

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
(An Autonomous Institution approved by UGC and affiliated to JNTUH)
(Accredited by NAAC with ‘A’ Grade, Accredited by NBA of AICTE and
Recipient of World Bank under TEQIP-I and II)
Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301

COURSE FILE

For

B. Tech. IV year - I Semester

COMPUTER SCIENCE ENGINEERING



**DEPARTMENT OF
COMPUTER SCIENCE ENGINEERING**

JUNE 2018

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
AN AUTONOMOUS INSTITUTION
COURSE FILE FOR
CSE BRANCH
4th Year 1st Sem

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COURSE FILE

PRINCIPALS OF OPERATIONS RESEARCH

For

**B. Tech. III year - I Semester
CSE BRANCH**



**DEPARTMENT OF
MECHANICAL ENGINEERING
(2018)**

Syllabus for B. Tech. III Year I semester
Computer Science Engineering
PRINCIPALS OF OPERATIONS RESEARCH

CODE 5BC63

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Course Objectives:

This course aims to introduce students to use quantitative methods and techniques for effective decisions-making; model formulation and applications that are used in solving business decision problems..

Course Outcomes:

After completing the subject, students will be able to:

[CO-1]: Appreciate the importance of OR in decision making and able to express the problem as objective function of variables to obtain optimal solution using LP technique

[CO-2]: Understand the formulation and hence obtaining optimal solution of transportation and assignment problems

[CO-3]: Understand the machine sequencing problems and their solutions under various job-machine conditions, Analyze & solve replacement policy for an item under various conditions

[CO-4]: Interpret optimal strategies formulated in conflict and competitive environment.

[CO-5]: Analyze variances of performance measures of queuing systems, and identify and solve the inventory problems

[CO-6]: Understand the simulation aspects and its optimal decisions through analysis of data, understand the formulation and solution for problems stage wise using dynamic programming approach

Mapping of Course Outcomes with Program Outcomes:

	P0a	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	POl
CO1	H	M		L	M						H	L
CO2	H	M		L	M						H	L
CO3	H			L	M	L					H	L
CO4	H			L	M				L		H	L
CO5	H			L	M	L					H	L
CO6	M			L	H	M	L				H	L

UNIT – I

INTRODUCTION: Definition– characteristics - Models in Operation Research – applications of various OR techniques

LINEAR PROGRAMMING PROBLEM- Formulation – Graphical solutions, Simplex method- maximization and minimization, Artificial variables techniques - Two-phase method, Big-M method - Degeneracy, Duality Principle.

UNIT – II

TRANSPORTATION PROBLEM –

Finding an initial feasible solution - North West corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution by MODI method,

Special cases in Transportation problems - Unbalanced Transportation problem - Degeneracy

ASSIGNMENT PROBLEM – Formulation – Hungarian method-Optimal solution

- Variants of Assignment Problem-Unbalanced, problems with restrictions, Traveling Salesman problem.

UNIT – III

WAITING LINES: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

INVENTORY : Introduction – Single item Deterministic models without shortages– Single item inventory models with one price break and multiple price breaks – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT – IV

THEORY OF GAMES: Introduction – Pure strategies-Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Mixed Strategies-Rectangular games without saddle points- Dominance principle – 2 X 2 games , m X 2 & 2 X n games -Graphical method.

UNIT – V

SEQUENCING – Introduction – Flow Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines.

REPLACEMENT: Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly - Individual replacement policy, Group replacement policy.

UNIT – VI

SIMULATION: Definition – Types of simulation – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages

DYNAMIC PROGRAMMING: Introduction – Bellman’s Principle of optimality – Characteristics of DP- Applications of dynamic programming- shortest path problem - linear programming problem.

TEXT BOOKS:

1. Operations research / Hira & Gupta
2. Operation Research /J.K.Sharma/MacMilan publishers.

REFERENCES:

1. Operations Research / S.D.Sharma/Kedarnath publishers
2. Operations research/V.K.Kapoor

LECTURE SCHEDULE

S. No. of the Period	Title of chapter	No. of periods Allotted	Topics to be covered
1.	Unit-I	14	Introduction – Development – Definition- Characteristics and Phases
2.			Types of models – Operations Research models – applications
3			Linear Programming Problem Formulation
4			Graphical solution
5			Graphical solution, types
6			Simplex method,
7			Simplex method, exercises
8			Simplex method, exercises
9			Artificial variable techniques Big-M method
10			Big-M method
11			Two phase method
12			Two phase method, exercises
13			Duality Principle
14			Duality Principle, exercises
15	Unit-II	09	TRANSPORTATION PROBLEM: Formulation
16			IBFS , VAM , NWCM , etc,
17			Optimal solution, Stepping stone method
18			Optimal solution, MODI method
19			unbalanced transportation problem, Degeneracy
20			Assignment Problem – Formulation
21			Optimal solution
22			Variants of Assignment Problem

23			Traveling salesman Problem.
24	Unit-III	09	SEQUENCING: Introduction – Flow – Shop sequencing
25			n jobs through two machines
26			n jobs through three machines – Job shop sequencing
27			Two jobs through m machines.
28			REPLACEMENT: Introduction
29			Replacement of items that deteriorate with time – when money value is not counted
30			Replacement of items that deteriorate with time – when money value is counted
31			Replacement of items that fail completely
32			Replacement of items that fail completely, Group replacement
33	Unit-IV	6	THEORY OF GAMES: Introduction – Minimax (maximin) – Criterion and optimal strategy
34			Solution of games with saddle points
35			Rectangular games without saddle points
36			2 x 2 games – dominance principle
37			m x 2– graphical method
38			2 x n games – graphical method
39	Unit-V	11	WAITING LINES: Introduction.
40			Single Channel , multi channel
41			Poisson arrivals – exponential service times, – with infinite population
42			Poisson arrivals – exponential service times, finite population models
43			Multi channel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals
44			INVENTORY: Introduction

45			Single item – Deterministic models
46			Purchase inventory models with one price break and multiple price breaks –
47			Shortages are not allowed
48			Stochastic models – Demand may be discrete variable or continuous variable –
49			Instantaneous production. Instantaneous demand and continuous demand and no setup cost
50	Unit-VI	12	SIMULATION: Definition - Introduction
51			Types of simulation models
52			Phases of simulation
53			Application of simulation.
54			Inventory and Queuing problems
55			Advantages and Disadvantages – computers in Simulation.
56			DYNAMIC PROGRAMMING: Introduction.
57			Bellman's Principle of Optimality
58			Applications of dynamic programming
59			capital budgeting problem.
60			Shortest path problem
61			linear programming problem
62, 63			Discussion of diff. topics, etc.

Program Outcomes

The Programme Outcomes (POs) of the B.Tech (ME) programme, which every graduate must attain, are listed below:

- a. An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b. An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c. An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d. An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e. To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f. An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g. Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h. To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i. An ability to identify, formulate and analyze engineering problems.
- j. An ability to conduct investigation of complex problems in multidisciplinary areas.
- k. An understanding of professional ethics and responsibilities.
- l. An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m. An ability to understand the impact of environmental protection and sustainable development.

Unit -I

Linear Programming Problem

Objective type questions:-

- 1) The solution for an LPP with two exact constraints and no inequality constraints will be
 - a) infeasible
 - b) multiple optimal
 - c) unbounded
 - d) unique point size solution
- 2) The feasible region will be _____ type of one of the constraint is exact type in a two variable LPP
 - a) point
 - b) area
 - c) line
 - d) volume
- 3) In graphical solutions, if x is unrestricted and $y \geq 0$, we get the solution in
 - a) I quadrant
 - b) I and IV quadrant
 - c) I and II quadrant
 - d) any quadrant
- 4) In which of the following cases we do not maximize the objective function
 - a) sales
 - b) contribution
 - c) profits
 - d) costs
- 5) If every point of a line drawn with any two points in feasible region fall in the feasible region the region is said to be
 - a) convex
 - b) island
 - c) concave
 - d) infeasible
- 6) In a LPP, if the values given to the variable satisfy conditions and constraints but not the objective function, then the solution is
 - a) feasible solution
 - b) Infeasible solution
 - c) Optimal solution
 - d) we can not say
- 7) The feasible region in the form of a ring is _____
 - a) convex
 - b) concave-convex
 - c) concave
 - d) convex- concave
- 8) The number of basic feasible solutions in a feasible region will be
 - a) finite
 - b) zero
 - c) infinite
 - d) we can not say
- 9) The solution for max. $Z = 10x_1 + 6x_2$ subject to $5x_1 + 3x_2 \leq 30$ $x_1 + 2x_2 \leq 18$; $x_1, x_2 \geq 0$ is _____
 - a) unique
 - b) multiple optimal
 - c) infeasible
 - d) unbounded
- 10) Which of the following constraints has no effect on solution space
 - a) exact constraint
 - b) available constraint
 - c) requirement constraint
 - d) redundant constraint
- 11) There will be no solution in
 - a) unbounded solutions
 - b) infeasible solutions
 - c) multiple solutions
 - d) unique solutions
- 12) Which of the following solutions is independent of objective function
 - a) unique
 - b) unbounded
 - c) infeasible

- d) multiple
- 13) To get multiple optimal solutions in LPP which of the following is necessary condition
- objective function is perpendicular to one of the constraint
 - any two constraints are parallel
 - no two constraints are parallel
 - objective function is parallel to one of the constraints
- 14) The number of optimal solutions of LPP for a maximizing objective function on unbounded feasible region is
- infeasible
 - multiple
 - unique
 - infinite
- 15) The solution for the LPP: $\max Z = 20x_1 + 30x_2$ subject to $5x_1 + 6x_2 \leq 15; 2x_1 + 3x_2 \geq 200; x_1, x_2 \geq 0$ may be _____ solution
- infeasible
 - unique
 - multiple
 - unbounded
- 16) Which of the following is not a limitation in graphical solution?
- limited to two variables only
 - accuracy is not possible
 - infeasible solutions can not be predicted
 - multiple solutions can not be predicted easily
- 17) In simplex table, the value $Z_j - C_j$ for basic variables will be
- negative
 - positive
 - zero
 - unity
- 18) The solution of LPP is not an infeasible if
- all minimum ratios are either infinity or negative
 - artificial variables are not replaced
 - a replacement of variables is cycle
 - phase -I does not yield any solution in II – phase method
- 19) Which of the following is degeneracy in case of simplex?
- total supply is equal to total demand
 - the number of allocated cells exceed the rows +columns -1
 - The number of occupied cells is less than rows +columns -1
 - A tie exists for leaving basic variable
- 20) If a primal has unrestricted variable, its dual will have
- corresponding variable unrestricted
 - corresponding constant is requirement type
 - corresponding constraint is exact type
 - the constraint is written by splitting the corresponding variable into two parts

Descriptive type questions:-

- Define Operations Research
- Explain the role of OR in management decision making
- Discuss the merits and demerits of graphical solutions in OR
- Discuss the various types of optimal solutions to LPP through graphical methods. How do you identify them
- How do you identify the following solution in graphical methods? I) multiple optimal solutions ii) Infeasible solutions iii) unbounded solution

- 6) Discuss the merits and demerits of 2-phase and Big-M methods
- 7) Do you think two-phase method is superior to Big-M method to solve LPP. If so why?
- 8) What is meant by degeneracy in simplex? When does it occur? How do you resolve it?
- 9) Give the applications of dual problem in LPP
- 10) What do you understand by the concept of duality in simplex?
- 11) How do you convert the non-standard simplex into standard one in the following cases? Give examples in each case i) Objective function ii) Constraint set iii) Conditions of variables.
- 12) A firm manufactures two products in three departments, Product A contributes Rs.5/- per unit and requires 5hrs. in department M, 5hrs. in department N and one hour in department P. Product B contributes Rs.10/- per unit and requires 8hrs. in department M and 3 hrs. in department N and 8hrs in department P. Capacities for departments M,N,P are 48hr/week. Find out optimal product mix.
- 13) The manufacturer of a patent medicines is proposed to prepare a production plan for medicines A and B. There is sufficient ingredient available to make 20000 bottles of medicine A and 40000 bottles of medicine B but there are only 45000 bottles into which either of the medicines can be filled. Further, it takes 3hr to prepare enough material to fill 1000 bottles of medicine A and one hour to prepare enough material to fill 1000 bottles of medicine B and there are 66hr available for this operation. The profit in Rs. 8/- per bottle for medicine A and Rs.7/- per bottle for medicine B. Formulate the LPP, and solve graphically.
- 14) A firm can produce 3 types of cloth, say A, B, and C. Three kinds of wool are required for it, say: red, green, and blue wool. One unit length of type A cloth needs 2m. of red wool and 3m of blue wool, one unit length of type B cloth needs 3m of red wool, 2m of green wool, and 2m of blue wool, and the one unit length of cloth C needs 5m of green wool, and 4m of blue wool. The firm has only a stock of 8m of red wool, 10m of green wool and 15m of blue wool. It is assumed that the income obtained from one unit length of type A cloth is Rs.3/- of type B is Rs.5/- and of type C cloth is Rs.4/-.

Determine how the firm should use the available material so as to maximize the income from the finished cloth.

- 15) A furniture manufacturer makes wooden racks and cots. These products are completed in two sections. Each rack contributes a profit of Re.1/- and each cot of Rs. 5/-. In first section each rack required 5 hrs and each cot 6hr of processing. Similarly in section -2 each rack has 3hr and each cot has 2hr of work on them. The manufacturer is interested to optimize his profits if the two sections can be availed for more than 30 and 12 hr respectively.
- 16) Food X contains 6 units of Vitamin A per gram and 7 units of Vitamin B per gram and costs 12 paisa per gram. Food Y contains 8 units of Vitamin A per gram and 12 units of Vitamin B and cost 20 paisa per gram. The daily minimum requirements of Vitamin A and Vitamin B are 100 units and 120 units respectively. Find the minimum cost of product mix. Use simplex method.
- 17) Solve Graphically

$$Z_{\max} = 8x_1 + 6x_2$$

Subject to

$$2x_1 + x_2 \leq 72$$

$$x_1 + 2x_2 \leq 48$$

$$x_1 \geq 0, x_2 \geq 0$$

18) Solve Graphically

$$Z_{\max} = 50x_1 + 60x_2$$

Subject to

$$x_1 + x_2 \leq 12$$

$$2x_1 + 3x_2 \geq 60$$

$$x_1 \geq 0, x_2 \geq 0$$

19) Solve Graphically

$$Z_{\max} = 15x_1 + 9x_2$$

Subject to

$$10x_1 + 6x_2 \leq 60$$

$$x_1 + 2x_2 \leq 10$$

$$x_1 \geq 0, x_2 \geq 0$$

20) Solve Graphically

$$Z_{\max} = 3x_1 + 4x_2$$

Subject to

$$x_1 - x_2 \leq 1$$

$$-x_1 - x_2 \leq 2$$

$$x_1 \geq 0, x_2 \geq 0$$

21) Solve Graphically

$$Z_{\min} = 15x_1 + 20x_2$$

Subject to

$$x_1 + 2x_2 \geq 10$$

$$2x_1 - 3x_2 \leq 6$$

$$x_1 + x_2 \geq 6$$

$$x_1 \geq 0, x_2 \geq 0$$

22) Solve problem 4 by simplex method

23) Solve by simplex method

$$Z_{\max} = 6x_1 + 9x_2$$

Subject to

$$2x_1 + 2x_2 \leq 24$$

$$x_1 + 5x_2 \leq 44$$

$$6x_1 + 2x_2 \leq 60$$

$$x_1 \geq 0, x_2 \geq 0$$

24) Solve by simplex method

$$Z_{\max} = 4x_1 + 3x_2$$

Subject to

$$x_1 \leq 5$$

$$x_1 - x_2 \leq 8$$

$$x_1 \geq 0, x_2 \geq 0$$

25) Solve by simplex method

$$Z_{\min} = 3x_1 + 6x_2$$

Subject to

$$x_1 + x_2 \leq 5$$

$$x_1 + 2x_2 \leq 6$$

$$x_1 \geq 0, x_2 \geq 0$$

26) Solve problem 5 by Big-M method

27) Solve by Big-M method

$$Z_{\max} = -4x_1 - 3x_2$$

Subject to

$$3x_1 + x_2 = 3$$

$$3x_1 + 4x_2 \geq 6$$

$$x_1 + x_2 \leq 4$$

$$x_1 \geq 0, x_2 \geq 0$$

28) Solve by Big-M method

$$Z_{\max} = 3x_1 - x_2$$

Subject to

$$2x_1 + x_2 \geq 2$$

$$x_1 + 3x_2 \leq 3$$

$$x_2 \leq 4$$

$$x_1 \geq 0, x_2 \geq 0$$

29) Solve problem 5 by two phase method

30) Solve by two phase method

$$Z_{\min} = 4x_1 + 3x_2$$

Subject to

$$3x_1 + x_2 = 3$$

$$3x_1 + 4x_2 \geq 6$$

$$x_1 + x_2 \leq 4$$

$$x_1 \geq 0, x_2 \geq 0$$

31) Solve by two phase method

$$Z_{\max} = 4x_1 + 3x_2$$

Subject to

$$3x_1 + 4x_2 \leq 6$$

$$5x_1 + 6x_2 \geq 15$$

$$x_1 \geq 0, x_2 \geq 0$$

32) Use degeneracy principle to solve the following LPP

$$Z_{\max} = 3x_1 + 9x_2$$

Subject to

$$x_1 + 4x_2 \leq 8$$

$$x_1 + 2x_2 \leq 4$$

$$x_1 \geq 0, x_2 \geq 0$$

33) Write the dual of the following primal and solve the LPP

$$Z_{\min} = 4x_1 + 3x_2$$

Subject to

$$3x_1 + x_2 = 3$$

$$3x_1 + 4x_2 \geq 6$$

$$x_1 + x_2 \leq 4$$

$$x_1 \geq 0, x_2 \geq 0$$

34) A company manufactures two products of ice creams A and B. Each unit of A gives a profit of Rs.40 while that of softy gives Rs.50/- .For manufacturing a pack of A it requires 2 units of milk and 8 units of cream while that of B it requires 3 units of milk and 4 units of cream. Formulate the LPP and also write the dual.

Unit -II

Transportation Problem

Objective type questions:-

- 1) Which of the following is not false in the case of the concept of ε introduced to resolve degeneracy in T.P.
a) $\varepsilon + a = V$ b) $\varepsilon - a = \varepsilon$ c) $\varepsilon = 0$ d) $\varepsilon_+ \varepsilon = \varepsilon$
- 2) Which of the following is false in optimal T.P. whose $C_{ij} - (u_j + v_j)$ values of
 - a) all unoccupied cells must be equal to zero
 - b) all unoccupied cells must be less than zero
 - c) all occupied cells must be equal to zero
 - d) all occupied cells must be greater than or equal to zero
- 3) Which of the following method may yield same IBFS for both minimization and maximization of same data
 - a) Vogel's approximation
 - b) Least cost entry method
 - c) north west corner rule
 - d) row minima method
- 4) In which of the following cases degeneracy may not appear
 - a) Partial sum of suppliers is equal to partial sum of demands
 - b) Both row and column are satisfied in same step in Vogel's approximation
 - c) Same least cost for more than one cell
 - d) No. of allocated cells is less than rows + columns -1

- 5) Which of the following methods uses penalties to find IBFS
- North west corner method
 - Vogel's approximation method
 - Least cost entry method
 - Column minima method
- 6) Which of the following method to find IBFS of transportation problem is independent of costs/profits of transportation matrix
- North west corner rule
 - Vogel's approximation
 - Matrix minima method
 - Row minima method
- 7) Multiple optimal solutions in TP are observed if
- $C_{ij} = u_i + v_j$ for some occupied cells
 - $C_{ij} \neq u_i + v_j$ for some occupied cells
 - $C_{ij} = u_i + v_j$ for some unoccupied cells
 - $C_{ij} \neq u_i + v_j$ for some unoccupied cells
- 8) The solution is said to be optimal in TP if
- $C_{ij} \geq u_i + v_j$ for all occupied cells
 - $C_{ij} \leq u_i + v_j$ for all unoccupied cells
 - $C_{ij} \geq u_i + v_j$ for all unoccupied cells
 - $C_{ij} \leq u_i + v_j$ for all unoccupied cells
- 9) A T.P is said to be balanced if
- No. of rows = no. of columns
 - no. of allocated cells = no. of rows + no. of columns - 1
 - Total supply = total demand
 - No. of supply centers = no. of demand centers
- 10) In a maximization case of T.P., we convert it to minimization case by
- Adding every cell value to highest among them
 - subtracting every cell value from highest among them
 - dividing cell value with lowest among them,
 - subtracting least value of each row in the corresponding row

Descriptive type questions:-

- Give the applications of transportation problem in the industries
- What is meant by degeneracy in TP. How do you resolve it?
- What is a balanced TP?
- When do you get multiple optimal solution in TP. Explain with an example, how you identify this situation.
- Consider the TP and find the initial feasible solution.

