systems: The growth of international information systems, organizing international information systems, Technology issues and opportunities for global value chain.	
V	**Business Applications**	**07**

	Introduction to e-business systems: Functional Business systems, cross functional Enterprise systems. Customer Relationship Management: The Business focus, Enterprise Resource Planning: The business backbone, Supply chain Management: Business Network. Electronic Commerce Systems: Fundamentals, **e-commerce** applications and issues. **Decision support systems:** Decision support in Business, DSS Components, Decision Supports Trends, OLTP, Data Mining for Decision Support, Knowledge Management System.	
VI	**Artificial Intelligence & Data Science for MIS**	07
	Business and AI, An overview of Artificial Intelligence, Neural Network, Fuzzy Logic System, Genetic Algorithms, Virtual Reality, Intelligent Agents, Expert Systems: Components, Applications, Developing Expert Systems, The Value of Expert Systems: Benefits & Limitations. MIS in Data Science: Transition into data science for a Business Intelligence (BI)/MIS professional: performing detective analytics and generate insights from reports, statistics to support your insights about reports, present your findings to the right group, explore an open-source tool to generate reports OR to perform detective analysis, the model building / predictive modeling steps, Methods to evaluate your model's performance.	

Teaching Plan

Sr. No.	Unit	Broad Topic to be covered	Books Referred	Total Lectures Planned
1	An Overview of Management Information System	MIS, management, organization, decision making, information, knowledge and business intelligence	1.1.,1.2.,2.4.	7
2	Organization, Management, and Network Enterprise	Information systems and business processes, systems for collaboration, ethical, social issues in an information system	1.1,1.2.	7
3	Information Technology Infrastructure	IT infrastructure including hardware, software and networking, information and database management for business intelligence, information systems security	1.1,2.1.	7
4	Key System Applications for Digital Age	Enterprise applications, E-commerce, project management, international information systems	2.1,2.2.,2.3.	7
5	Business Applications	Functional business systems, ERP, CRM, SCM, decision support system, knowledge management system	1.1,2.1,2.2.	7
6	Artificial Intelligence and Data Science for MIS	Artificial intelligence, expert systems and data science	2.1.,2.2.	7

1. **Text Books:**

1. Waman S. Javadekar, "Management Information System: A Global Digital Enterprise Perspective", McGraw Hill Education Pvt. Ltd. 5ᵗʰ Edition, ISBN – 13:978-1-25-902669-0.
2. James A. O'Brien, George M Marakas, "Management Information Systems", The McGraw-Hill Companies, 7ᵗʰ Edition, ISBN-0-07-062-003-2.

2.   **Reference Books:**

1. Kenneth C. Laudon, Jane P. Laudon, "Management information Systems: Managing the Digital Firm, Pearson, 12ᵗʰ Edition, ISBN-978-81-317-8746-5.
2. James A. O'Brien," Management Information Systems: Managing information Technology in the Business Enterprise", Tata McGraw Hill Edition, 6ᵗʰ Edition, ISBN- 0-07-058739-6.
3. Robert Schultheis, Marry Sumner, "Management information system: The Manager's View", Tata McGraw Hill Edition, 4ᵗʰ Edition, ISBN-0-07-463879-3.
4. Gordon B. Davis, Margrethe H. Olson, "Management Information Systems: Conceptual