Source	Destinations				Total
	D1	D2	D3	D4	
O1	1	2	1	4	30
O2	3	3	2	1	50
O3	4	2	5	9	20

Total	20	40	30	10	100
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- 6) Consider the TP and find the initial feasible solution by NWCM

Source	Destinations				Supply
	D1	D2	D3	D4	
1	3	7	6	4	5
2	2	4	3	2	2
3	4	3	8	5	3
Demand	3	3	2	2	10

- 7) Find the initial basic feasible solution of the T.P by LCEM, where the cost matrix is given below.

		Destinations				Supply
		1	2	3	4	
Source	1	1	5	3	3	34
	2	3	3	1	2	15
	3	0	2	2	3	12
	4	2	7	2	4	19
Demand		21	25	17	17	

- 8) A firm has three factories at locations A,B,C which supplies three warehouses located at D, E and F. Monthly factory capacities are 10, 80 and 50 units respectively. Monthly warehouse requirements are 75, 20 and 50 units respectively. Unit shipping costs in Rs. are given as

Warehouse \ Factory	D	E	F
A	5	1	7
B	6	4	6
C	3	2	5

The penalty costs for not satisfying demand at warehouses D, E and F are Rs.5, Rs.3 and Rs.2 per unit respectively. Determine the optimal distribution for the transportation technique.

- 9) Find the optimal solution for the problem 1 by stepping stone method.
- 10) Find the optimal solution for the problem 1 by MODI method.
- 11) Solve the following transportation problem, and find the optimal solution, where the entries are cost coefficients.

		Destinations				Availability
		1	2	3	4	
Origins	1	15	0	20	10	50
	2	12	8	11	20	50
	3	0	16	14	18	100
Requirement		30	40	60	70	200

- 12) An oil company has got three refineries P, Q and R and it has to send petrol to four different depots A, B, C and D. The costs of shipping 1 gallon of petrol at the refineries are given in the table. The requirement of the depots and the available petrol are also given. Find the minimum cost of shipping after obtaining an initial solution by VAM.

Depot Refineries \	A	B	C	D	Availability
P	10	12	15	8	130
Q	11	11	9	10	150
R	20	9	7	18	170
Required	90	100	140	120	450

- 13) Determine the Optimum basic feasible solution to the following Transportation Problem.

To From \	A	B	C	Availability
1	50	30	220	1
2	90	45	170	3

3	250	200	50	4
Required	4	2	2	

14) Determine the Optimum basic feasible solution to the following Transportation Problem.

To From	D1	D2	D3	Availability
S1	8	5	6	120
S2	15	10	12	80
S3	3	9	10	80
Required	150	80	50	

15) ABC agency transports material from one place to the other on commission basis. The following are estimated commissions per unit of material to be transported from the plants P1, P2 and P3 to markets M1, M2, M3. Optimize the commissions to be earned by the agency. Note: there is no route available to transport from P2 to M1.

To From	M1	M2	M3	Availability
P1	6	9	8	120
P2	-	4	2	80
P3	11	5	4	80
Required	150	70	60	

Assignment Problem

Descriptive type questions:-

- 1) Discuss the applications of assignment problems.
- 2) What is meant by restricted assignment? Explain how you can solve the AP in such a case.
- 3) What is meant by unbalanced assignment problem?
- 4) There are five jobs to be assigned on five m/c and associated cost matrix is as follows

Jobs	Machines				
	1	2	3	4	5
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	15

Find the optimum assignment and associated cost of the assignment..

5) Find the minimum cost assignment for the following problem.

Workers	Jobs				
	I	II	III	IV	V
A	6	5	8	11	16
B	1	13	16	1	10
C	16	11	8	8	8
D	9	14	12	10	16
E	10	13	11	8	16

6) Five lectures have to deal a subject common to five different branches of engineering. Due to understanding level of the branches and the efficiency of lecturer, the probable no of periods of 45min required for each lecturer is given in the following matrix. A particular lecturer A refuses to go to CSE and CSIT students do not accept C. Obtain an optimal assignment.

Lecturers	Branch				
	ECE	EEE	CSE	IT	ME
A	50	50	-	20	60
B	70	40	20	30	40
C	90	30	50	-	30
D	70	20	60	70	20
E	60	50	70	90	10

7) A machine operator process five types of items on his machine each week and must choose sequence for them. The setup cost per change depends on the items presently on the machine and item to be made, according to the table

From	To				
	A	B	C	D	E
A	-	4	7	3	4
B	4	-	6	3	4
C	7	6	-	7	5
D	3	3	7	-	7
E	4	4	5	7	-

If he produces each type of item once and only once each week, how should he sequence the item on his machine in order to minimize the total setup cost

8) A company has four lathe machines on which four workers operate. Any worker can operate any machine but due to the difference in skill and machine complexity the time of operation varies. The average times in hours when the same job done on each machine by each worker is given below.

Workers \ Jobs	L1	L2	L3	L4
W1	7	6	4	9
W2	5	5	8	8

W3	4	5	4	6
W4	7	8	5	8

- a) Find the optimal solution
 b) The company wants to replace the less efficient worker with a new lathe machine. The probable times (in hrs.) that each worker can operate is estimated as 4, 5, 6, and 6 respectively. Verify whether the company has to replace any machine. If so, which machine is to be replaced?

UNIT III

Seqencing

Objective type questions:-

- 1) The time required for printing of four project reports P, Q, R and S is 4,7,9 and 6 hours while its data entry requires 6,3,2 and 5 hrs respectively. The sequence that minimizes the total elapse is _____
 a) PSQR b) PQRS
 c) PSRQ d) RQSP
- 2) Printing of five books P, Q, R, S and T takes 9, 3,4,6 and 7 hrs while for binding they take 6,5,8,5 and 2 hrs respectively. The correct sequence that maximizes the total elapse is _____
 a) QRPST b) TSPRQ
 c) PTSQR d) RQSTP
- 3) In which of the following we get multiple optimal solutions _____
 a) Same least time for two jobs in both series of machines of $2 \text{ m/c} \times n$ jobs sequence model
 b) If we can connect the zeros as the corners of a rectangular loop , allocated cells alternatively in AP or TP
 c) If objective function has same slope to that of one of non-redundant constraint of an LPP
 d) All of the above
- 4) Which of the following is wrong in assumptions of sequencing 2 machines $\times n$ jobs by Johnson's rule
 a) No passing is allowed
 b) Processing times are known
 c) Time of moving job from one machine to the other is negligible
 d) The time of processing is dependent on order of processing
- 5) According to the assumptions of $2 \text{ m/c} \times n$ job sequencing
 a) Once a job loaded can be removed before completing
 b) Two jobs can be simultaneously processed on a machine
 c) Machines used are different
 d) The order of completion of jobs are dependent on sequence of jobs
- 6) According to Johnson's rule, the smallest processing time if occurs in
 a) First series, place it in the first available position
 b) Second series, place it in first available position
 c) First series, place it middle
 d) Second series, place it middle

- 7) The sequencing of a $3m/c \times n$ jobs should pass Jackson's rule according to which Maximum process time of 2^{nd} series
- 1) \geq minimum process time of 1^{st} or 3^{rd} series
 - 2) \geq maximum process time of 1^{st} or 3^{rd} series
 - 3) \leq minimum process time of 1^{st} or 3^{rd} series
 - 4) \leq maximum process time of 1^{st} or 3^{rd} series
- 8) Which of the following does not characterize the sequencing problem
- a) No passing rule
 - b) Idle time of machine
 - c) Number of machines and number of jobs
 - d) Number of movements while processing the jobs
- 9) FCFS rule is most applicable to _____ case of sequencing
- a) $1m/c \times n$ jobs
 - b) $2m/c \times n$ jobs
 - c) $3m/c \times n$ jobs
 - d) $n m/c \times n$ jobs
- 10) The sequencing rule usually followed at a petrol bunk when n vehicle are waiting, is
- a) FIFO
 - b) LIFO
 - c) Lowest process time
 - d) highest profit rule

Descriptive type questions:-

- 1) What are the assumptions made in sequencing problems?
- 2) Explain the rules of sequencing n jobs when there is only one machine to process
- 3) Describe various sequencing models
- 4) Explain the working rules of n jobs \times 2 machines and n jobs \times 3 machines with suitable examples
- 5) Explain the Jackson's conditions in working with n jobs \times 3 machine sequencing problems.
- 6) The repair in an automobile workshop consists of two step procedure viz., Dent removing and painting. The time estimates are as follows

Car No	1	2	3	4	5	6
Time(denting)	16	10	11	13	8	18
Time(Painting)	15	9	15	11	12	14

Find the correct sequence of operations and prepare Gantt Chart and time schedule chart so as to minimize the idle time

- 7) An old shopping complex is intended to be renovated. This is done in two phases namely repairing the patches, and then white washing. The time estimates in hr. for each of these floors are given below.

	Floors				
	1	2	3	4	5
Repair	20	28	25	20	22
White wash	24	26	15	27	15

Find the sequence that minimizes the idle time.

- 8) A desk top publishing operator has 5 Jobs to process for which he has to first type a copy of DTP and then printing. The estimated timings are as follows. Find the optimal sequence to minimize the idle time

Jobs					
	A	B	C	D	E
DTP	5	6	7	9	6
Printing	5	8	10	11	8

What will be expected delivery time for Job C. If there is a urgency what sequence is preferred.

- 9) A company uses its maintenance crew in three teams for their preventive maintenance of their heavy vehicles. First team looks after the replacement of worn out parts, the second oiling and resetting and the third checking and tests running. Time estimates for these are given below. Find the sequence and schedule them so as to minimize the total elapsed time and idle time.

Vehicle No		1	2	3	4	5	6	7
Team								
Replacement team		3	8	7	4	9	8	7
Resetting team		4	3	2	5	1	4	3
Inspection team		6	7	5	11	5	6	12

- 10) Find the sequence that minimizes total machining time to complete, the following data is given

Tasks	A	B	C	D	E	F
M -I	4	9	8	5	10	9
M-II	5	4	3	6	2	5
M-III	7	8	6	12	6	7

- 11) There are two jobs to be processed through five M/C A,B,C,D,E . The prescribed technological order is

Job-1: A → B → C → D → E

Job-2: B → C → A → D → E

The process times in hrs are given below.

M/C	A	B	C	D	E
Job-1	3	4	2	6	2
Job-2	3	5	4	2	6

Find the optimal sequence of the jobs on M/Cs and minimize the time. Also find the minimum time required to process these jobs.

Replacement Analysis:-

Objective type questions:-

- 1) When a machine is in infant stage, the major maintenance policy considered is
 - a) corrective maintenance
 - b) contractual maintenance with OEM
 - c) preventive maintenance
 - d) condition monitoring
- 2) When money value changes with time at 10% then PWF for first year is
 - a) 0.909
 - b) 1
 - c) 0.826
 - d) 0.9

- 3) Which of the following maintenance policy is not used in old age stage of a machine?
- operate to failure and corrective maintenance
 - renovation/ reconditioning
 - replacement
 - scheduled preventive maintenance
- 4) When money value is changing with time @20%, the discount factor for 2nd year =
- 1
 - 0.833
 - 0
 - 0.6944
- 5) If the probability of failure of a machine is gradually decreasing, the failure mode is said to be
- | | |
|----------------|------------------|
| a) progressive | b) retrogressive |
| b) regressive | d) recursive |
- 6) Which of the following replacement policy is probability model?
- when money value does not change with time where time is continuous variable
 - when money value does not change with time were time is a discrete variable
 - when money value changes with time
 - group replacement policy
- 7) Which of the following replacement polity is considered to be dynamic?
- when money value does not change with time where time is continuous
 - when money value does not change with time where time is discrete variable
 - when money value changes with time
 - none
- 8) A machine is to be replaced if the average running cost
- is not equal to current running cost
 - of current period is greater than that of next period
 - till current period is greater than that of next period
 - of current period is less than that of next period
- 9) Which of the following is correct assumption for replacement policy when money value does not change with time?
- | | |
|----------------------------|------------------------|
| a) no initial cost | c) Scrap value is zero |
| b) scrap value is constant | d) no maintenance cost |
- 10) In replacement analysis the maintenance cost is the function of
- | | |
|-----------------------|-----------------|
| a) present value | c) time |
| b) maintenance policy | d) resale value |

Descriptive type questions:-

- What are the costs involved in failure and replacement analysis of equipment explain
- Explain the machine life cycle, with reference to costs
- Discuss the effect of running age of a machine on failures and machine behavior with the aid of graph (Bath tub curve) Where do you fid machine replacement in the graph
- How does equipment behave in the following stages? What type of maintenance do you suggest?
 - early stage when just bought and installed
 - When it is producing at its highest rate
 - When its expected life is almost completed.
- Distinguish between the individual replacement and group replacement policies.

- 6) What policy do you recommend for the items that fail completely? Justify your answer with examples
- 7) Discuss the different types of failures that occur on a machine
- 8) A firm is thinking of replacing a m/c whose cost price is Rs.12200/- The scrap price of this m/c is only Rs.200/- The maintenance costs are found to be as follows.

Year	1	2	3	4	5	6	7	8
Maintenance cost	220	500	800	1200	1800	2500	3200	4000

Determine when the firm should get the m/c replaced.

- 9) The initial price of the equipment is Rs.5000/- The running cost varies as below.

Year	1	2	3	4	5	6	7
Running cost	400	500	700	1000	1300	1700	2100

Taking a discount rate of 0.9. Find the optimum replacement interval.

- 10) A manufacturer is offered 2 m/c A and B. A is priced Rs.5000 and running costs are estimated at Rs. 800/- for each of the first five years and is increasing by Rs. 200/- per year in the sixth and subsequent years. M/C B which has the same capacity as A with Rs2500 but will have running cost of Rs1200 per year for 6 years, increasing by Rs200/-per year there after. If money is worth 10% per year, which m/c should be purchased? (Assume the m/c s will eventually be sold for scrap at a negligible price)

- 11) A factory has a large no. of bulbs all of which must be in working condition. The mortality of bulbs is given in the following table.

Work	1	2	3	4	5	6
Proportion of bulbs failing during the week	0.1	0.15	0.25	0.35	0.12	0.03

If a bulb fails in service, it costs Rs.3.5/- to replace but if all bulbs are replaced at a time it cost Rs.1.2/- each. Find the optimum group replacement policy. (Assume 1000 bulbs as available in the beginning)

- 12) A fleet owner finds from his past records that the cost/year of running a vehicle whose purchase price is Rs.50000 are as under.

Year	1	2	3	4	5	6	7
Running cost	5000	6000	7000	9000	21500	16000	18000
Resale value	30000	15000	7500	3750	2000	2000	2000

There after running cost increase by Rs.2000/- but, resale value remains constant at Rs.20000/- At what age is a replacement due?

- 13) A decorative series lamp set circuit contains 10000 bulbs, when any bulb fails it is replaced. The cost of replacing a bulb individually is Re1/- only. If all the bulbs are replaced at the same time the cost/ bulb would be reduced to 35 paisa. The % surviving $S(t)$ at the end of month t and $P(t)$ the probabilities of failure during the month t are given below.

t	0	1	2	3	4	5	6
---	---	---	---	---	---	---	---

S(t)	100	97	90	70	30	15	0
P(t)	-	0.03	0.07	0.2	0.4	0.15	0.15

What is the optimum replacement plan?

Week	1	2	3	4	5
% failing by the end of week	10	25	50	80	100

14) 1000 bulbs are in use and its costs Rs.10/- to replace an individual bulb which has burnt out. If all bulbs were replaced simultaneously it would cost Rs4/- per bulb. It is proposed to replace all bulbs at fixed intervals of time, whether or not they have burnt out and to continue replacing burnt out bulbs as and when they fail. The failure rates have been observed for certain type of light bulbs are as follows. **At what intervals all the bulbs should be replaced?**

Unit – IV

Game Theory:-

Objective type questions:-

- 1) If the value of the game is zero, then that game/ strategy is known as
 - a) pure strategy
 - b) mixed strategy
 - c) fair game
 - d) pure game
- 2) When minimax and maximin criteria match, then
 - a) saddle points exist
 - b) mixed strategies are adopted
 - c) fair game is resulted
 - d) game will be unfair
- 3) A predetermined plan of action based on which the games are played that does not change during the game is said to be
 - a) fair strategy
 - b) pure strategy
 - c) mixed strategy
 - d) value of the game
- 4) Which of the following is true in the case of row dominance in a game theory
 - a) least of the row \geq highest of another row
 - b) least of the row \leq highest of another row
 - c) every element of a row \geq corresponding element of another row
 - d) every element of a row \leq corresponding element of another row
- 5) If a gain of a player is loss of another player then the game is called
 - a) fair game
 - b) unfair game
 - c) zero sum game
 - d) non zero sum game
- 6) Which of the following is never called a two person game
 - a) chess b) caroms
 - c) Horse race d) cricket
- 7) In a two person zero sum game, the following assumption is wrong
 - a) row player is always a loser
 - b) column player always minimizes losses
 - c) there are only two persons
 - d) if one loses, the other gains

- 8) Games with saddle points are _____ in nature

 - a) deterministic
 - c) probabilistic
 - b) stochastic
 - d) normative

9) If a two person zero sum game is covered to LP problem

 - a) no. of variables are two only
 - b) no. of constraints are two only
 - c) if row player represents primal, column player represents dual
 - d) it will not have objective function

10) Which of the following is wrong?

 - a) games without saddle points are probabilistic
 - b) games with saddle points will have pure strategies
 - c) games without saddle points use mixed strategies
 - d) game with saddle points can not be solved by dominance rule

Descriptive type questions:-

- 1) Explain i) strategy ii) Payoff matrix iii) saddle points
 - 2) What is optimal strategy? Discuss rectangular games without saddle points
 - 3) Write short notes on solution of games with saddle points
 - 4) Write short notes on minimax criteria
 - 5) Distinguish between zero sum and non zero sum game
 - 6) Write short notes on pure and mixed strategies
 - 7) List out the assumptions made in the theory of game
 - 8) Players Adithi and Sahithi have a competition to reach college early. Each has two strategies viz going by car or going by a two wheeler. If both go by cars, Sahithi reaches 5 minutes early but if both go by two wheeler, Adithi reaches 2 minutes early while Adithi by two wheelers and Sahithi by car keep Sahithi 7 minutes early. If both can choose their strategies independently and simultaneously and know these estimated pay offs each other, find who will win. What is the outcome of the game and their optimal choices?
 - 9) Solve the following game graphically.

$$\left[\begin{array}{cccc} -6 & 0 & 6 & -\frac{3}{2} \\ 7 & -3 & -8 & 2 \end{array} \right]$$

10) Solve the following game graphically.

$$\begin{array}{ccc} & B_1 & B_2 \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \\ A_6 \end{matrix} & \left[\begin{matrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{matrix} \right] & \end{array}$$

11) Two companies A and B are competing for the same product. Their different strategies are given in the following pay off matrix.

$$\begin{array}{ccc}
 A_1 & A_2 & A_3 \\
 B_1 & \left[\begin{array}{ccc} 2 & -2 & 3 \end{array} \right] \\
 B_2 & \left[\begin{array}{ccc} -3 & 5 & -1 \end{array} \right]
 \end{array}$$

Use the linear programming to determine the best strategies for both the players.

UNIT V

Waiting Lines:-

Objective type questions:-

- 1) A customer buying tickets in a black market at a cinema hall is said to be
 - a) Balker
 - b) reneger
 - c) jockeyer
 - d) dissatisfied
- 2) An expediting in production shop is an example for _____ queue discipline
 - a) FIFO
 - b) LIFO
 - c) SIRO
 - d) pre-emptive
- 3) The dead bodies coming to a grave yard is an example of
 - a) pure death process
 - b) birth and death process
 - c) pure birth process
 - d) not a queue process
- 4) In (M/M/S) : (N/FIFO) , which of the following is wrongly stated
 - a) poisson arrival
 - b) exponential service
 - c) single server
 - d) limited service
- 5) Which of the following is not considered as the negative behavior of customer according to queue discipline?
 - a) reneging
 - b) jockeying
 - c) balking
 - d) boarding
- 6) A steady state can exist in a queue if
 - a) $\lambda > \mu$
 - b) $\lambda < \mu$
 - c) $\lambda \leq \mu$
 - d) $\lambda \geq \mu$
- 7) The system of loading and unloading of goods usually follows
 - a) FIFO
 - b) LIFO
 - c) SIRO
 - d) pre-emptive
- 8) If the operating characteristics of a square are dependent on time, then it is said to be
 - a) steady state
 - b) transient state
 - c) balking
 - d) boarding
- 9) A person who goes out of queue by losing patience to wait is said to be
 - a) reneging
 - b) jockeying
 - c) balking
 - d) boarding
- 10) An office filing system follows
 - a) FIFO
 - b) LIFO
 - c) SIRO
 - d) pre-emptive
- 11) The queue discipline is stack of plates is
 - a) FIFO
 - b) LIFO
 - c) SIRO
 - d) pre-emptive
- 12) The queue discipline is selecting the contestants for a game such as "kaun Banega Corodpathi " is
 - a) FIFO
 - b) LIFO
 - c) SIRO
 - d) pre-emptive
- 13) SIRO discipline is found generally in
 - a) office filing
 - b) lottery
 - c) trains arriving to platform
 - d) loading and unloading
- 14) A Poisson arrival, exponential service by single server to limited queue selected randomly is represented as
 - a) (M/E/S): (∞ /SIRO)
 - b) (M/M/S): (N/SIRO)

- c) $(M/M/1)$: $(N/SIRO)$ d) $(M/M/1)$: $(\infty/SIRO)$

15) For a simple queue $(M/M/1)$, $\rho = \lambda/\mu$ is called
 a) traffic intensity b) fraction of busy period
 b) utilization factor d) any of the above

16) The unit of traffic intensity is _____
 a) Poisson b) Markov
 c) Erlang d) Kendall

17) In a $(M/M/S)$: $(\infty/FCFS)$ model, the length of the system is given by
 a) $\rho^2 / (1-\rho)$ b) $\lambda^2 / (\mu - \lambda)$
 b) $\rho / (1-\rho)$ d) $\lambda^2 / \mu(\lambda - \mu)$

18) In $(M/M/1)$: $(\infty/FIFO)$ model, $1 / (\mu - \lambda)$ represents
 a) length of system b) length of queue
 c) waiting time in queue d) waiting time in system

19) Which of the following model is same as that of $(M/M/1)$: $(\infty/FIFO)$
 a) $(M/M/1)$: $(N/FIFO)$ b) $(M/M/S)$: $(\infty/FIFO)$
 c) $(M/M/1)$: $(\infty/SIRO)$ d) none

20) The characteristics of queue model are independent of
 a) service pattern b) number of service points
 b) limit of queue d) queue discipline

Descriptive type questions:-

- 1) Write short note on waiting line situations
 - 2) What are waiting line costs? Explain them with the aid of graph
 - 3) Write short note on queuing models
 - 4) Briefly explain the important characteristics of a queuing system
 - 5) Briefly explain the representation of queue models based on Kdndall –Lee notations
 - 6) Discuss the arrival and service patterns used in queue models
 - 7) Discuss the customer behaviors that are often found in queue systems.
 - 8) In a bank, cheques are cashed at a single teller counter. Customers arrive at the counter in a Poisson manner at an average rate of 30 customer/hr. The Teller takes, on an average a minute and a half to cash cheque. The service time has been shown to be exponentially distributed i) calculate the % of time the teller is busy ii) calculate the average time a customer is expected to wait.
 - 9) The mean arrival rate to a service centre is 3/hr. The mean service time is 10 min. Assuming Poisson arrival rate and exponential servicing time, determine the following i) Utilization factor ii) probability of two units in the system iii) Expected number of units in the system iv) expected number of units in the queue v) expected time in minutes , customer has to wait in the system.
 - 10) Customers arrive at a box office window, being managed by a single individual, according to a Poisson input process with mean rate of 30 /hr. The time required to serve a customer has an exponential distribution with a mean of 90 sec. Find the average waiting time of a customer. Also determine the average number of customers in the system and average queue length.

Inventory Management:-

Objective type questions:-

- 1) At EOQ
 - a) annual purchase cost = annual ordering cost
 - b) annual ordering cost = annual carrying cost
 - c) annual carrying cost = annual shortage cost
 - d) annual shortage cost = annual purchase cost
- 2) If shortage cost is infinity
 - a) order cost is zero
 - b) no shortages are allowed
 - c) no inventory carrying is allowed
 - d) purchase cost = carrying cost
- 3) The stock maintained to withstand unknown demand changes is known as
 - a) De-coupling inventory c) Q-system
 - b) fluctuatory inventory d) anticipatory inventory
- 4) The inventory policy followed for water consumption from a water tank operated with municipal water supply connection is usually
 - a) P- system c) Q-system
 - b) 2-bin system d) Poisson model
- 5) The inventory system designed for a petrol tank of a two-wheeler is
 - a) P-system b) Q-system c) Stochastic system d) Poisson model
6. The most suitable analysis for a retail marketer is
 - a) F-S-N analysis c) A-B-C analysis
 - b) G-O-L-F analysis d) V-E-D analysis
- 6) Which of the following inventory is maintained to meet expected demand fluctuations?
 - a) Buffer stock c) de-coupling inventory
 - b) fluctuatory inventory d) anticipators inventory
- 7) Which of the following increases with quantity ordered per order?
 - a) order cost c) carrying cost
 - b) demand d) purchase cost
- 8) The time difference between ordering point and replenishment point is called
 - a) re-order period b) lead time
 - b) inventory cycle time d) inventory horizon
- 9) Which of the following is assumed to be constant in deterministic inventory models?
 - a) annual demand b) annual ordering cost
 - b) annual carrying coast d) annual shortage cost

Descriptive type questions:-

- 1) Derive the expression for EOQ, stating the assumptions
- 2) What is ABC analysis in inventory control?
- 3) Derive the expression for EOQ in deterministic model with back orders
- 4) What are the functions of inventory
- 5) What are the advantages of having inventory
- 6) Discuss various costs involved in inventory control in an industry
- 7) Write short notes on i) Lead time ii) Inventory cycle iii) Re-order cycle iv) Re-order period
- 8) What are the limitations of EOQ
- 9) A company uses 10000 units per year of an item. The purchase price is Rs.1 per item. Ordering cost is Rs. 25 per order. Carrying cost per year is 12% of the inventory value. Find
 - i) The EOQ

- ii) The number of orders per year
 - iii) If the lead time is 4 weeks and assuming 50 working weeks per year, find the reorder point.
- 10) A certain item costs Rs. 235 per ton. The monthly requirement is 5 ton and each time the stock is replenished, there is a setup cost of Rs. 1000. The costs of carrying inventory have been estimated at 10% of the value of the stock per year. What is the optimum order quantity?
- 11) A company uses 24000 units of raw material which costs Rs. 12.5 per unit. Placing each order costs RS.22.5 and carrying cost is 5.4% per year of the average inventory. Find the EOQ and the total inventory cost (include the cost of the material.)

Unit -VI

Simulation

Objective type questions:-

- 1) An advantage of simulation as opposed to optimization is that
 - a) several options of measure of performance can be examined
 - b) complex real life problems can be studied
 - c) it is applicable in cases where there is an element of randomness in a system
 - d) all of the above
- 2) The purpose of using simulation technique is to
 - a) simulate a real world situation
 - b) understand properties and operating characteristics of complex real life problems
 - c) reduce the cost of experiment on a model of real situation
 - d) all of the above
- 3) Which of the following is not the special purpose simulation language?
 - a) BASIC
 - b) GPSS
 - c) GASP
 - d) SIMSCRIPT
- 4) As simulation is not an analytical model, therefore result of simulation must be viewed as
 - a) Unrealistic
 - b) exact
 - c) approximation
 - d) simplified
- 5) While assigning random numbers in Monte Carlo simulation, it is
 - a) Not necessary to assign the exact range of random number interval as the probability
 - b) Necessary to develop a cumulative probability distribution
 - c) Necessary to assign the particular appropriate random numbers
 - d) all of the above

6) Analytical results are taken into consideration before a simulation study so as to

- a) Identify suitable values of the system parameters
- b) Determine the optimal decision
- c) Identify suitable values of decision variables for the specific choices of system parameters
- d) all of the above

7) Biased random sampling is made from among alternatives which have

- a) Equal probability
- b) Probability which do not sum to 1
- c) Unequal probability
- d) none

8) Large complicated simulation models are appreciated because

- a) Their average costs are not well defined
- b) It is difficult to create the appropriate events
- c) They may be expensive to write and use as an experimental device
- d) all of the above

9) Simulation should not be applied in all cases because it

- a) Requires considerable talent for model building and extensive computer programming efforts
- b) Consumes much computer time
- c) Provides at best approximate solution to problem
- d) all of the above

10) Simulation is defined as

- a) A technique which uses computers
- b) An approach for reproducing the process by which events by chance and changes are created in a computer
- c) A procedure for testing and experiments on models to answer what if ,then so and so ... types of questions
- d) all of the above

Descriptive type questions:-

- 1) What is simulation technique?"
 - 2) Explain simulation modeling
 - 3) Distinguish between mathematical models and simulation models
 - 4) What are simulation and Mont-Carlo methods used in Operations Research?
 - 5) Write short note on simulation methods in sampling?
 - 6) Briefly explain the Monte-Carlo simulation with suitable example
 - 7) Define simulation. Why simulation used? Give on application area where this technique is used in practice.
 - 8) Write short note on simulation and its applications.
 - 9) Discuss simulation techniques with suitable examples. What are their advantages and disadvantages?
- 10) Consider a situation where customers arrive at a one-man barber shop for hair cutting. The problem is to analyze the system in order to evaluate the quality of service and economic feasibility of offering the service. To measure the quality of service one has to make the assessment of the average waiting time per customer and the percentage of time the barber remains idle. Construct the simulation model.
- 11) Customers arrive at a milk booth for the required service. Assume that inter arrival and service time are constant and given by 1.8 and 4 time units, respectively. Simulate the system by hand computations for 14 time units. What is the average waiting time per customer? What is the percentage idle time of the facility? (Assume the system starts at $t=0$)

Dynamic Programming:-

Objective type questions:-

- 1) In dynamic programming, which of the following does not change at every stage
 - (a) Objective function
 - (b) recursive function
 - (c) Results
 - (d) state variables
- 2) An optimal policy (set of decisions) has the property that whatever the initial state and decision are, the remaining' decisions must constitute an optimal policy with regard to the resulting from the first decision
 - (a) state
 - (b) function
 - (c) recursion
 - (d) stage
- 3) The sub problem of a main problem in a DPP is said to be
 - (a) state
 - (b) function
 - (c) recursion
 - (d) stage
- 4) An LPP solved by using DPP method assumes the variables as-

- | | | | |
|-------------------------|------------|----------------|------------|
| (a) states
functions | (b) stages | (c) recursions | (d) return |
|-------------------------|------------|----------------|------------|
- 5) Which of the following is considered as recursive optimization?
- | | |
|--------------------------------|---------------------------------|
| (a) Linear programming problem | (b) dynamic programming problem |
| (c) Assignment problem | (d) transportation problem |
- 6) The optimality principle (to solve DPP) is given by
- | | |
|-------------|-------------------|
| (a) Dantzig | (b) Richard Brown |
| (c) Bellman | (d) Kimball |
- 7) The conditions prevailing in decision process at a sub-problem of a main problem are said to be
- | | | | |
|------------|------------|---------------|----------------|
| (a) stages | (c) states | (b) functions | (d) recursions |
|------------|------------|---------------|----------------|
- 8) A decisions that is made lies its own benefits represented in an algebraic equation is called
- | | |
|-----------|---------------------|
| (a) stage | (b) return function |
|-----------|---------------------|
- 9) Return function of DPP depends on
- | | |
|---------------------|--------------------|
| (a) state variables | (b) stage decision |
| (c) decision policy | (d) all the above |
- 10) The equation that converts all the stages of the DPP is known as
- | | |
|-------------------------|---------------------|
| (a) state function | (b) stage function |
| (c) transition function | (d) return function |

Descriptive type questions:-

- 1) Explain the salient features of DPP.
- 2) Write short notes on Dynamic Programming for Optimization
- 3) Define the Bellman's principle of optimality and its application to DPP
- 4) Write short notes on i) Stage ii) State iii) Recursive approach
- 5) Explain the tabular method of solving DPP
- 6) Write short note on the characteristics of DPP
- 7) A medical representative located at city 1 has to travel to city 10. He knows the distance of alternative routes from city 1 to city 10 and has drawn the network map as shown in the following fig. along with the distance between the cities. Find the shortest possible route. Also find the shortest routes from any city to city 10.



Code No: 4BC11

Date:3-Dec-16(FN)

B. TECH. III-Year I-Semester Examinations, Nov/Dec 2016 (Regular)
OPERATIONS RESEARCH FOR ALLIED BRANCHES (CSE)

Time: 3 Hours

Max. Marks: 70

Note: a) *No additional answer sheets will be provided.*
b) *All sub-parts of a question must be answered at one place only, otherwise it will not be valued.*

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. Mention different phases in an Operations Research approach to problem solving.
2. What do you understand by balanced and unbalanced transportation problem?
3. Distinguish between individual replacement and group replacement.
4. Define a saddle point. How does it different from a pseudo-Saddle point.
5. Mention types of inventory models.
6. Define simulation. Mention phases of simulation model.
7. Give the mathematical formulation of an assignment problem.
8. Determine the optimal sequence to the below problem when the order is AB

Machines	Jobs			
	J ₁	J ₂	J ₃	J ₄
A	16	26	14	29
B	21	12	19	14

9. Define Dynamic programming. How is it different from linear programming?
10. Define renegeing and jockeying with reference to Queuing Models.

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. Solve the following Linear Programming problem by using Big M Method

$$\text{Minimize } Z=4X_1 + 8X_2 + 3X_3$$

$$\text{Subject to: } X_1 + X_2 \geq 2$$

$$2X_1 + 2X_3 \geq 5$$

$$X_1, X_2, X_3 \geq 0$$

2. Find the optimal solution for the following transportation problem in which cell values are unit transportation costs in rupees.

To

	P	Q	R	Supply
--	---	---	---	--------

	A	1	2	3	50
From	B	3	2	1	80
	C	4	5	6	75
	D	3	1	2	95
	Demand	120	80	100	

3. A foreman wants to process eight different jobs on three machines: a shaping machine, a drilling machine and a tapping machine, the sequence of the operation being shaping-drilling-tapping. The time taken in minutes by each job on each machine is indicated as below. Each machine can process only one job at a time. Find out the optimal sequence and total elapsed time. Also find idle time of each machine.

		Jobs							
Machines		J ₁	J ₂	J ₃	J ₄	J ₅	J ₆	J ₇	J ₈
	Shaping	5	6	2	3	4	9	15	11
	Drilling	4	6	7	4	5	3	6	2
	Tapping	8	10	7	8	11	8	9	13

4.a) Briefly explain "dominance property" with examples.
[4 Marks]

b) Two players A and B are playing a game with five rupees, ten rupees, and a twenty rupees note. Each player selects a note without the knowledge of the other. If the sum of the notes selected is even, A gets B's note and if the sum is odd B gets A's note. Construct the payoff matrix with respect to A. Find the best strategy for each player and the value of the game.

[6 marks]

5. A milk plant distributes its products by trucks, loaded at the loading dock. It has its own fleet plus the truck of a transport company is used. This company has complained that sometimes the truck has to wait in the queue and thus the company loses money. The company has asked the management either to go in for a second loading dock or discount prices equivalent to waiting time. The data available is as follows:

Average arrival time=3 per hour and average service rate=4 per hour. The transport company has provided 40% of the number of trucks.

Determine:

- i) The probability that a truck has to wait
- ii) The waiting time of a truck
- iii) Expected waiting time for transport company trucks per day

6a) Explain Bellman's principle of optimality
[3 Marks]

b) Maximize $Z = U_1^2 + U_2^2 + U_3^2$
Subject to $U_1 + U_2 + U_3 = 6$ and U_1, U_2, U_3 all positive integers
[7 Marks]

7. Use graphical method to solve the following problem

$$\text{Maximize } Z = 5x_1 + 3x_2$$

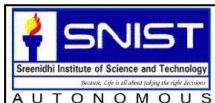
Subject to the Constraints

$$\begin{aligned}x_1 + x_2 &\leq 6 \\0 \leq x_1 &\leq 3 \\0 \leq x_2 &\leq 3 \\2x_1 + 3x_2 &\geq 3 \\ \text{and } x_1, x_2 &\geq 0\end{aligned}$$

8 a) Derive the expression for EOQ of Wilson-Harris model. What are its limitations?

b) What are advantages and disadvantages of simulation? Explain any two popular simulation languages

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Sreenidhi Institute of Science & Technology
(An Autonomous Institution)

A10

Code No: 101ME22/111ME22

B. TECH. III-Year II-Semester Examinations, Jan/Feb 2016
(Supplementary)
OPERATIONS RESEARCH (CSE)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part-A

Max. Marks: 20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. Name the various phases of O.R
2. What is the difference between slack variable and surplus variable?
3. Explain degeneracy in Transportation Problem?
4. What is meant by unbalanced Assignment Problem?
5. Define total elapsed time in sequencing.
6. Name the various replacement problems
7. Define pure strategy.
8. Define arrival rate and service rate.
9. Define reorder point.
10. Explain the concept of Dynamic programming problem.

Part-B

Max. Marks: 50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. Use Big-M method to

$$\text{Maximize } Z = 3x_1 - x_2$$

Subject to the constraints

$$\begin{aligned}
 2x_1 + x_2 &\geq 2 \\
 x_1 + 3x_2 &\leq 3 \\
 x_2 &\leq 4 \\
 \text{and } x_1, x_2 &\geq 0
 \end{aligned}$$

2. A company has three factories A, B and C which supply units to warehouses X, Y and Z every month. The capacities of the factories are 60, 70 and 80 units at A, B and C respectively. The requirements of X, Y and Z per month are 50, 80 and 80 units respectively. Transportation cost per unit in rupees is given in the following table. Find out the minimum cost of transportation.

	X	Y	Z
A	8	7	5
B	6	8	9
C	9	6	5

3. Following Table shows the machine time (in hrs) for five jobs to be processed on two different machines

Job	1	2	3	4	5
Machine A	3	7	4	5	7
Machine B	6	2	7	3	4

Passing is not allowed. Find the optimal sequence in which jobs should be processed.

4. The cost of a machine is Rs. 6100 and the scrap value is only Rs.100. The maintenance cost are found from experience to be

year	1	2	3	4	5	6	7	8
Maintenance cost in Rs.	100	250	400	600	900	1250	1600	2000

When should machine be replaced.

5. For the following pay-off matrix for firm A, Determine the optimal strategies for both the firms(A&B)and the value of the game

	B1	B2	B3	B4	B5
A1	3	-1	4	6	7
A2	-1	8	2	4	12
A3	16	8	6	14	12
A4	1	11	-4	2	1

6. Trains arrive at the yard every 12 minutes and the service time is 35 minutes. If the capacity of the yard is limited to 4 trains find:
- Probability that the yard is empty
 - The average number of trains in the system.
 - The average number of trains in the queue

7. Find the optimal economic order quantity for a product having the following characteristics

Annual demand = 2400 units
 Ordering cost = Rs. 10.00
 Cost of storage = 24% of the unit cost

price break:

Quantity	Unit cost (Rs.)
$0 \leq Q \leq 500$	10.00
$500 \leq Q$	9.00

8. Determine the values of u_1 , u_2 and u_3 so as to

$$\text{Maximize } Z = u_1.u_2.u_3$$

$$\text{Subject to constraints } u_1+u_2+u_3=10$$

$$\text{where } u_1, u_2, u_3 \geq 0$$

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Sreenidhi Institute of Science and Technology
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**Regulations:
A14**

**Code No: 4BC11
(AN)**

Date: 15-May-17

**B.Tech III-Year I-Semester End Examination, May- 2017
 (Supplementary)
 OPERATIONS RESEARCH (CSE)**

Time: 3 Hours

Max.Marks:70

Note: a) No additional answer sheets will be provided.
 b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
 c) Assume any missing data.

Part - A **Max.Marks:20**

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

- Define slack variable and artificial variable with reference to linear programming problem.
- Give the mathematical formulation for general transportation problem.
- What do you mean by “money value is counted and not counted” in replacement analysis? .
- Define Zero-Sum and nonzero-sum Game. Give example to your definition.
- Briefly explain the significance of lead time and safety stock in inventory management
- Define simulation. Mention simulation languages.
- Compare between the Big-M method and the two phase method.

8. Write briefly on Johnson's procedure for determining an optimal sequence for processing 'n' jobs on two machines
9. Give any four examples to illustrate the applications of queuing theory.
10. Briefly explain the difference between a transportation problem and an assignment problem.

Part – B **Max.Marks:50**
ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. Use Penalty Method to Solve the following LPP

$$\text{Minimize } Z=5X_1 +3X_2$$

Subject to $2X_1 +4X_2 \leq 12$
 $2X_1 +2X_2 = 10$
 $5X_1 +2X_2 \geq 10$
 $X_1, X_2 \geq 0$

2. A team of 5 horses and 5 riders has entered a jumping show contest. The number of penalty points to be expected when each rider rides any horse is shown below.

		Riders				
		R ₁	R ₂	R ₃	R ₄	R ₅
Horses	H ₁	5	3	4	7	1
	H ₂	2	3	7	6	5
	H ₃	4	1	5	2	4
	H ₄	6	8	1	2	3
	H ₅	4	2	5	7	1

How should the horse be allotted to the riders so as to minimize the expected loss of the team?

3. A milk plant is offered an equipment 'A' which is priced at Rs.60, 000 and the costs of operation and maintenance are estimated to be Rs.10, 000 for each of the first 5 years, increasing every year by Rs. 3000 per year in the sixth and subsequent years. If money carries the rate of interest 10% per annum what would the optimal replacement period?
4. a) What is game theory? Describe some of the applications of game theory. [4 Marks]
b) Consider the following game played by players A and B. Solve it optimally by using dominance property.
[6
Marks]

Player B				
	I	II	III	IV
a	12	4	8	14

Player A		b	4	-2	2	15
		c	4	6	6	13
		d	10	4	12	17

5. a) What are the assumptions used while deriving the EOQ formula in Wilson-Harris model? What are the limitations of EOQ?
- b) A certain item costs Rs. 235 per ton. The monthly requirement is 5 tons and each time the stock is replenished, there is a set-up cost of Rs. 1,000. The cost of carrying inventory has been estimated at 10% of the value of the stock per year. What is the optimum order quantity?

6. Solve the following LPP by using dynamic programming technique.

$$\text{Maximize } Z = 10X_1 + 30X_2$$

Subject to $3X_1 + 6X_2 \leq 168$
 $12X_2 \leq 240$
 $X_1, X_2 \geq 0$

7. Solve the following Transportation Problem optimally after finding the initial B.F.S by Vogel's method.

	I	II	III	IV	V	Supply
A	6	4	4	7	5	100
B	5	3	7	4	8	125
C	3	4	6	3	4	175
Demand	60	80	85	105	70	400

8. Write short notes on the following:

- a) Bellman's principle
[3 Marks]
- b) Practical application of simulation
[3 Marks]
- c) Types of Inventory Models
[4 Marks]

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COURSE FILE
FOR
Fundamentals of Communications



**4th YEAR I SEMESTER
CSE BRANCH**

**DEPARTMENT
OF
ELECTRONICS AND
COMMUNICATIONS ENGINEERING**

JUNE 2018

Vision of the Department

To emerge as a leading centre for students and faculty in their pursuits of professional excellence in the fields of Electronics and Communication Engineering by making use of current Scientific and Technological advancements, with focus on human values, professional ethics and social responsibility.

Mission of the Department

Training students in the basic core and application oriented subjects of Electronics and Communication engineering with due focus on multi-disciplinary areas.

Establishing liaison with relevant industries, R&D organizations and renowned academia for exposure to practical R&D aspects of technology.

Inculcating team work, leadership, professional ethics and other skills such as effective communication, logical reasoning, career goal setting, liberal use of modern tools, familiarity with IPR to make students globally competent in employment as well as entrepreneurship.

Promoting scientific temper and research culture in the graduates towards lifelong learning to produce useful research outcomes.

PEOs and POs

Program Educational Objectives of B. Tech (ECE) Program :

PEO-1:

To provide strong foundation in basic sciences including mathematics and engineering fundamentals required to solve engineering problems so that they will be able to identify, formulate and apply creatively their understanding of sciences and core engineering to design solutions and systems for the problems arising in the context of public health and safety, cultural, societal and environmental considerations.

PEO-2:

To develop core competences in the field of Electronics and Communication Engineering to conduct experiments, analyze, design and use appropriate techniques and tools to provide optimum solutions with professional engineering practices considering the social responsibilities and environmental issues.

PEO-3

To inculcate individual & team work, leadership, professional ethics, IPR and regulatory issues in multidisciplinary areas and to develop good communication skills for ensuring their professional career advancements.

PEO-4:

To promote entrepreneurship with sufficient knowledge of project/financial management techniques and to engage in lifelong learning in the broad context of technological change.

**DEPARTMENT
OF
ELECTRONICS AND COMMUNICATIONS ENGINEERING**
PROGRAM OUTCOMES (POs) OF B. TECH ECE

- a) An ability to apply knowledge of basic sciences, mathematics and engineering fundamentals and specialization to the solutions of complex engineering problems in the area of Electronics and Communication Engineering.
- b) Graduate will demonstrate an ability to identify, formulate and solve complex problems in key areas of Circuits and Systems Design related to Electronics and Communication Engineering.
- c) Graduate will demonstrate an ability to design and conduct experiments; implement and validate a software/ hardware system to meet the desired needs within realistic constraints such as cost and time.
- d) Graduate will demonstrate ability in conducting investigations to solve problems in the fields of Electronics and Communication Engineering using research based knowledge and methods to provide logical conclusions.
- e) Graduate will demonstrate skills to apply modern engineering and IT tools, softwares and equipments in order to identify and analyze the problems in Electronics and Communication Engineering and propose a design methodology.
- f) Graduate will demonstrate the need and impact of engineering solutions related to Electronics and Communication Engineering, on the society to assess public health & safety, legal, Professional ethics and social issues involved.
- g) Graduate will demonstrate the impact of professional engineering solutions in environmental context and to be able to respond effectively to the needs of sustainable development.
- h) Graduate will demonstrate the knowledge and the principles of Professional and ethical responsibilities in their engineering practice.
- i) Graduate will demonstrate an ability to work effectively as an individual and/or as a team member/leader in multidisciplinary areas.
- j) Graduate will be able to learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini and major projects.
- k) Graduate will demonstrate knowledge of management principles and apply these to manage projects in multidisciplinary environments either as an individual or a team leader.
- l) Graduate will recognize the need of self-learning and ability to engage in independent and life - long learning in the broadest context of technology change.

- m) Graduate will be able demonstrate the applications of knowledge gained into the advanced fields such as Wireless Communications, VLSI and Embedded Systems, Signal Processing.

Syllabus for B. Tech. IV Year I semester

Computer Science and Engineering

FUNDAMENTALS OF COMMUNICATION ENGINEERING

(Open Elective - II)

Code: 5CC49

C

L T P/D

2 1 - 2

Course Objectives:

To provide a conceptual understanding of Basics of Analog and digital Communication system and also study of different digital modulation techniques along with error control coding

Course Outcomes: After completing this course, student shall be able to

1. To understand the basics of communication system and noise as the biggest challenge for communication.
2. To learn the detailed Analog communication techniques used in today's scenario.
3. Discriminate different types of sampling techniques required to convert an analog signal to a Discrete signal.
4. Describe different types of digital communication techniques to convert analog signal to digital .
5. To study ASK,PSK,FSK,DPSK,QPSK modulators and demodulators and error control coding
6. To study about different Multiple Access techniques

UNIT I

Introduction to Communication Systems

Communication system, Analog and digital signals, frequency domain representation of signal Channel effect, Modulation and detection, Historical review of telecommunication, Noise: External noise, internal noise,

UNIT II

Analog Modulation Techniques

Amplitude modulation: AM Theory, generation of AM, SSB techniques: Suppression of carrier, suppression of unwanted sideband, Frequency modulation: FM Theory, noise and FM, generation of FM.

UNIT III

Base Band Modulation

Base band system, sampling theorem, Sampling and signal Re-construction, Aliasing, Types of sampling, Quantization, Pulse Analog modulation PAM,PWM,PPM

UNIT IV

Digital Communication Model of Digital Communication Systems, Advantages of digital communication systems, Digital Representation of Analog signal,PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta Modulation, T1 carrier system, shanon fano coding and Huffman coding

UNIT V

DIGITAL MODULATION TECHNIQUES AND ERROR CONTROL CODING

ASK,FSK,PSK,DPSK,QPSK modulation and demodulation techniques,Comparison of Digital modulation systems.

Linear Block Codes, Error detection and correction capabilities of Linear Block Codes Cyclic Codes: Encoding, , Decoding, Convolution Codes: Encoding, Decoding

UNIT VI

MULTIPLE ACCESS TECHNIQUES FDMA,TDMA.CDMA DSSS-CDMA, FHSS-CDMA

TEXT BOOKS:

1. B. P. Lathi, *Modern Analog and Digital Communication*, 3rd Ed., Oxford University Press
2. K. Sam Shanmugham, *Digital and Analog Communication Systems*, John Wiley & Sons
3. Simon Haykin, *Digital communications* -, John Wiley, 2005
4. H. Taub and D. Schilling, *Principles of Communication Systems* –, TMH, 2003

REFERENCES:

1. John Proakis, *Digital Communications* –, TMH, 1983.
2. Singh & Sapre, *Communication Systems Analog & Digital* –, TMH, 2004.
3. Sklar: *Digital Communication*, 2nd Ed., Pearson Education
4. “Digital Communications”, J.S Chitode, Technical publication, Pune.
1. 5. George Kennedy and Bernard Davis ,*Electronics & Communication System*, TMH,2nd Edition, 2004.
2. 6. Analog and Digital Communications, Theory and Lab work, Abhay Gandhi, Cengage Learning.

Course objectives and outcomes

Course objectives :

- To understand the basic of signals, mathematical representations and effects of noise over signals.
- To understand various CW analog modulation techniques such as AM and FM and effect of noise over them.
- To understand sampling, quantization techniques and Pulse modulation techniques such as PAM, PWM and PPM and effect of noise over them.
- To analyze digital modulation techniques such as PCM, DPCM, DM and ADM.
- To understand source coding techniques
- To analyze digital modulation techniques like ASK, FSK and PSK.
- To understand channel coding techniques
- To understand various multiple access techniques

Pre Requisites: Mathematics, Data communication.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

S. No	Course code Number & Title	Course Outcomes (CO's)	Programme Outcomes		
			POs for each of the CO	High	Medium
64	SCC49 FOC	UNIT-I (CO 1) Ability to understand the basics of communication system and noise as the biggest challenge for communication.	a	a	b
		UNIT-II (CO 2) Ability to learn the detailed Analog communication techniques used in today's scenario	c, a		
		UNIT-III (CO 3) Ability to Discriminate different types of sampling techniques required to convert an analog signal to a Discrete signal.	b, a		
		UNIT-IV (CO 4) Ability to Describe different types of digital communication	e		

		techniques to convert analog signal to digital.			
		UNIT-V (CO 5) Ability to study ASK,PSK,FSK,DPSK, QPSK modulators and demodulators and error control coding	a		
		UNIT-VI (CO 6) Ability to study about different Multiple Access techniques	e		

SUBJECT: CAD/CAM	POs												
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	
CO 1	X												
CO 2	X		X										
CO 3	X	X											
CO 4					X								
CO 5	X												
CO 6					X								

Micro Plan:

**Name of the Faculty: S K SATYANARAYANA, Assistant Professor, ECE
Dept.**

Branch: CSE

Year & Sem: IV-I

Subject: Fundamentals of Communications

Lecture Schedule: Fundamentals of Communications

SNO	Name of the Unit	Name of the Topic	Points to be Covered	Periods	cu mu lati ve
1	Unit-I	Introduction to Communication Systems	Communication system, Analog and digital signals,	1	1
2			frequency domain representation of signal	2	2
3			Channel effects	1	3
4			Modulation and detection,	1	4
5			Historical review of telecommunication,	1	5
6			Noise: External noise, internal noise,	2	7
9	Unit-II	Analog Modulation Techniques	Amplitude modulation: AM Theory	1	8
10			generation of AM	2	10
11			SSB techniques: Suppression of carrier, suppression of unwanted sideband	2	12
12			Frequency modulation: FM Theory,	2	14
13			generation of FM.	3	17
14			noise and FM	2	19
15	Unit-III	Base Band Modulation	Base band system,	1	20
16			sampling theorem,	1	21
17			Sampling and signal Reconstruction, Aliasing,	2	23
18			Types of sampling,	2	25
19			Quantization,	2	27
20			Pulse Analog modulation PAM,PWM,PPM	2	29
25	Unit-IV	Digital Communication	Model of Digital Communication Systems,	1	30

26			Advantages of digital communication systems,	1	31
27			Digital Representation of Analog signal, PCM,	2	33
28			Companding,	1	34
29			DPCM, ADPCM,	2	36
30			Delta modulation, Adaptive delta Modulation,	2	38
31			T1 carrier system,	2	40
			shanon fano coding and Huffman coding	2	42

	Unit-V	Digital modulation techniques and error control coding	ASK,FSK,PSK,	2	43
33			DPSK,QPSK modulation and demodulation techniques,	2	45
34			Comparison of Digital modulation systems.	2	47
35			Linear Block Codes, Error detection and correction	2	49
36			capabilities of Linear Block Codes Cyclic Codes: Encoding, Decoding,	3	52
			Convolution Codes: Encoding, Decoding	3	55
43	Unit-VI	Multiple Access Techniques	FDMA	1	56
44			TDMA	1	57
45			CDMA	1	58
46			DSSS-CDMA	2	60
47			FHSS-CDMA	2	62

Unit-I

Short answer questions:

1. Define modulation?
2. Define detection?
3. Define Noise?
4. What are the types of Noises?
5. Define analog signals?
6. Define digital signals?
7. Give few applications of CAD?
8. What are the effects of channel over various signals?
9. What is frequency domain representation of signals?
10. Define the blocks of communication system.

Long answer questions:

1. Give the historical review of the telecommunications
2. Discuss about various types of Noises.
3. Explain the frequency domain representations of various kinds of signals
4. Briefly explain the various categories of manufacturing activities
5. Describe the communication system with neat block diagram

Objective Type question

1. In a communications system, noise is most likely to affect the signal
 - a) at the transmitter
 - b) in the channel
 - c) in the information source
 - d) at the destination
2. Indicate the false statement. Fourier analysis shows that a sawtooth wave consist of
 - a. fundamental and subharmonic sine waves
 - b. a fundamental sine wave and an infinite number of harmonics
 - c. fundamental and harmonic sine waves whose amplitude decreases with the harmonic number
 - d. sinusoidal voltages, some of which are small enough to ignore in practice
3. Indicate the false statement. Modulation is used to
 - a. reduce the bandwidth used
 - b. separate differing transmissions
 - c. ensure that intelligence may be transmitted over long distances
 - d. allow the use of practicable antennas
4. Indicate the false statement. From the transmitter the signal deterioration because of noise is usually
 - a. unwanted energy
 - b. predictable in character
 - c. present in the transmitter
 - d. due to any cause
5. Indicate the true statement. Most receivers conforms to the

- a. amplitude-modulated group b. frequency-modulated group
c. superheterodyne group d. tuned radio frequency
receiver group
6. Indicate the false statement. The need for modulation can best be exemplified by the following.
- Antenna lengths will be approximately $\lambda/4$ long
 - An antenna in the standard broadcast AM band is 16,000 ft
 - All sound is concentrated from 20 Hz to 20 kHz
 - A message is composed of unpredictable variations in both amplitude and frequency
7. Amplitude modulation is the process of
- superimposing a low frequency on a high frequency
 - superimposing a high frequency on a low frequency
 - carrier interruption
 - frequency shift and phase shift
8. One of the following types of noise becomes of great importance at high frequencies. It is the
- | | |
|------------------|-----------------------|
| a. shot noise | b. random noise |
| c. impulse noise | d. transit-time noise |
9. Indicate the false statement.
- HF mixers are generally noisier than HF amplifiers.
 - Impulse noise voltage is independent of bandwidth.
 - Thermal noise is independent of the frequency at which it is measured.
 - Industrial noise is usually of the impulse type.
10. The value of a resistor creating thermal noise is doubled. The noise power generator is therefore
- | | |
|------------|---------------|
| a. halved | b. quadrupled |
| c. doubled | d. unchanged |
11. One of the following is not a useful quantity for comparing the noise performance of receivers:
- | | |
|------------------------|--------------------------------|
| a. Input noise voltage | b. Equivalent noise resistance |
| c. Noise temperature | d. Noise figure |
12. Indicate the noise whose source is in a category different from that of the other three.
- | | |
|----------------------|-------------------|
| a. Solar noise | b. Cosmic noise |
| c. Atmospheric noise | d. Galactic noise |
13. Indicate the false statement. The square of the thermal noise voltage generated by a resistor is proportional to
- | | |
|-------------------------|--------------------------------------------|
| a. its resistance | b. its temperature |
| c. Boltzmann's constant | d. the bandwidth over which it is measured |

14. Which of broad classifications of noise are most difficult to treat?
- a. noise generated in the receiver
 - b. noise generated in the transmitter
 - c. externally generated noise
 - d. internally generated noise
15. Space noise generally covers a wide frequency spectrum, but the strongest interference occurs
- a. between 8 MHz and 1.43 GHz
 - b. below 20 MHz
 - c. between 20 to 120 MHz
 - d. above 1.5 GHz
16. When dealing with random noise calculations it must be remembered that
- a. all calculations are based on peak to peak values
 - b. calculations are based on peak values
 - c. calculations are based on average values
 - d. calculations are based on RMS values
17. Which of the following is the most reliable measurement for comparing amplifier noise characteristics?
- a. signal-to-noise ratio
 - b. noise factor
 - c. shot noise
 - d. thermal noise agitation
18. Which of the following statements is true?
- a. Random noise power is inversely proportional to bandwidth
 - b. Flicker is sometimes called demodulation noise
 - c. Noise in mixers is caused by inadequate image frequency rejection
 - d. A random voltage across a resistance cannot be calculated

Unit-II

Short answer questions

1. Define AM
2. Define FM
3. What are the types of AM modulation technique.
4. List the generation methods of AM.
5. Mention the generation methods for FM signal
6. What is the importance of carrier suppression?

Long answer questions

1. Discuss the various methods of generation of AM signal
2. Discuss the various methods of generation of FM signal
3. Explain SSB modulation technique
4. Compare AM and FM modulation techniques
5. Explain the theory of AM with neat sketches.
6. Explain the theory of FM with neat sketches.
7. Compare FM with PM

Objective Type Questions

1. If the carrier of a 100 percent modulated AM wave is suppressed, the percentage power saving will be
 - a. 50
 - b. 150
 - c. 100
 - d. 66.66
2. The modulation index of an AM wave is changed from 0 to 1. The transmitted power is
 - a. unchanged
 - b. halved
 - c. doubled
 - d. increase by 50 percent
3. A carrier is simultaneously modulated by two sine waves with modulation indices of 0.3 and 0.4; the total modulation index
 - a. is 1
 - b. cannot be calculated unless the phase relations are known
 - c. is 0.5
 - d. is 0.7
4. Amplitude modulation is used for broadcasting because
 - a. it is more noise immune than other modulation systems.
 - b. Compared with other systems it requires less transmitting power
 - c. its use avoids receiver complexity.
 - d. no other modulation system can provide the necessary bandwidth for high fidelity
5. What is the ratio of modulating power to total power at 100 percent modulation?
 - a. 1:3
 - b. 1:2
 - c. 2:3
 - d. None of the above
6. Indicate the false statement regarding the advantages of SSB over double sideband, full-carrier AM
 - a. More channel space is available.
 - b. Transmitter circuits must be more stable, giving better reception.
 - c. The signal is more noise-resistant
 - d. Much less power is required for the same signal strength
7. When the modulation index of an AM wave is doubled, the antenna current is also doubled. The AM system being used is
 - a. Single-sideband, full carrier (H3E)
 - b. Vestigial sideband (C3F)
 - c. Single-sideband, suppressed carrier (J3E)
 - d. Double-sideband, full carrier (A3E)
8. Indicate which one of the following advantages of the phase cancellation method of obtaining SSB over the filter method is false:
 - a. Switching from one sideband to the other is simpler.
 - b. It is possible to generate SSB at any frequency.
 - c. SSB with lower audio frequencies present can be generated
 - d. There are more balanced modulators; therefore the carrier is suppressed better.
9. The most commonly used filters in SSB generation are
 - a. mechanical
 - b. RC

- c. LC
d. low-pass
10. In an SSB transmitter, one is most likely to find a
- class C audio amplifier
 - tuned modulator
 - class B RF amplifier
 - class A RF output amplifier
11. Indicate in which one of the following only one sideband is transmitted.
- H3E
 - A3E
 - B8E
 - C3F
12. One of the following cannot be used to remove the unwanted sideband in SSB. This is the
- filter system
 - phase-shift method
 - third method
 - balanced modulator
13. R3E modulation is sometimes used to
- allow the receiver to have a frequency synthesizer
 - simplify the frequency stability problem in reception
 - reduce the power that must be transmitted
 - reduce the bandwidth required for transmission
14. In the spectrum of a frequency-modulated wave
- the carrier frequency disappears when the modulation index is large
 - the amplitude of any sideband depends on the modulation index
 - the total number of sidebands depends on the modulation index
 - the carrier frequency cannot disappear
3. The difference between phase and frequency modulation
- is purely theoretical because they are the same in practice
 - is too great to make the two system compatible
 - lies in the poorer audio response of phase modulation
 - lies in the different definitions of the modulation index
4. Indicate the false statement regarding the Armstrong modulation system
- The system is basically phase, not frequency modulation,
 - AFC is not needed, as crystal oscillator is used.
 - Frequency multiplication must be used
 - Equalization is unnecessary
15. An FM signal with a modulation index mf is passed through a frequency tripler. The wave in the output of the tripler will have a modulation index of
- | | |
|-----------|----------|
| a. $mf/3$ | b. mf |
| c. $3mf$ | d. $9mf$ |
16. An FM signal with a deviation δ is passed through a mixer, and has its frequency reduced fivefold. The deviation in the output of the mixer is
- | | |
|---------------|------------------|
| a. 5δ | b. Indeterminate |
| c. $\delta/5$ | d. δ |
17. A pre-emphasis circuit provides extra noise immunity by
- boosting the bass frequencies
 - amplifying the higher audio frequencies
 - preamplifying the whole audio band

- d. converting the phase modulation to FM
18. Since noise phase-modulates the FM wave, as the noise sideband frequency approaches the carrier frequency, the noise amplitude
- a. remains constant
 - b. is decreased
 - c. is increased
 - d. is equalized
19. When the modulating frequency is doubled, the modulation index is halved, and the modulating voltage remains constant. The modulation system is
- a. amplitude modulation
 - b. phase modulation
 - c. frequency modulation
 - d. any of the three
20. Indicate which one of the following is not an advantage of FM over AM:
- a. Better noise immunity is provided
 - b. Lower bandwidth is required
 - c. The transmitted power is more useful
 - d. Less modulating power is required
21. One of the following is an indirect way of generating FM. This is the
- a. reactance FET modulator
 - b. varactor diode modulator
 - c. Armstrong modulator
 - d. reactance bipolar transistor modulator
22. In an FM stereo multiplex transmission, the
- a. sum signal modulates 19 kHz subcarrier
 - b. difference signal modulates the 19 kHz subcarrier
 - c. difference signal modulates the 38 kHz subcarrier
 - d. difference signal modulates the 67 kHz subcarrier

Unit-III

Short answer questions

1. What is sampling?
2. What is quantization?
3. Mention the types of sampling methods.
4. What are the different types of quantization methods
5. What is Aliasing?
6. List the pulse modulation techniques.
7. Define Nyquist rate

Long answer questions

1. Explain the various sampling techniques with neat sketches
2. Describe the quantization and errors caused by it
3. Explain the generation of PAM
4. Explain the generation of PWM
5. Explain the generation of PPM
6. Compare PAM, PWM and PPM
7. Prove that aliasing can be avoided when Nyquist criteria is satisfied.

Objective Type Questions

1. Digital signals
 - a. do not provide a continuous set of values
 - b. represent values as discrete steps
 - c. can utilize decimal or binary systems

- d. all of the above
2. A forward error-correcting code corrects errors by
- requiring partial retransmission of the signal
 - requiring retransmission of the entire signal
 - requiring no part of the signal to be retransmitted
 - using parity to correct the errors in all cases
3. Indicate which of the following is not a binary code
- | | |
|------------|-----------|
| a. Morse | b. Baudot |
| c. CCITT-2 | d. ARQ |
4. To permit the selection of 1 out of 16 equi-probable events, the number of bits required is
- | | |
|------|-------------------|
| a. 2 | b. $\log_{10} 16$ |
| c. 8 | d. 4 |
5. A signaling system in which each letter of the alphabet is represented by a different symbol is not used because
- it would be too difficult for an operator to memorize
 - it is redundant
 - noise would introduce too many errors
 - too many pulses per letter are required
6. The Hartley states that
- the maximum rate of information transmission depends on the channel bandwidth
 - the maximum rate of information transmission depends on the depth of modulation
 - redundancy is essential
 - only binary codes may be used
7. Indicate the false statement. In order to combat noise,
- the channel bandwidth may be increased
 - redundancy may be used
 - the transmitted power may be increased
 - the signaling rate may be reduced
8. The most common modulation system used for telegraphy is
- | | |
|---------------------------|---------------------------|
| a. frequency-shift keying | b. two-tone modulation |
| c. pulse-code modulation | d. single-tone modulation |
9. Pulse-width modulation system used for telegraphy is
- by differentiating pulse-position modulation
 - with a monostable
 - by integrating the signal
 - with a free-running multivibrator
10. Indicate which of the following system is digital.
- | | |
|------------------------------|-------------------------------|
| a. Pulse-position modulation | b. Pulse-code modulation |
| c. Pulse-width modulation | d. Pulse-frequency modulation |
11. Quantizing noise occurs in
- | | |
|----------------------------|---------------------------------|
| a. time-division multiplex | b. frequency division multiplex |
| c. pulse-code modulation | d. pulse-width modulation |
12. The modulation system inherently most noise-resistant is
- | | |
|------------------------------|--------------------------|
| a. SSB, suppressed-carrier | b. Frequency modulation |
| c. pulse-position modulation | d. pulse-code modulation |
13. In order to reduce quantizing noise, one must
- increase the number of standard amplitudes

- b. send pulses whose sides are more nearly vertical
 - c. use an RF amplifier in the receiver
 - d. increase the number of samples per second
14. The Hartley-Shannon theorem sets a limit on the
- a. highest frequency that may be sent over a given channel
 - b. maximum capacity of a channel with a given noise level
 - c. maximum number of coding levels in a channel with a given noise level
 - d. maximum number of quantizing levels in a channel of a given bandwidth
15. Indicate which of the following pulse modulation systems is analog
- a. PCM
 - b. Differential PCM
 - c. PWM
 - d. Delta
16. Companding is used
- a. to overcome quantizing noise in PCM
 - b. in PCM transmitters, to allow amplitude limited in the receivers
 - c. to protect small signals in PCM from quantizing distortion
 - d. in PCM receivers, to overcome impulse noise
17. The biggest disadvantage of PCM is
- a. its inability to handle analog signals
 - b. the high error rate which its quantizing noise introduces
 - c. its incompatibility with TDM
 - d. the large bandwidths that are required for it
18. Quantization is a _____ process.
- a) Few to few mapping
 - b) Few to many mapping
 - c) Many to few mapping
 - d) Many to many mapping
19. Quantization is a _____ process.
- a) Non linear
 - b) Reversible
 - c) Non linear & Reversible
 - d) None of the mentioned

Unit-IV

Short answer questions

1. What are the advantage of digital modulation techniques
2. What is PCM?
3. What is DPCM
4. What is companding
- 5.

Long answer questions

1. Explain in detail about PCM
2. Describe Delta modulation
3. Look out the problems for Shannon Fano and Huffman coding.
4. Describe Adaptive Delta modulation
5. Compare PCM with DPCM

Objective questions

1. Which corrects the sampling time problem in a digital system?
 - a) Interpolator
 - b) Decimator
 - c) Equalizer
 - d) Filter
2. 1. Digital communication is _____ to environmental changes?
 - a) Less sensitive
 - b) More sensitive
 - c) Does not depend
 - d) None of the mentioned
3. 2. Advantages of digital communication are
 - a) Easy multiplexing
 - b) Easy processing
 - c) Reliable
 - d) All of the mentioned
4. Sampling theorem is used for converting
 - a) Continuous time signal to discrete
 - b) Discrete to continuous time signal
 - c) Both of the mentioned
 - d) None of the mentioned
5. 8. A signal can be recovered from its sample by using
 - a) Low pass filter
 - b) High pass filter
 - c) Band pass filter
 - d) Band stop filter
6. 10. In flat top sampling scheme, _____ is kept constant after sampling.
 - a) Amplitude
 - b) Phase
 - c) Frequency
 - d) Time period
7. Which helps in maintaining the step size?
 - a) Delta modulation
 - b) PCM
 - c) DPCM
 - d) Adaptive delta modulation
8. The sequence of operations in which PCM is done is
 - a. Sampling, quantizing, encoding
 - b. Quantizing, encoding, sampling
 - c. Quantizing, sampling, encoding
 - d. None of the above
9. In Delta modulation,
 - a. One bit per sample is transmitted
 - b. All the coded bits used for sampling are transmitted
 - c. The step size is fixed
 - d. Both a and c are correct
10. In digital transmission, the modulation technique that requires minimum bandwidth is

- a. Delta modulation
 - b. PCM
 - c. DPCM
 - d. PAM
11. DPCM is a technique
- a. To convert analog signal into digital signal
 - b. Where difference between successive samples of the analog signals are encoded into n-bit data streams
 - c. Where digital codes are the quantized values of the predicted value
 - d. All of the above
12. The technique that may be used to increase average information per bit is
- a. Shannon-Fano algorithm
 - b. ASK
 - c. FSK
 - d. Digital modulation techniques

Unit-V

Short Answer Questions

1. List the digital modulation techniques
2. Mention some of the block codes
3. What is the difference between block codes and convolution codes
4. What is error detection
5. What is error correction

Long answer questions

1. Compare ASK, FSK and PSK
2. Explain ASK modulation technique
3. Explain FSK modulation technique
4. Compare PSK DPSK and QPSK modulation technique
5. Explain about linear block codes
6. Explain about convolution codes
7. Explain the generation of ASK
8. Explain the generation of FSK
9. Explain the generation of PSK
10. Describe the significance of linear block codes. Give any one example

Objective questions

1. The coherent modulation techniques are
 - a) PSK
 - b) FSK
 - c) ASK
 - d) All of the mentioned
2. The FSK signal which has gentle shift from one frequency level to another is called as
 - a) Differential PSK
 - b) Continuous PSK

- c) Differential & Continuous PSK
d) None of the mentioned
3. Which modulation scheme is also called as on-off keying method?
a) ASK
b) FSK
c) PSK
d) GMSK
4. The detection method where carrier's phase is given importance is called as
a) Coherent detection
b) Non coherent detection
c) Coherent detection & Non coherent detection
d) None of the mentioned
5. Envelope detector consists of
a) Rectifier and high pass filter
b) Rectifier and low pass filter
c) Amplifier and low pass filter
d) Amplifier and high pass filter
6. Which can detect two bit errors?
a) Parity check
b) Cyclic redundancy check
c) Parity & Cyclic redundancy check
d) None of the mentioned
7. CRC uses
a) Multiplication
b) Binary division
c) Multiplication & Binary division
d) None of the mentioned
8. Which are forward error correcting codes?
a) Block codes
b) Convolutional codes
c) Block & Convolutional codes
d) None of the mentioned
9. Which has better minimum distance?
a) Check sum
b) Cyclic redundancy check
c) Check sum & Cyclic redundancy check
d) None of the mentioned
10. Which reduces the size of the data?
a) Source coding
b) Channel coding
c) Source & Channel coding
d) None of the mentioned
11. Which achieves greater compression?
a) Lossless coding
b) Lossy coding
c) Lossless & Lossy coding
d) None of the mentioned
12. For decoding in convolution coding, in a code tree,
a. Diverge upward when a bit is 0 and diverge downward when the bit is 1
b. Diverge downward when a bit is 0 and diverge upward when the bit is 1
c. Diverge left when a bit is 0 and diverge right when the bit is 1
d. Diverge right when a bit is 0 and diverge left when the bit is 1

13. The code in convolution coding is generated using
 - a. EX-OR logic
 - b. AND logic
 - c. OR logic
 - d. None of the above
14. The data rate of QPSK is _____ of BPSK.
 - a. Thrice
 - b. Four times
 - c. Twice
 - d. Same

Unit-VI

Short answer questions

1. What is multiple access?
2. List out the multiple access techniques
3. What is FDMA
4. What is TDMA
5. What is CDMA
6. What is spreading
7. List the types of spreading mechanism.
8. What is DSSS
9. What is FHSS

Long answer questions

1. Compare FDMA, TDMA and CDMA
2. What is spreading? Explain the methods used for spreading the signal
3. Describe the DSSS
4. Describe the FHSS
5. With an example explain CDMA multiple access technique.

Objective type answers

1. Pseudorandom signal _____ predicted.
 - a) Can be
 - b) Cannot be
 - c) Both of the mentioned
 - d) None of the mentioned
2. The frequency hopping system uses _____ modulation scheme.
 - a) FSK
 - b) BPSK
 - c) MFSK
 - d) MPSK
3. Spread spectrum is a _____ technique.
 - a) Encoding
 - b) Decoding
 - c) Encoding & Decoding
 - d) None of the mentioned

4. Spread spectrum can be used to transmit
 - a) Analog data
 - b) Digital data
 - c) Analog & Digital data
 - d) None of the mentioned
5. In CDMA the incoming signal is _____ with the spreading code.
 - a) Added
 - b) Multiplied
 - c) XOR-ed
 - d) None of the mentioned
6. In DSSS the signal is recovered using
 - a) Low pass filter
 - b) High pass filter
 - c) Band pass filter
 - d) Band stop filter
7. Which filter is used to get the final FHSS signal?
 - a) Low pass filter
 - b) High pass filter
 - c) Band pass filter
 - d) Band stop filter

**COURSE FILE
ON
ENTERPRISE RESOURCE
PLANNING**

B.TECH, SNIST

ACADEMIC YEAR 2018

COURSE OBJECTIVES:

Co1 : To Provide the basic concepts of ERP, integrated information systems and growth will be useful for managing the diversity, contemporary societal and global issues.

Co2 : To Provide knowledge about BPR and other Business Intelligence systems so that the firm can develop capacity to adapt and innovate and to manage in unpredictable environments.

Co3 : To Understand the various modules and gain knowledge and apply in new unfamiliar circumstances

Co4 : To Provide the benefits of ERP in order to understand the value of customers by identifying their needs and providing the services.

Co5 : To Understand the implementation and maintenance strategy for ERP for better financial decisions and Achieve higher levels of proficiency and self-actualization through pursuing lifelong learning.

Co6 :To Understand the benefits of ERP in order to reduce the lead time, cycle time and to improve the resource utilization.

PROGRAM OUT COMES:

- a. Graduate will demonstrate knowledge in fundamentals of mathematics, science and engineering.
- b. Graduate will demonstrate an ability to identify, formulate and solve problems in key areas of Engineering
- c. Graduate will demonstrate an ability to design and conduct experiment, analyze and interpret data Engineering.
- d. Graduate will demonstrate ability in conducting investigations to solve problems using research based knowledge and methods to provide logical conclusions.
- e. Graduate will demonstrate skills to use modern engineering and IT tools, softwares and equipment to analyze the problems in the society.
- f. Graduate will show the understanding of impact of engineering solutions on the society to assess health, safety, legal, and social issues.
- g. Graduate will demonstrate the impact of professional engineering solutions in environmental context and to be able to respond effectively to the needs of sustainable development.

- h. Graduate will demonstrate the knowledge of Professional and ethical responsibilities.
- i. Graduate will demonstrate an ability to work effectively as an individual and as a team member/leader in multidisciplinary areas.
- j. Graduate will be able to critique, writing samples (abstract, executive summary, project report), and oral presentations.
- k. Graduate will demonstrate knowledge of management principles and apply these to financial and project management in multidisciplinary environments.
- l. Graduate will recognize the need of self education and ability to engage in life - long learning.

Program outcome	A	B	C	D	E	F	G	H	I	J	K	L
Course Objectives												
Co 1						x		x			x	
Co 2						x		x			x	
Co 3				x				x			x	
Co 4			x					x			x	
Co 5										x	x	
Co 6			x					x			x	

a	b	c	d	e	f	g	h	i	j	k	l
			x			x		x			x

L	T	P/D	C
2	1	0	2

5ZC08 ENTERPRISE RESOURCE PLANNING

Course Objective: This course helps to provide the basic concepts of Enterprise Resource Planning and Management of Information System. This course will enable the students to study areas of BPR, ERP Modules, and types of information systems, security controls, and audit. This course explores the nature and applications of ERP &MIS.

UNIT I

INTRODUCTION TO ERP: Overview of ERP, MRP, MRPII and Evolution of ERP, Integrated Management Systems, Reasons for the growth of ERP, Risks of ERP.

UNIT II

ERP & RELATED TECHNOLOGY: Introduction to BPR, BPR process; ERP System Options and Selection, ERP proposal Evaluation.

UNIT III

ERP MODULES- I: Finance, Accounting Systems, Manufacturing and Production Systems.

UNIT IV

ERP MODULES- II: Sales and Distribution Systems, Human Resource Systems, Plant Maintenance System, Materials Management System.

UNIT V

ERP IMPLEMENTATION AND MAINTENANCE: Implementation challenges, ERP Implementation strategies, ERP Implementation life cycle- Pre evaluating screening, Package evaluation-Project planning Phase- GAP Analysis-Reengineering, Configuration-Team Training-Testing & Going Live, Maintaining ERP.

UNIT VI

BENEFITS OF ERP: Reduction of Lead Time, On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.

Books Recommended:

- David L Olson, Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2012.
- Alexis Leon, ERP (Demystified), 5/E, Tata McGraw-Hill, 2012.

References:

- Mary Sumner “Enterprise Resource planning” Pearson, 2012
- Robert Schultheis and Mary Summer, Management Information System the Manager’s View, Tata McGraw-Hill-2008
- Murthy, CSV, Management Information Systems- Text and Applications, Himalaya Publishing House- 2009.

LECTURE SCHEDULE

S. No	UNIT	No. of PERIODS	TOPIC TO BE COVERED
1	I	8	INTRODUCTION TO ERP: Overview of ERP
2			MRP
3			continuation class
4			MRPII
5			Evolution of ERP,
6			Integrated Management Systems,
7			Reasons for the growth of ERP, Risks of ERP
8			Risks of ERP
9	II	8	ERP & RELATED TECHNOLOGY
10			Introduction to BPR
11			BPR process;
12			continuation class
13			ERP System Options and Selection
14			continuation class
15			ERP proposal Evaluation.
16			continuation class
17	III	8	ERP MODULES- I
			Various modules briefing
18			Finance,
19			continuation class
20			Accounting Systems,
21			continuation class
22			Manufacturing and Production Systems
3			continuation class

24			
25	IV	9	ERP MODULES- II Sales and Distribution Systems, continuation class Human Resource Systems, continuation class Plant Maintenance System, continuation class Materials Management System. continuation class
26			
27			
28			
29			
30			
31			
32			
33			
34	V	13	ERP IMPLEMENTATION AND MAINTENANCE: Maintaining ERP. Implementation challenges, ERP Implementation strategies, ERP Implementation life cycle Pre evaluating screening, Package evaluation Project planning Phase continuation class GAP Analysis continuation class Reengineering continuation class Configuration-Team Training-Testing & Going Live,
35			
36			
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41			
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46			
47	VI	10	BENEFITS OF ERP: Reduction of Lead Time On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.
48			
49			
50			
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53			
54			
55			
56			

Questions (Unit Wise)

Unit – I & II

Short Answers Questions:

1. Write about ERP?
2. Write about MRP?
3. Write about MRP II?
4. Write about evolution of ERP?
5. Write about Integrated management System?
6. Write about growth of ERP?
7. Write about risks of ERP?
8. Write about BPR?
9. Write about BPR process?
10. Write briefly about ERP proposal evaluation

Long Answer Questions:

1. Describe evaluation of Enterprise Resource Planning?
2. List the benefits of ERP.
3. How does ERP improves supplier performance?
4. Explain the reasons for the growth of ERP.
5. Explain the Evolution of ERP.
6. What is BPR? What are the best practices in ERP?
7. What is clean state reengineering
8. Write short notes on Data Mining
9. What is OLAP? What are the strengths? Give the schematic diagram of OLAP.
10. Explain the process of BPR?
11. Explain the concept of data warehousing.
12. How Business process Re-engineering can be integrated to ERP? Explain with suitable illustrations.
13. Write short notes on the following
 - a. Integrated data model
 - b. Social-Technical system approach

Unit –III &IV

Short Answers Questions:

1. What are various ERP Modules?
2. Write about Finance Module in ERP?
3. Write about Accounting Systems module in ERP?
4. Write about Manufacturing and production systems modules in ERP?
5. Write about Sales and distribution systems module?
6. Write about Human Resource systems module?
7. Write about Plant maintenance systems module?
8. Write about materials management systems?

Long Answer Questions:

1. Discuss ERP Accounting Module. How does the ERP proposal evaluation done?
2. Write Short Notes on the following
Sales and Distribution
Quality Management
Finance Management
3. Out line the various issues in Business module of ERP in Human Resource Management.
4. Explain the benefits of ERP.
5. Short Notes on
On time shipment
Reduction in cycle time

Unit -V &IV

Short Answers Questions:

1. Write about implementation challenges in ERP?
2. Write about implementation strategies in ERP?
3. Write about EPR maintenance life cycle?
4. Write about Pre evaluation screening of Project?
5. Write about Project planning Phase?
6. Write about GAP analysis?
7. Write about Re-engineering?
8. Write about maintaining ERP?
9. Write about Lead time?
10. Write about Reduction cycle time?
11. Write about On-time shipment?
12. Write about Resource utilization?
13. Write about Reduced Quality costs?
14. Write about increased flexibility due to ERP?
15. Write about improved Information accuracy and design making capabilities by implementing ERP?

Long answer Questions:

1. Discuss the strategic information system.
2. What are the strategies to attain success in ERP implementation? Discuss the features of successful ERP implementation.
3. What are the methods of minimizing risk? How do you ensure system quality?
4. "ERP can be perceived as an effective tool to enhance customer satisfaction". Do you agree/disagree with the above statement? Elaborate.
5. Elaborate the future trends and directions in ERP in the lime light of new markets and new technologies.
6. Discuss the merits and demerits of SAP of Baan.

Code No:

MODEL PAPER

ENTERPREISE AND RESOURCE PLANNING

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part-A

Max.Marks:20

ANSWER ALL QUESTIONS.

- 1) Define Enterprise resource planning?.
- 2) Define BPR?
- 3) Define OLAP?
- 4) What are ERP Modules?
- 5) Write short notes on Data Mining
- 6) What are benefits of ERP?
- 7) What are the various issues in Business module of ERP in HRM?
- 8) What is Business process Re-engineering?
- 9) What is Reduction in cycle time?
- 10) Define On time shipment

Part – B

Max. Marks: 50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- 1 a.Explain the origin. Evaluation and structure of ERP?
b. How is business integration achieved by ERP? Why are ERP systems said to be flexible?
- 2 a. What is meant by network database model?
b. What is ERP? What do you mean by On-Line Analytical Processing (OLAP)?
3. a. What is BPR?
b. What are the benefits of ERP system? What are the intangible benefits of an ERP implementation?
4. a. Explain clearly the BOM Module of ERP.
b. Why is end-user training said to be critical for the success of the ERP implementation?.
5. a. What are the major domains of AI? Under each of the domain bring out the major application areas.
b. Who are the major ERP players in the Indian market and what are their market shares?
- 6 a. 'The heady mix of tangible and intangible benefits makes ERP packages highly sought after in industry.' Do you agree? Comment on the statement.
b. What is the role of windows NT in the future?.

7. a. Bring out the importance of top management support in ERP implementation..
b. Draw a business model for an organization with which you are familiar. Identify major processes and entities and show them in figure..
8. a. Why are ERP vendors trying to improve their products and offerings?
b. Explain the ERP Proposal Evaluation
c. Project Evaluation Techniques

-- 00 -- 00 --



H.T No | 15311A0A08

Regulations:
A15

Sreenidhi Institute of Science and Technology
(An Autonomous Institution)

Code No: 5ZC08

Date: 18-Apr-2018 (FN)

B.Tech III-Year II-Semester End External Examination, April - 2018 (Regular)
ENTERPRISE RESOURCE PLANNING (ECE & BT)

Time: 3 Hours

Max.Marks:75

- Note: a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
c) Missing data can be assumed suitably.

Part - A
ANSWER ALL QUESTIONS.

- | | |
|-------------------------------------------------------------------------------------------|------|
| 1. What is an integrated information system? | [3M] |
| 2. Write about some of the intangible costs and benefits typically found in ERP proposal. | [3M] |
| 3. Write short notes on financial accounting. | [3M] |
| 4. Define personal management. | [3M] |
| 5. Define package evaluation. | [3M] |
| 6. How ERP systems provide benefits to the organization? | [2M] |
| 7. Define business processes. | [2M] |
| 8. What are the sub systems of the manufacturing module? | [2M] |
| 9. Define pre-evaluation screening. | [2M] |
| 10. What are the major functions of the material management? | [2M] |

Part - B
ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 11. a) Why are integrated information systems important for the organization success?
b) How does an MRP-II system work? | [5M]
[5M] |
| 12. a) Explain different technologies are related to ERP system.
b) Explain ERP proposal evaluation. | [5M]
[5M] |
| 13. a) Explain about material and capacity planning.
b) Discuss production system in ERP. | [5M]
[5M] |
| 14. a) How does the plant maintenance module help in achieving competitive advantage?
b) Explain time management module in ERP system | [5M]
[5M] |
| 15. a) Explain implementation strategy options in ERP.
b) What is the purpose of gap analysis and how are the gaps fixed? | [5M]
[5M] |
| 16. a) How does an ERP system reduce cycle time? Elaborate
b) Discuss about reduced quality costs. | [5M]
[5M] |
| 17. a) What are the various risks involved in ERP?
b) List and Explain ERP technology.
c) Explain about controlling system. | [3M]
[3M]
[4M] |
| 18. a) Explain various sub systems under HR module.
b) Why pre-selection screening important?
c) Discuss about increased flexibility. | [3M]
[3M]
[4M] |

- 00 -- 00 -

Page 1 of 1

**Code: 5AC45
SOURCES**

**IV year B.Tech – I Sem-CSE
FUNDAMENTALS OF RENEWABLE ENERGY**

(OPEN ELECTIVE)

L T P C
2 1 - 2

a	b	c	d	e	f	g	h	i	j	k	l
					x	x					

Course Objectives:

Becomes familiar with solar energy, its radiation, Collection, storage and application and also gets introduced to other forms of Renewable Energy sources viz., the Wind energy, Biomass energy, geothermal energy and ocean energy.

Course Outcomes:

The student should be able to

- Understand the role and potential of new and renewable energy sources realize the potential of solar energy, its impact on environment; define and understand the terms describing the different angles that one may incur in setting up a solar panel and be able to use the instruments for measuring solar radiation.
- Demonstrates the knowledge of different techniques of solar collection and storage.
- The student becomes familiar with the different types of horizontal and vertical axis wind mills and understands the performance characteristics of the same. The student also demonstrates the knowledge of different Bio-gas digesters and factors influencing its yield.
- Aware of the potential of geothermal energy in India and will be able to characterize different types of geothermal wells.
- Aware of the different methods of kinetic energy extraction from Ocean waves and tides and thermal energy extraction from Oceans.
- Demonstrates the knowledge of Direct Energy Conversion in different phenomena viz., Joule Thomson effect, Seebeck effect, Peltier effect etc. and the principle of operation of Fuel Cells.

UNIT – I -PRINCIPLES OF SOLAR RADIATION:

Role and potential of new and renewable source, The solar energy option, Environmental impact of solar power, Physics of the sun, the solar constant, Extraterrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, Solar radiation data.

UNIT-II- SOLAR ENERGY COLLECTION STORAGE AND APPLICATIONS: Flat plate and concentrating collectors, Classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Different methods, Sensible, Latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT – III WIND ENERGY:

Sources and potentials, Horizontal and vertical axis windmills, Performance characteristics, Betz criteria

BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, Types of Bio-gas digesters, Gas yield, Combustion characteristics of bio-gas, Utilization for cooking, I.C.Engine operation and economic aspects.

UNIT – IV GEOTHERMAL ENERGY:

Resources, types of wells, methods of harnessing the energy, Potential in India.

UNIT-V OCEAN ENERGY:

OTEC, Principles utilization, Setting of OTEC plants, Thermodynamic cycles. Tidal and wave energy, Potential and conversion techniques, Mini-hydel power plants and their economics.

UNIT-VI DIRECT ENERGY CONVERSION:

Need for DEC, Carnot cycle, Limitations, principles of DEC. Thermoelectric generators, seebeck, Peltier and joule Thomson effects, Figure of merit, materials, Applications, MHD generators, Principles, Dissociation and ionization, Hall effect, Magnetic flux, MHD accelerator, MHD Engine,

Power generation systems, Electron gas dynamic conversion, economic aspects. Fuel cells – principles - Faraday's law's - Thermodynamic aspects - selection of fuels and operating conditions.

TEXT BOOKS:

1. Non-Conventional Energy Sources - G.D. Rai
2. Renewable Energy Technologies - Ramesh & Kumar /Narosa.

REFERENCES:

1. Renewable energy resources - Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy - Ashok V Desai /Wiley Eastern.
3. Non-Conventional Energy Systems - K Mittal /Wheeler
4. Solar Energy - Sukhame

Lecture Schedule

UNIT – I			
PRINCIPLES OF SOLAR RADIATION			
1	Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power,	2	2
2	physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation,	1	3
3	solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.	2	5
UNIT – II			
SOLAR ENERGY COLLECTION			
4	Flat plate and concentrating collectors	2	6
5	classification of concentrating collectors,	2	8
6	orientation and thermal analysis, advanced collectors.	2	10
SOLAR ENERGY STORAGE AND APPLICATIONS			
8	Different methods, Sensible,	1	11
9	latent heat and stratified storage, solar ponds.	2	13
10	Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion	4	17
UNIT – III			
WIND ENERGY			
11	Sources and potentials,	2	19
12	horizontal and vertical axis windmills,	2	21
13	performance characteristics, Betz criteria	2	23
BIO-MASS			
14	Principles of Bio-Conversion	2	25
15	Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking	3	28
16	I.C. Engine operation and economic aspects.	2	30
UNIT - IV			
GEOTHERMAL ENERGY			
17	Resources, types of wells	3	33
18	Methods of harnessing	2	35
19	The energy, potential in India.	3	38

	UNIT – V			
	OCEAN ENERGY			
20	OTEC, Principles utilization	2	40	
21	Setting of OTEC plants, thermodynamic cycles	2	42	
22	Tidal and wave energy	2	44	
23	Potential and conversion techniques,	2	46	
24	Mini-hydel power plants, and their economics.	2	48	
	UNIT – VI			
	DIRECT ENERGY CONVERSION			
25	Need for DEC, Carnot cycle, limitations, principles of DEC.	2	50	
26	Thermo-electric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications	2	52	
27	MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects.	2	54	
28	Fuel cells, principles,	2	56	
29	faraday's law's, thermodynamic aspects,	2	58	
30	selection of fuels and operating conditions.	2	60	

UNIT – I

OBJECTIVE TYPE QUESTIONS

1. Renewable energy is drawn from the
 - a) wind b) solar c) Geothermal d) Environment
2. Per capita consumption (kwh) of energy in India
 - a) 400 b) 600 c) 1000 d) 2000
3. An example for Alternative fuel
 - a) Jatropha b) coal c) petrol d) Gas
4. Emission from fossil fuel use, increases concentration of
 - a) O₂ b) H₂O c) H₂ d) Co₂
5. Upgrading waste management is required for
 - a) Disposal of burntout CFL lamps b) Solar energy equipments
 - c) Geo thermal equipments d) wind energy equipments

6. Brown energy is known as
 a) sustainable energy b) Green energy
 c) Renewable energy d) conventional Energy
7. The motion and gravitational potential of the sun, moon and earth creates a)
 Solar energy b) Geothermal energy
 c) Tidal energy d) Bio mass energy
8. Solar constant W/sqm
 a) 1253 b) 1153 c) 1053 d)
 1353
9. Solar Energy estimated
 a) 10^{16} Watts b) 10^{40} Watts c) 10^{50} Watts d)
 10^5 Watts
10. Most clean and non polluting energy is
 a) Solar b) wind c) Geothermal d)
 Bio mass
11. Efficiency with finite supplies reduces
 a) pollution b) capital costs c) energy losses d) fuel
12. Energy crisis in _____ made all Govts to explore other energy resources
 a) 1950 b) 1963 c) 1973 d)
 1953
13. Energy Index means
 a) $\frac{\text{total energy cost}}{\text{output}}$ b) $\frac{\text{total energy}}{\text{output}}$
 c) $\frac{\text{Electrical energy cost}}{\text{output}}$ c) $\frac{\text{Electrical energy}}{\text{output}}$
14. Most of the primary Energy supply available now as
 a) coal b) gas c) petroleum d) hydro
15. While calculating local solar time - ve sign is used in the equation for
 a) Western hemisphere b) Northern hemisphere
 c) Southern hemisphere d) Eastern hemisphere
16. The Angle between sun's ray and perpendicular to the horizontal plane is called
 a) Zenith angle b) Tilt angle
 c) Azimuth angle d) Angle of incidence

17. Declination angle today is

a) $23.45 \sin\left[\frac{360}{365}(284 + \text{_____})\right]$

b) $23.55 \sin\left[\frac{360}{365}(283 + \text{_____})\right]$

c) $23.45 \sin\left[\frac{360}{365}(282 + \text{_____})\right]$

d) $23.55 \sin\left[\frac{365}{360}(283 + \text{_____})\right]$

UNIT – I ESSAY TYPE QUESTIONS

1. a). What are the prospects of various renewable energy resources in India?
2. Describe the general principles of Energy Management with suitable examples.
3. (a) What do you mean by renewable energy sources ?
(b) Explain various sources of energy briefly.
(c) Compare synchronous condenser with static capacitors with regard to pf improvement.
4. (a) What are ultimate energy sources ?
(b) Discuss the factors, which affect the efficiency of electrical systems.

How can they be improved?

5. (a) Highlight the energy potential associated with any four types of renewable energy sources with examples.
(b) Discuss the advantages and limitations of these sources.
6. Calculate the angle made by beam radiation with the normal to a flat collector on December 1 at 9.00AM, solar time for a location at 28°35' N. The collection is tilted at an angle of latitude plus 10°, with the horizontal and is pointing due south.
7. Explain the followings:
 - (a) Beam and diffuse solar radiation
 - (b) The hour angle
 - (c) The Sun's declination
 - (d) The latitude and longitude
8. (a) Highlight the energy potential associated with any four types of renewable energy sources with examples.

- (b) Discuss the advantages and limitations of these sources.
9. Explain the following with neat sketches:
- sunshine recorder
 - Eppley pyranometer
 - Pyrheliometer
10. Discuss in detail about solar radiation on tilted surfaces.
- 11 (a) Write short notes on the following:
- Solar constant
 - Local solar time
 - Surface azimuth angle.
- (b) Determine the local solar time and declination at a location latitude 23°01'
- N, longitude 77°03' E at 12.30 IST on June 19. Equation of time correction is given from standard table to be = - (1' 01").
12. What is the principle of solar photo-voltaic cell's power generation?
13. Highlight the energy potential associated with any four types of renewable energy sources with examples.
14. Discuss the advantages and limitations of renewable energy sources.

UNIT – II (SOLAR ENERGY COLLECTION)

OBJECTIVE TYPE QUESTIONS

- Concentration ratio=

 - $$\frac{\text{Area of the concentrator Aperture}}{\text{Energy absorbing Area of the receiver}}$$
 - $$\frac{\text{Energy, Absorbing Area of the receiver}}{\text{Area of the concentrator Aperture}}$$
 - $$\frac{\text{Diameter of concentrator Aperture}}{\text{Energy absorbing Area of the receiver}}$$
 - $$\frac{\text{Circumference of the concentrator Aperture}}{\text{Energy, Absorbing Area of the receiver}}$$

- What is heliostat?
- What is fill factor?
- Expand CPC.
- For a concentration system the cost per unit area of solar collecting surface is _____ thus that for plates collectors.

6. To be fully effective Fresenel lens must be continuously aligned with the sun in two directions namely _____
7. the CPC is also known as _____ collector.
8. Unlike the single parabolic through reflector, the CPC is _____
9. A central receiver with a fill factor of 40% means _____

UNIT – II (SOLAR ENERGY COLLECTION)

ESSAY TYPE QUESTIONS

1. Explain the following with sketch:
 - a). Flat plate arrays of solar cell modules
 - b) solar cell connecting arrangements
2. Explain with a neat sketch, the operation of a central tower receiver system for power generation.
3. Explain the operation and of solar pond for electric power generation with a line diagram.
4. Describe a passive solar space heating system
5. Explain line focusing collectors in detail with a neat diagram..
6. Derive the necessary equations for thermal analysis of flat plate collector and useful heat gained by the fluid.
7. With the help of neat sketch, describe a solar heating system using water heating solar collectors. What are the advantages and disadvantages of this method?
8. What are the different approaches of thermal electric conversion system from Solar energy?
9. Write short notes on a) Solar distillation b) Solar Pumping c) Solar Cooking
10. What is the principle of Photo Voltaic power generation ?

UNIT – II (SOLAR ENERGY STORAGE AND APPLICATIONS)

OBJECTIVE TYPE QUESTIONS

1. 2000 Sq.m solar pond can generate approximately kw

a)	20kw	b)	10kw
a)	30kw	b)	d)
40kw			
2. Fill factor value in a silicon cell is

a)	1	b)	0.8
a)	c)	b)	d)
0.6	0.4	0.6	0.4
3. Conversion efficiency in a PV cell

$$\begin{array}{ll}
 \text{a) } \frac{J_L E_g}{e P_{sun}} \times VF \times FF & \text{b) } \frac{e P_{sun}}{J_L E_g} \cdot VF \cdot FF \\
 \text{c) } \frac{P_{sun}}{J_L E_g} \quad \frac{VF}{FF} & \text{d) } \frac{J_L E_g}{e P_{sun}} \quad \frac{FF}{VF}
 \end{array}$$

4. A single converter cell is called_____
 5. A combination of photo voltaic cell is called_____
 6. The best known application of photovoltaic cell for electrical power generation has been_____
 7. Define photovoltaic effect.
 8. Solar PV systems can produce only during sunshine, if it is to be used during non-shine hours, it requires_____
 9. The pure water can be obtained by distillation in the simplest solar still, generally known as_____
 10. The performance of a solar still is generally expressed as the quantity of water produced by_____
 11. the main disadvantage is photovoltaic_____
 12. The photovoltaic water pumping system essentially consists of
 - i._____
 - ii._____
 - iii._____
 - iv._____
- and

UNIT – II (SOLAR ENERGY STORAGE AND APPLICATIONS)

ESSAY TYPE QUESTIONS

1. Discuss the advantages and disadvantages of horizontal over vertical axis Wind turbines.
2. With the line diagram, explain how power can be generated from photo voltaic cells.
3. What is the principle of solar photo-voltaic cell power generation?
4. What is central receiver system.
5. What is solar farm?

UNIT –III (WIND ENERGY)

OBJECTIVE TYPE QUESTIONS

1. Cost of wind power generation comparable to _____ and lower than _____
 - a) Nuclear power and solar power
 - b) Solar power and nuclear power
 - c) Hydro power and thermal power
 - d) Thermal power and diesel power
2. Isovents means
 - a) contours of constant wind power
 - b) contours of constant wind velocity
 - c) contours of wind power & wind velocity
 - d) contours of (wind velocity)
3. Wind Energy Estimation =

a) $\int \eta_m C_{pe} A v^3 \delta T$	b) $\int \eta_m C_{pe} A v^2 \delta T$
c) $\int \eta_m C_p A v^3 \delta T$	d) $\int \eta_m C_p v \delta T$
4. Icing problem on blades means
 - a) Presence of salt only
 - b) Presence of moisture only
 - c) Presence of salt or dust
 - d) Presence of dust only
5. Available wind power

a) $\frac{1}{9} \rho \Pi D^2 v^3$	b) $\frac{1}{7} \rho \Pi D^2 V^3$	c) $\frac{1}{8} \rho \Pi D v^3$	d) $\frac{1}{8} \rho \Pi D^2 v^3$
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6. Between 30^0 N and 30^0 S air circulation is known as
 - a) Rossby circulation
 - b) Coriolis circulation
 - c) Prandtl circulation
 - d) Hadley circulation
7. Mention one main advantage (in terms of generator location) of VAWT over HAWT.
8. Define Yaw Active
9. HAWT of lift type uses
 - a) multi blade
 - b) slender blade
 - c) two blade
 - d) single blade
10. Company manufacturing WEC devices

a) Tata	b) Birla	c) Philips	d) Suzlon
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11. Solidity ratio =

a) $\frac{\text{Blades swept Area}}{\text{Blade Area}}$	b) $\frac{\text{Blade Area}}{\text{Blades swept Area}}$
c) $\frac{\text{Wind V tip}}{\text{wind V rotor}}$	d) $\frac{\text{Wind V rotor}}{\text{wind V tip}}$

12. $P_{\max} =$

a) $\frac{8}{27} \rho A^2 V_i^3$

b) $\frac{8}{27} \rho A V_i^2$

c) $\frac{8}{27} \rho A V_i^3$

d)

$$\frac{8}{27} \rho^2 A V_i^2$$

13. General Energy equation for steady state flow

a) $P_i + \rho \frac{V_i^2}{2g_c} = P_a + \rho \frac{V_a^2}{2g_c}$

b) $P_i + \frac{\rho_i^2}{2g_c} = P_a + \frac{\rho_a^2}{2g_c}$

c) $P_i + \rho \frac{P_a V_i^2}{2g_c} = P_a + \rho \frac{V_a^2}{2g_c}$

d) $P_i + \frac{P_a^2}{2g_c} = P_a + \rho \frac{V_a^2}{2g_c}$

14. There are two main families of wind turbines _____ pumps and
_____ generators.

15. Expand TSR_____

16. TSR_____

17. The overall conversion efficiency, of and aero generator is _____

18. Wind energy conversion devices are commonly known as_____

19. The combine of wind and generator referred to as_____

20. The power in the wind can be computed by using the concept of

UNIT – III (WIND ENERGY)

ESSAY TYPE QUESTIONS

1. Derive an expression for power Coefficient of Wind energy conversion system.
- 2.. (a) Explain the factors to be considered in the design of wind turbine.
(b) Describe the following:
 - i. power control
 - ii. over speed control
4. Explain the operation and control of horizontal axis wind turbine generator unit with neat sketch.
5. Briefly explain the followings:
 - i. Stalling
 - ii. Squall
 - iii. Choice of tip speed ratio & solidity

6. What are various factors to be considered while locating wind energy conversion systems.
7. Explain how a wind farm is controlled? What are the hierarchical control levels?
8. Enumerate the advantages and disadvantages of wind power.
9. Write a short note on potential wind power in India.
10. List few companies manufacturing WEC devices.
11. Explain briefly the formation of wind and the energy potential of it.

UNIT – III (BIO-MASS)

OBJECTIVE TYPE QUESTIONS

1. An example for Bio-liquid
 - a) Methane
 - b) Ethanol
 - c) Soya
 - d) Euphorbia
2. To use Dual-fuel, we require
 - a) Electric heater
 - b) D.C. Motor
 - c) Solar energy
 - d) Induction motor
3. Producer gas consists of
 - a) Co and H₂
 - b) H₂ and O₂
 - c) Co₂ and H₂
 - d) Co and O₂
4. Bio-gas consists of
 - a) Ethanol and H₂
 - b) Methanol and Co₂
 - c) Methane H₂
 - d) Ethanol and O₂
5. Bio-chemical is
 - a) Thermal chemical
 - b) Action of Bacteria
 - c) Action of O₂
 - d) High energy process
6. Depth in semi thermal areas of Geo-thermal
 - a) 40°C per km
 - b) 100°C per km
 - c) 70°C per km
 - d) 150°C per km
7. One tonne of sugar approximately gives Biomass
 - a) 520 liters
 - b) 700 liters
 - c) 900 liters
 - d) 300 liters
8. Bio-gas has following draw back
 - a) consists of H₂O
 - b) consists of H₂S
 - c) Consists of AlCl
9. Define Anaerobic Digestion.
10. Using bio-gas in industries will curtail the consumption of _____
11. Methane bacteria work best at a temperature between _____

12. The major nutrients required by the bacteria in the digester are C, H₂ and _____
13. The general equation for an aerobic digestion is _____
14. Bio-gas technology is concerned to _____
15. Define Gasification _____
16. Bio-chemicals conversion takes two forms one is anaerobic digestion and the other is _____
17. Fermentation is the breakdown of _____ in organic compound under the influence of _____
18. Methane is a clean gas with _____ value.

UNIT – III (BIO-MASS)

ESSAY TYPE QUESTIONS

1. With a help of a neat sketch explain the working principle of any one type of biogas plant?
2. What are the techniques suggested for maintaining the biogas production? Explain.
3. What are the main applications of biogas?
4. How are biogas plants classified? Explain the dome with a sketch type plant.
5. What are the various phases of anaerobic digestion in a Biogas plant?

Discuss

- them in brief.
6. What are the different inputs which produce Biogas? List out the factors affecting bio-digestion.
 7. Give a neat sketch of Biogas production plant for domestic use for a family of 5-6 persons.
 8. Explain “Energy Plantation” and state its advantages and disadvantages.
 9. How Bio-gas can be used as a fuel in I.C. engine? Explain the working of such engine with neat sketch.
 10. How are Bio-gas plants classified? Explain the dome with a neat sketch type plant.
 11. Explain with a neat sketch the double chamber bio-gas digester. How it differs from single chamber digester? Are there any advantages of double chamber digester? If any, state them.
 12. What are the parameters on which bio-gas production depends? Discuss them in

- brief.
13. What are the different inputs which produce Biogas? List out the factors affecting bio-digestion.

UNIT –IV

OBJECTIVE TYPE QUESITONS

1. Draw T.S. diagram of vapour dominated system
2. Draw T.S. diagram of liquid dominated system
3. Efficiency of Geo-thermal
 - a) 15% b) 25% c) 5% d) 35%
4. Magma is commonly present at depths greater than _____
5. The average temperature at a depth of 10 km is about _____
6. Expand HDR_____
7. Dry geothermal fields means_____
8. _____ is almost always present in geo-thermal field. If present in excess, causes harmful effect on bearings.
9. Overall efficiency for power production is about _____ from geo-thermal.
10. Geo-thermal energy is _____ in its use.
11. Hot water resources are _____ temperature.
12. Being cycle is an example for _____ system.

UNIT – IV

ESSAY TYPE QUESITONS

1. Explain Hot Dry rocks (petrothermal) resources of geothermal energy and how they can be exploited as a source of energy.
2. Explain vapour dominated hydrothermal power plant with neat sketch and its representation on T-S diagram.
3. Describe various disadvantages and operational problems associated with geothermal energy.
4. Explain Hot Dry rocks (petrothermal) resources of geothermal energy and how they can be exploited as a source of energy.
5. Explain vapour dominated hydrothermal power plant with neat sketch and its representation on T-S diagram.
6. Describe various disadvantages and operational problems associated with geothermal energy.
7. Describe a vapour dominated or dry steam field.

8. A vapour dominated system of 100MW capacity uses saturated steam with a shut off pressure of 30 bar and enters turbine at 5.0 bar and condenses at 0.15 bar. Polytropic efficiency of turbine is 80%, generator - turbine combined mechanical and electrical efficiency is 90% water output temperature from cooling tower is 200C. and reinjection occurs prior to cooling tower. Calculate:
 - i. Steam required.
 - ii. Heat rate.
 - iii. Plant efficiency and
 - iv. Cooling water rate.
9. Describe a Binary cycle system for liquid dominated system.
10. What are the limitations of a flashed steam system?
11. Explain Hot Dry rocks (petrothermal) resources of geothermal energy and how they can be exploited as a source of energy.
12. Explain vapour dominated hydrothermal power plant with neat sketch and its representation on T-S diagram.
13. Describe various disadvantages and operational problems associated with geothermal energy.

UNIT -V

OBJECTIVE TYPE QUESTIONS

1. In open system the following working fluid is used.

a)	Propane	b)	Ammonia	c)	Freon	d)	sea water
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2. In closed system the following working fluid is required

a)	NH_5	b)	NH_3	c)	NH_4	d)	NH_6
----	---------------	----	---------------	----	---------------	----	---------------
3. Closed cycle produces following by- product

a)	not applicable	b)	NH_3
c)	Propane	d)	fresh water
4. Open cycle produces following by- product

a)	fresh water	b)	NH_3
c)	not applicable	d)	Freon
5. Anderson cycle is known as

a)	open	b)	closed	c)	semi-closed	d)	not applicable
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6. The potential energy density per unit area (wave energy)

a)	$1/2 \rho g a^2$	b)	$1/4 g \rho a^2$
----	------------------	----	------------------

- c) $1/6 g \rho a^2$ d) $1/8 \rho ga^2$
7. The following is known as a wave energy conversion device
 a) Dolphin b) Anderson c) klood d) claude
8. Expand DOWA or SSPP
9. Yearly power generation is double cycle (tidal energy) is
 a) $\int_0^t \frac{\rho Q h dt}{75} \times \eta_0 \times 0.736 \times 705$ b)
 $\int_0^t \frac{\rho h dt}{75} \times \eta_0 \times 0.736 \times 705$
 c) $\int_0^t \frac{\rho Q h dt}{75} \times \eta_0 \times 0.776 \times 705$ d)
 $\int_0^t \frac{\rho Q h dt}{705} \times \eta_0 \times 0.736 \times 705$
10. Overall efficiency in OTEC is
 a) 25% b) 2.5% c) 12% d) 40%
11. Lambert's law is
 a) $I^x = I_o e^{-kx}$ b) $I^x = I_o e^{kx}$
 c) $I^x = I_o e^{1/kx}$ d) $I^x = I_o e^{-1/kx}$
12. Deposition and growth of micro originations on the cooling sides of condenser is known as (only one answer is permitted) _____
13. Best site for OTEC is
 a) 20^0N and 20^0S latitude b) 30^0N and 30^0S latitude
 c) 40^0N and 40^0S latitude d) 20^0N and 30^0S latitude
14. MW = 1
 $\rho = 1010$
 $\Delta T = 19^0C$
 $C_p = 4200 J/kg$
 Calculate Q.
15. Ocean thermal energy conversion is based on utilization of temperature difference between surface _____ 0C and _____ km below _____ 0C (two points must be correct to get full marks).
16. On full moon, tides of following occurs
 a) Neap b) spring c) High d)
 Low

17. Average tidal lower (single basin) permit area
 a) $0.115 R^2$ b) $0.125 R^2$ c) $0.225 R^2$ d) $0.215 R^2$
18. Practical power due to tidal power
 a) 25% of Theoretical power b) 45% of Theoretical power
 c) 50% of Theoretical power d) 60% of Theoretical power
19. Expand SSPP _____
20. Expand OTEC _____

UNIT – V

ESSAY TYPE QUESTIONS

1. (a) Explain the working of ocean thermal energy conversion (OTEC) plant.
 (b) Discuss the various equipment for the establishment of an off shore OTEC system.
2. Discuss the methods of harnessing wave energy.
3. (a) How are tides formed? Show by sketches the methods of harnessing the energy potential associated with ocean tides.
 (b) In any estuary, which is being developed for tidal power generation during the tide cycle the observed difference between the high and low water of the tide was 4.3m. It is estimated that the estuary's area is 0.45 sq. km which can generate power for 3 hours in each cycle. Assuming the average available head to be 5m, and the overall efficiency of generation to be 65% calculate:
 i. The power in kW at any instant and
 ii. The total energy in the year ($= 1025 \text{ kg/m}^3$ for sea water).
4. (a) Draw a neat layout diagram of a typical OTEC plant showing salient features and explain the principle of operation.
 (b) In a Claude's cycle of OTEC conversion producing 100 KWpower, warm water at 270C. is admitted into flash-evaporator, where a pressure corresponding to saturation temperature of water at 250C is maintained. Saturated vapor is then sent through a turbine having a polytropic efficiency of 80%. The pressure in the direct contact condenser is maintained at a value corresponding to saturation

- temperature of water at 150C by means of deep sea cold water at 130C calculate.
- Turbine mass flow rate of vapor
 - Mass flow rate of deep sea cold water.
 - Mass flow rate of warm water.
 - Gross cycle efficiency on the basis of energy available from warm surface water.
- Also explain the reasons of obtaining low value of efficiency. [8+8]
- Discuss the advantages and limitations of wave energy conversion. [16]
 - (a) With reference to typical examples, explain the nature and magnitude of energy possessed by ocean tides.
 - (b) The observed difference between the high and low water tide is 0.85 meters, for a proposed tidal site. The basin area is about 0.5 sq. Km which can generate power for 3 hours in each cycle. The average available head is assumed to be 8 meters and the overall efficiency of generation to be 75%. Calculate the power in HP at any instant and the yearly power output.
 - (a) What is the basic principle of OTEC? Discuss the advantages of the closed cycle system over open cycle system.
 - (b) The efficiency of power plant working on OTEC system is very less. However, the secondary advantages make it commercially attractive. Discuss.
 - How are ocean waves formed? Explain with a schematic diagram how this energy can be tapped.
 - (a) With reference to typical examples, explain the nature and magnitude of energy possessed by ocean tides.
 - (a) With a schematic diagram, explain briefly the working of open cycle OTEC plant
 - (b) What are its advantages and limitations of open system over closed cycle system.
 - Explain in brief the energy potential of ocean waves and methods of harnessing the wave energy.
 - (a) Explain the various components of Tidal power plants. Discuss the single

basin retaining dam tidal power generation method.

13. Discuss the various wave energy conversion devices.
14. Explain the operation of a closed OTEC system.
15. Discuss the advantages and disadvantages compared to open cycle OTEC plant.
16. What are present trends in micro-hydro technologies?

UNIT –VI

OBJECTIVE TYPE QUESTIONS

1. A _____ is forced into the MHD channel at high speed and high temperature through a nozzle.
2. Conversion efficiency of MHD-steam hybrid plant may be around _____
3. Hot flue gas at but _____ used as MHD, generator working fluid in MHD generation.
4. The direct conversion of heat energy into electric energy based on the _____ effect.
5. The Seebeck coefficient unit is in terms of _____
6. A thermal converter is a form _____
7. If a metal is heated, electrons are emitted from it, this is _____
8. The energy required to extract an electron from the metal is an important parameter, known as _____ function of the metal.
9. A major problem is to design a thermionic converter that would withstand the _____ and combination gases.
10. Expand MHD _____
11. The inlet temperature of MHD is about _____
12. In a closed cycle system the carrier gas operates in a form of _____ cycle.
13. What is Seebeck effect _____
14. What is Thomson effect _____
15. What is Peltier effect _____
16. What is Joule effect _____

UNIT – VI

ESSAY TYPE QUESTIONS

1. Explain the need for the Direct Energy Conversion.
2. Describe Carnot Cycle. Explain its limitations.
3. What is Hall Effect? How can it be used to generate electricity?
4. What is a fuel cell and what are its main advantages?
5. What are the chemical reactions taking place at Anode and Cathode of a
(a) Alkaline type fuel Cell (b) Acidic type fuel Cell
6. Describe the basic principle of operation of an MHD generator.
7. Describe the basic principle of operation of an MHD Accelerator.
8. What are the major advantages and limitations of MHD generating system?

Sreenidhi Institute of Science and Technology
(An Autonomous Institution)

**Code No: 4A715
(FN)**

Date: 20-Dec-17

B.Tech IV-Year I-Semester External Examination, Dec - 2017 (Regular)
NON CONVENTIONAL SOURCES OF ENERGY (EEE)

**Time: 3 Hours
Max.Marks:70**

Note: a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only,
otherwise it will not be valued.
c) Missing data can be assumed suitably.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS.

- | | | |
|----|------------------------------------------------------------|------|
| 1 | Define extra terrestrial and terrestrial solar radiation. | [2M] |
| 2 | What are concentrating collectors? | [2M] |
| 3 | Write short notes Bertz criteria. | [2M] |
| 4 | Write limitations of geo thermal energy. | [2M] |
| 5 | Write advantages of wave energy conversion. | [2M] |
| 6 | Explain in brief about Hall Effect. | [2M] |
| 7 | Define Beam solar radiation. | [2M] |
| 8 | List out types of bio gas digesters. | [2M] |
| 9 | Write limitations of tidal energy conversions. | [2M] |
| 10 | Write in brief about materials used in bio gas generation. | [2M] |

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- | | | |
|---|------------------------------------------------------------------------------------------------------------------|-------|
| 1 | a) Define solar radiation and solar irradiance. Describe the influence of irradiance by wavelength of radiation. | [5M] |
| | b) Explain any one instrument in detail for measurement of solar radiation. | [5M] |
| 2 | a) What are the advantages and disadvantages of concentrating collectors over flat plate collectors? | [6M] |
| | b) Explain main components of flat plate solar collectors with neat sketch. | [4M] |
| 3 | a) Discuss the salient features of horizontal axis wind turbines and vertical axis wind turbines. | [6M] |
| | b) List and briefly discuss the factors that influences the selection of site of land based wind mill. | [4M] |
| 4 | a) List and explain different forms of geothermal energy. | [6M] |
| | b) Write advantages and disadvantages of geothermal energy. | [4M] |
| 5 | Explain various methods of tidal power generation with neat | [10M] |

sketches.

- 6 Write short notes on:
 a) MHD generator. [5M]
 b) Fuel cell. [5M]
- 7 a) Explain about Solar constant in detail. [2M]
 b) Describe any one application of solar energy. [4M]
 c) Explain in brief about principles of Bioconversions. [4M]
- 8 a) Write short notes factors influencing establishing a geothermal plant. [4M]
 b) Discuss applications of OTEC systems. [4M]
 c) Explain Faraday's law. [2M]

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Intellectual Property Rights

5GC49

Department of Biotechnology



Sreenidhi Institute of Science and Technology

(An Autonomous College under JNTUH, Approved by AICTE and Accredited by
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INTRODUCTION

Intellectual property right is not a new concept to Science & Technology. It is a product of industrial world. It became famous among scientists and laymen equally due to the advancement in the scientific researches and marketing of its products. Some of the concerns about modern technology have focused on the nature, impact and legitimacy of IP rights as they are applied to technology and to inventions. Today most of the Industries, Institutes and Universities have their own expert people or groups to deal with their own IP problems.

Intellectual Property Rights is a collective term given to a number of different types of legal rights granted by each country. It can be considered as recognition for the contribution of the inventor, by the country to the development of a new technology, process or product. It is protected against the unauthorized exploitation for the industrial or commercial purpose.

Deals with Introduction to IPR followed by discussion on individual type of IPR namely, Patents, Trademarks, Trade Secrets, Industrial Designs, Integrated Circuits, Copyrights and related Rights.

Unit VI discusses topics like WIPO, GATT, TRIPS, Indian IPR Legislations and Indian IP Policy. It concludes with Case Studies related to different types of IP.

INTELLECTUAL PROPERTY RIGHTS

L T P C
2

1

Unit I: Introduction: Discovery, Creativity, Innovation, Invention, Need for IPR, Types of IPR, Genesis & development of IPR in India

Unit II: Patents: Definition, Scope, Protection, Patentability Criteria, Types of Patents (Process, Product & Utility Models), Case studies on Patents (Basmati Rice, Turmeric, Neem), Software Patenting.

Unit III: Patent Searching & Filing: Types of Searching, Public & Private Searching Databases, Drafting & Filing of Patent applications, Patent Cooperation Treaty (PCT), Patent infringement.

Unit IV: Types of IPR-I: Copyrights – Definition, granting, infringement, searching & filing, distinction between copy rights and related rights; Trade Marks - role in commerce, importance, protection, registration, Domain names; Case Studies.

Unit V: Types of IPR-II: Trade Secrets, Unfair competition; Industrial Designs – Scope, protection, filing, infringement; Semiconductors, Integrated Circuits & Layout design; Geographical Indications & Appellations of Origin; Case Studies.

Unit VI: International and National Conventions & Treaties: Overview, WTO, GATT, TRIPS, WIPO, Berne Convention, Universal Copyright Convention, the Paris Convention, Madrid Protocol, Rome convention, Budapest Treaty, Hague agreement, Locarno agreement, Indian Patents Law, Copyright Law, Trademark Law, Trade secret Law, GI Law, Designs Act.

Text Book:

1. Deborah E. Bouchoux, Intellectual Property for Paralegals – The law of Trademarks, Copyrights, Patents & Trade secrets, 3rd Edition, Cengage learning, 2012
2. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property, Eastern Book Company, Lucknow, 2009.

References

1. M. M. S. Karki , Intellectual Property Rights: Basic Concepts, Atlantic Publishers, 2009
2. Neeraj Pandey & Khushdeep Dharni, Intellectual Property Rights, Phi Learning Pvt. Ltd
3. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 2006.
4. B. L. Wadehra. Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000.
5. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010

LECTURE SCHEDULE FOR IPR

Unit	Total No. of periods	No. of periods allotted	Topics
I	5	4-5	Invention and Creativity, Basic Types of Property, Need for Protection of IPR
II	5	4-5	Types Patents , Patentability Criteria, Case studies on Patents
III	5	5-6	Types of Searching , Drafting & Filing of Patent applications, PCT), Patent infringement.
IV	5	3	Copyrights and Related Rights
		2	Trade Marks
V	5	2	Trade secrets
		2	Industrial Designs and Integrated Circuits
		1	Geographical Indications
VI	5	2	WIPO Mission and Activities ,GATT & TRIPS, Indian position on WTO and strategies
		1	Indian IPR legislations- commitments to WTO
		2	Indian Patents Law, Copyright Law, Trademark Law, Trade secret Law, GI Law, Designs Act.

INTELLECTUAL PROPERTY RIGHTS

Multiple Choice Questions:

1. Intellectual property (IP) refers to property created with
 - a) Use of Money
 - b) Use of Physical Resources
 - c) Use of Intellect
 - d) Use of Property

2. Intellect refers to
 - a) Creation of art
 - b) Creation of the mind
 - c) Creation of the brain
 - d) Creation of soul

3. Intellectual property law is a law that involves
 - a) The creation, vesting and the use of the IP rights
 - b) The creation and the use of the IP rights
 - c) The vesting and use of the IP rights
 - d) Only IP rights

4. Industrial property rights refer to vesting of rights over matter that will be useful for
 - a) Industries
 - b) Commerce
 - c) Business
 - d) Industries and in Commerce

5. Industrial property rights covers / includes
 - a) Patents and Trademarks
 - b) Industrial designs and Geographic Indicators
 - c) Patents, Trademarks, Industrial designs and Geographic Indicators
 - d) Trademarks, Industrial designs and Geographic Indicators

6. Copy right refers to merely
 - a) Literary
 - b) Artistic work
 - c) Geographic Indicators
 - d) Literary and Artistic work

7. The first Indian law on IPR was
 - (a) Indian Trade and Merchandise Marks Act
 - (b) Indian Patents and Designs Act
 - (c) Indian Copy Right act
 - (d) Indian Design Act

8. Who issues patent
 - a) Government Office
 - b) Private Office
 - c) Self declaration
 - d) None

9. What is a patent?
 - a) A document issued upon application by a Government office
 - b) Right of the organization
 - c) An application filed to a Government office
 - d) Government document

10. A patent describes
 - a) An Invention
 - b) An Inventor
 - c) An Organization
 - d) Creation

11. The right created by patent is a
a) Family right b) Property right
c) Public right d) Monopoly right
12. Patents are given only for
a) An Organization b) An Inventor
c) Inventions d) Creation
13. An invention may relate to a
a) Product b) process
c) Product and process d) All of the above
14. The protection conferred by the patent is
a) Permanent b) Period of time
c) Statutorily specified period of time d) Lifelong
15. In order to patent an invention one need to prove
a) Novelty b) Non-obviousness
c) Utility d) Novelty, Non-obviousness and Utility
16. Novelty essentially means that the invention should be
a) Great and new b) New
c) Different d) Similar
17. What is not new and exist already in public domain is called
a) Art b) Future Art c) Past Art d) Prior Art
18. Non-obviousness part of the patent is assessed by
a) Any skilled person b) Skilled in related art
c) Any artist d) One skilled in the same art

Key: 1-c; 2-b; 3-a; 4-d; 5-c; 6-d; 7-a; 8-a; 9-a; 10-a; 11-d; 12-c; 13-c; 14-c; 15-d; 16-b; 17-d; 18-d.

1. Copyright covers _____ in case of literary, dramatic, musical or artistic work.
a) 60 years
b) Lifetime of authors plus 60 years
c) Lifetime of legal heir plus 60 years
d) 50 years
2. In case of cinematograph films and sound recording copyright subsists for a period of
a) 50 years from publication b) 70 years from publication
c) 60 years from publication d) 80 years from publication
3. Deceptive similarity in trademark is considered when the
a) Mark lacks distinctiveness b) Mark has distinctiveness
c) Mark should be similar d) Mark should be identical

4. Phonetic similarity in trademark is said to occur if the
a) Names are similar b) Names and Sounds are similar
c) Sounds are similar d) None of the above
5. A registered trademark is valid for a period of
a) 10 years b) 8 years c) 9 years d) 12 years
6. Copyright law deals with the rights of protecting
a) Creativity b) Ingenuity
c) Creativity and Ingenuity d) Art
7. Copy right protection is irrespective of
a) Quality of work b) Quantity of work
c) Readability of work d) Sales of work
8. The law governing copyright in India is
a) The Copyright Act, 1957 and The Copyright Order of 1991
b) The Copyright Act, 1957 c) The Copyright Order of 1991
d) The Copyright Order of 1994
9. The Copy right Act, 1957 provides for exclusive rights to
a) Authors b) Authors and other owners of original work
c) Publishers d) Printers
10. Is registration a mandatory requirement under copyright act?
a) Yes b) No
c) May be d) Personal opinion
11. Term of protection for Copyright varies based on whether
a) the author is natural or a legal person
b) the publisher is natural or a legal person
c) the printer is natural or a legal person
d) Same irrespective of the author or legal person
12. Trademarks provides
a) The identity of a product b) The origin of a product
c) The identity and origin of a product d) None of the above
13. A trademark can be defined as any sign that
a) Individualizes the goods of a given enterprise
b) Distinguishes them from the goods of its competitors.
c) Just a mark
d) Individualizes the goods of a given enterprise and distinguishes them from the goods of its competitors.
14. The law with reference to trademarks in India is governed by
a) Trade and Merchandise Marks Act b) Copyright Act
c) General Agreement of Tariffs and Trade d) Trade Act
15. The attributes that a trademark should possess are
a) It should be an invented work b) It should be distinctive

- c) It could be a repeat of old invented work d) It should be distinctive and
16. A trademark should not possess the following attribute
a) It should be deceptively similar to any other existing mark
b) It should not be deceptively similar to any other existing mark
c) It could be similar to any other existing mark
d) It could be identical to any other existing mark
17. The rights once acquired in a trademark are
a) Proprietary in nature
b) Open for anyone to use
c) Government can permit others to use it
d) Private property

Key: 1-b; 2-c; 3-a; 4-b; 5-a; 6-c; 7-a; 8-a; 9-b; 10-b; 11-a; 12-c; 13-d; 14-a; 15-d; 16-b; 17-a;

II. Short Answer / Long Answer Questions

1. What is Industrial Property? Explain types
2. What are Intellectual property Rights?
3. What is the need for Intellectual property protection?
4. Define the term patent?
5. Brief the procedure to apply for a Patent?
6. What forms of IP protection can you get for your Invention?
7. What is the role of a Patent lawyer in patenting?
8. What are process & Product patents?
9. Give the general structure of a patent?
10. What are the criteria for an Invention to be patented?
11. Why does the Government encourage filing of patents?
12. Is there an International / Global patent? Explain
13. What are Trade secrets? How are they different from Patents?
14. Write an Overview of Copyrights & Related Rights
15. What are trademarks? Explain the essential requirements to get a Trade mark
16. What are Geographical Indications? How do you differentiate GI from other IP?
17. Differentiate between Discovery and Invention

I. Multiple Choice Questions:

1. Hague Agreement is associated with
 - a) Deposit of Microorganisms
 - b) Deposit of Plant varieties
 - c) Deposit of Industrial Designs
 - d) Deposit of Trademarks
2. Budapest Treaty is associated with
 - a) Deposit of Microorganisms
 - b) Deposit of Plant varieties
 - c) Deposit of Patents
 - d) Deposit of Trademarks
3. Paris Convention focus was on the protection of _____ which was held in year _____.
 - a) Industrial Property in the year 1883
 - b) Intellectual Property in the year 1886
 - c) Industrial Property in the year 1886
 - d) Any Property in the year 1883
4. Paris Convention protected which of the main properties
 - a) Patents and Trademarks
 - b) Patents, Trademarks and Industrial Designs
 - c) Patents and Industrial Designs
 - d) Trademarks and Industrial Designs
5. Paris convention was entered into force in the year _____ with _____ member states.

a) 1888 with 18 member states	b) 1884 with 16 member states
c) 1884 with 14 member states	d) 1888 with 14 member states
6. India became a member of the Paris convention in the year
 - a) 1999
 - b) 1997
 - c) 1996
 - d) 1998
7. Berne convention is associated with
 - a) Protection of Literary works
 - b) Protection of Literary and Artistic
 - c) Protection of Artistic works
 - d) Protection of Trademarks
8. International Copy right Act was passed in the year
 - a) 1886
 - b) 1888
 - c) 1887
 - d) 1889
9. United International Bureaux for the Protection of IP (BIRPI) is based in
 - a) Berne, Switzerland
 - b) Rome, Italy
 - c) Paris, France
 - d) Madrid, Spain
10. Berne Convention aim is to ensure
 - a) Protection of Artistic works
 - b) Protection of Trademarks
 - c) Conservation of wildlife and natural habitats
 - d) Conservation of wildlife

11. The Madrid Agreement is related to
a) Trade secrets b) Literary work
c) Industrial designs d) Trademarks
12. The Madrid agreement was essentially a mechanism to
a) Standardize systems related to the registration of trade secrets
b) Standardize systems related to the registration of trademarks
c) Standardize systems related to the registration of industrial designs
d) Standardize systems related to the registration of artistic work
13. Rome convention for the protection of
a) Performers and broadcasting organizations
b) Performers and producers of phonograms
c) Performers, producers of phonograms and broadcasting organizations
d) Producers of phonograms and broadcasting organizations
14. WIPO stands for
a) World Industrial property rights
b) World Innovation property organization
c) World Intellectual property organization
d) World Intellectual property rights
15. GATT stands for
a) General Agreement on Tariffs and Trade
b) General Agreement on Trademark and Trade secrets
c) General Agreement on Turnover and Turn loss
d) General Agreement on Treaty and Treaties
16. GATT is established during
a) Second World War b) First world war
c) Iraq war d) No war

Key: 1-c; 2-a; 3-a; 4-b; 5-c; 6-d; 7-b; 8-a; 9-a; 10-c; 11-d; 12-b; 13-c; 14-c; 15-a; 16-a.

1. TRIPS stand for
a) Trade regulated Intellectual property System
b) Trade regulated Industrial property rights
c) Trade associated rights for Intellectual property system
d) Trade related aspects of Intellectual property rights
2. TRIPS is a treaty administered by the
a) UNISCO b) UNICEF c) UNO d) WTO
3. TRIPS was negotiated at the end of
a) Paris Convention b) Berne Convention
c) Uruguay Round of GATT d) Rome Convention

4. WTO aim is to ensure
 a) International trade b) Domestic protectionism
 c) International trade devoid of Domestic protectionism d) No
 trade
5. Under the proposed WTO regime what should flow unhampered between member states
 a) Goods, Capital, and Services b) Goods and Capital
 c) Capital and Services d) Goods and Services
6. Article 27 (1) of TRIPS covers
 a) Requires the availability of patents for any invention whether products or processes in all fields of technology
 b) Provides for exclusion from patentability inventions to protect order public or morality including to protect human, animal or plant life or health or to avoid serious prejudice to environment.
 c) Provides that members may exclude from patentability diagnostic, therapeutic and surgical methods for the treatments of humans or animals.
 d) All of the above
7. Article 27 (2) of TRIPS covers
 a) Requires the availability of patents for any invention whether products or processes in all fields of technology
 b) Provides for exclusion from patentability inventions to protect order public or morality including to protect human, animal or plant life or health or to avoid serious prejudice to environment.
 c) Provides that members may exclude from patentability diagnostic, therapeutic and surgical methods for the treatments of humans or animals.
 d) All of the above
8. Article 27 (3) of TRIPS covers
 a) Requires the availability of patents for any invention whether products or processes in all fields of technology
 b) Provides for exclusion from patentability inventions to protect order public or morality including to protect human, animal or plant life or health or to avoid serious prejudice to environment.
 c) Provides that members may exclude from patentability diagnostic, therapeutic and surgical methods for the treatments of humans or animals.
 d) All of the above
9. PCT stands for
 a) Property co-operation treaty b) Patent co-operation treaty
 c) Product co-operation treaty d) Process co-operation
 treaty

Key: 1-d; 2-d; 3-c; 4-c; 5-a; 6-a; 7-b; 8-c; 9-b

II. Short Answer / Long Answer Questions

1. What is the role of World Trade Organization?
2. Write a brief account on GATT
3. What is TRIPS agreement
4. What are the Activities of WIPO?
5. Write a brief account on Patent Cooperation Treaty
6. Write an essay on International agreements, conventions & multilateral treaties relevant to IP?
7. Write about the Indian Position on WTO and its IP Strategies?
8. What are the main Indian IP Legislations?
9. Explain the salient features of Patent Ordinance & Bill
10. What is an IP Policy? Why is it important?
11. Explain National IP Policy.

(5GC49) INTELLECTUAL PROPERTY RIGHTS ASSIGNMENT QUESTIONS

UNIT -1

1. Enumerate the types of Intellectual Property Rights ?
2. What are the types of properties of IPR?

UNIT - 2

1. Explain the criteria for patentability and types of patents?
2. What is software patenting and protection?
3. Define Patent Infringement? And brief two case studies ?
4. Outline patent search and its types?
5. State the parts of patent ,and describe the procedure for patent filing?

UNIT - 3

1. Describe the types of copyrights?
2. Illustrate procedure for filing of copyright?
3. Infer on copyright Infringement with two case studies?
4. Recall about Geographical Indications and its advantages?
5. Demonstrate the importance of giving Geographical Indications to Tirupati Laddu, Darjeeling Tea, and Basmati Rice?
6. write Case studies on patent and copyright infringement Eg. Electronics ,films and choreography , adaptations etc

UNIT – 4

1. What is a certification mark
2. Compare copyright and trade mark
3. What is a Service mark

UNIT – 5

1. What is scope and protection of Industrial design as intellectual property?
2. What is the difference between patent , industrial design and copyright?
3. What is the importance of filing for Industrial Design? And explain a case study on
4. What is the need for protection of integrated circuits and layout design?

UNIT – 6

1. What are the functions and agreements of World Trade organization?
2. Outline the objectives of General agreement on Tariff and trade?
3. What are the main activities of WIPO?
4. How does WIPO promote intellectual Property Rights?
5. Write the three basic principles of Berne Convention?
6. Summarize the role of Patent Cooperation Treaty?
7. Write short notes on:
 - a. Rome Convention
 - b. Paris Convention
 - c. Madrid agreement
 - d. Hague Agreement
 - e. Budapest Treaty



**GREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY
AUTONOMOUS, AFFILIATED TO JNTUH**

A 15

Code No: 5GC49

**B. Tech. III Year II–Sem COMMON TO ECE & EEE External Exam, 2018
Regular)**

SUBJECT: INTELLECTUAL PROPERTY RIGHTS– MODEL PAPER

Time: 3 Hours

Max.

Marks: 75

Part - A (Compulsory)

10x2M=25Marks

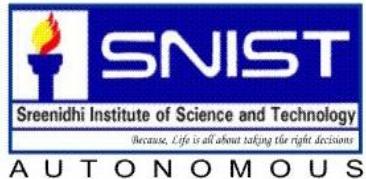
Q. No	Question	COs Addressed	Marks
1	Distinguish between Discovery and Invention?	1	3
2	What are utility patents ?	2	3
3	What are the methods of copyright protection?	3	3
4	What are the types of trademarks that can be registered?	4	3
5	Give three examples of industrial designs?	5	3
6	What are the key organizations in IP?	6	2
7	Distinguish between Invention and Innovation?	1	2
8	Name two patent search databases?	2	2
9	Give two examples of Geographical indications in India?	3	2
10	What is Rome convention?		2

Part - B (Answer any Five Questions) 5X10M=50Marks

Q. No	Question	CO Addressed	Marks
1.(a)	What is Intellectual Property? Enlist the types of Intellectual Property Rights?	1	5

(b)	What is the need for IP protection? Briefly mention about its significance?	1	5
2. (a)	Recall what is patent? Outline the types of patents?	1	5
(b)	Explain the criteria for Patentability ?	1	5
3. (a)	Infer on copyright Infringement with two case studies ?	3	5
(b)	Infer on Geographical indications with a case study Basmati Rice ?	3	5
4. (a)	What are the advantages of Trademark registration?	4	5
(b)	Distinguish between trademark and patent?	4	5
5. (a)	What is the scope and protection of Industrial design?	5	5
(b)	What is the need for protection of integrated circuits and layout design?	5	5
6. (a)	What are the objectives of GATT?	6	5
(b)	What is the role of WTO?	6	5
7. (a)	Write an explanatory note on : Non patentable inventions	1	3
(b)	Patent Infringement	2	5
(c)	Geographical indications	3	2
8 (a)	Trade secret – case study	4	3
(b)	Unfair competition	5	3
(c)	Patent Cooperation Treaty	6	4

SREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY
(An Autonomous Institution approved by UGC and affiliated to JNTUH))
(Accredited by NAAC with ‘A’ Grade, Accredited by NBA of AICTE and
Recipient of World Bank under TEQIP-I and II)
Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301.



COURSE FILE
FOR
DATA WAREHOUSING AND DATA MINING
FOR
B.Tech - IV year - I Semester

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING
JULY 2018

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

Mission of the Department

- I.** To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- II.** To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- III.** To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A.** Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B.** Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C.** Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D.** The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development.

a	b	c	d	e	f	g	h	i	j	k	l
x	x										

Syllabus for B. Tech. IV Year I semester

Computer Science and Engineering DATAWAREHOUSING AND DATA MINING

Code: 5FC05

L	T	P/D	C
3	1	-	3

Course Objectives:

- To understand the principles of Data warehousing and Data Mining.
- To know the Architecture of a Data Mining system and Data preprocessing Methods.
- To perform classification and prediction of data.

Course Outcomes: After Completing this Course, Student Shall be able to

UNIT – I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining

Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept

1. Students will understand the fundamentals of Data Warehousing and issues of mining with respect to architectures, technologies such as OLAP, Data Cube.
2. Student will identify the techniques used in the data preprocessing and the Data Mining Query language primitives.
3. Students will learn the significance and methods used for Characterization and the comparison of different classes of mining.
4. Students will be able to apply the algorithms for mining Association rules in large databases.
5. Students will be able to discuss and apply the models of classification and use those models for prediction of the new samples.
6. Students will be able to apply various clustering techniques available for numerous applications. identify the optimal clustering technique for a particular application

Hierarchy Generation, Data Mining Primitives, Data Mining Query Languages, Architectures of Data Mining Systems.

Applications: Medical / Pharmacy, Insurance and Health Care.

UNIT – II

Data Warehouse and OLAP Technology for Data Mining Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation

UNIT – III

Concepts Description: Characterization and Comparision: Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases.

Applications: Telecommunication Industry, Social Network Analysis, Intrusion Detection

UNIT – IV

Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases,

Applications: Financial/banking Data Analysis. Retail Marketing Industry

UNIT – V

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, k-nearest neighbor classifier, Prediction, Classifier Accuracy.

Applications: DNA Data Analysis, Biomedical Data Analysis

UNIT - VI

Cluster Analysis Introduction: Introduction to machine learning, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis. **Applications:** Climate and Ecosystem Data (Spatial and temporal), Graph based mining (graphs for chemical model structures).

TEXT BOOK:

1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER Harcourt India.

REFERENCES:

1. Data Mining Introductory and advanced topics –MARGARET H DUNHAM, PEARSON EDUCATION
2. Data Mining Techniques – ARUN K PUJARI, University Press.
3. Data Warehousing in the Real World – SAM ANAHORY & DENNIS MURRAY. Pearson Edn Asia.
4. Data Warehousing Fundamentals – PAULRAJ PONNAIAH WILEY STUDENT EDITION.
5. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL WILEY STUDENT EDITION
6. Introduction to Data Mining - First Edition, by Pang-Ning Tan, Michael Steinbach and Vipin Kumar, ISBN-13: 978-0321321367

Data Warehouse and Data Mining

Lecture Schedule

Unit – 1

S.No.	No. of Lectures	Name of the Topic
1	1	Fundamentals of Data Mining
2	1	Data mining Functionalities
3	1	Data mining systems classification
4	1	Major Issues in Data Mining
5	2	Needs Preprocessing the Data
6	1	Data Cleaning, Data Integration and Transformation
7	2	Data Reduction, Discretization and Concept Hierarchy Generation
8	1	Data Mining Primitives, Data Mining Query Language
9	1	Architectures of Data Mining Systems

Unit – 2

10	2	Data Warehouse and OLAP Technology for Data Mining Data Warehouse
11	1	Multidimensional Data Model
12	1	Data Warehouse Architecture, Data Warehouse Implementation
13	2	Efficient Methods for simple Data Cube Computation
14	2	Full Cube, Iceberg Cube
15	2	Closed Cube and Shell Cube
16	1	Discovery Driven exploration of data cubes
17	1	Data Warehouse Implementation

Unit – 3

18	2	Data Gen. and Summarization-Based Characterization
19	1	Analytical characterization
20	1	Mining class comparisons
21	1	Mining descriptive statistical measures in large DBs

Unit – 4

23	1	Association rule mining
24	2	Mining single dimensional Boolean association rules
25	1	Mining multi dimensional association rules from Tran. DB's
26	1	Mining multi dimensional association rules from Rel. DB's and Data Warehouses
27	1	From association mining to correlation analysis Constraint-Based Association Mining.

Unit – 5

28	1	Issues regarding classification & prediction
29	2	Classification by decision tree induction
30	1	Bayesian classification
31	1	Classification by Back propagation
32	1	Classification based on Concepts from Asso. Rule Mining Other Classification Methods
33	1	Prediction, Classifier Accuracy
Unit – 6		
34	1	Types of data in cluster analysis, A Categorization of major cluster methods
35	1	Partitioning methods
36	1	Density based methods
37	1	Grid-Based Methods
38	1	Model-Based Clustering Methods
39	1	Outlier analysis

Total Periods: $11+12+5+6+7+6 = 63$

UNIT -I

1. Explain KDD process (Data Flow) & its various Steps?
2. Architecture of a DM System? Explain its component?
3. Explain various data mining functionalities?
4. Compare in brief: characterization & discrimination vs classification & prediction.
5. Classify data mining systems based on kinds of difference?
6. What are major issues in DM?

Data Warehousing

1. What is data warehouse?
2. Differentiate between operational & informational systems?
3. Explain each of data of the feature of Data warehouse
4. Differentiate between OLTP & OLAP
5. Describe multidimensional data model (w.r.t data cube & dimension, fact tables, measures, key of fact table) ?
6. What is meant fact & dimension tables?
7. Schema models of data warehouse?
8. Explain various schemas their advantages & disadvantages
9. What is data mart?
10. DMQL primitives to define DW cube & dimension?
11. Detail snowflake schema with an example in DMQL?
12. Give an example of fact castellation using DMQL statements
13. What are different measures of DMQL?
14. What is meant by concept hierarchy?
15. What are the various OLAP operations?
16. What are views of DW design?
17. What are the DW design steps?

18. DW architecture
19. Strategies of building DW
20. What are the types of OLAP servers?
21. Write a short notes on efficient computation data cubes
22. What is cuboid & relation for number of cuboids?
23. What are the types of materialization of data cube.(Full, None, Partial) ?
24. Write brief notes on cube computations & limitations:
 - a) ROLAP-way
 - b) MOLAP-way
25. Explain the different indexing types of OLAP data
 - a) Bitmap index
 - b) Join indexes
- 26) What are the steps to process the OLAP queries efficiently?
- 27) Explain back end tools of data mining and utilities?

UNIT II

1. What is the need for preprocessing the data?
2. Explain various types of preprocessing (with diagrams)?
3. Explain the data smoothing techniques for noisy data?
4. What is meant by data cleaning? Explain its basic methods?
5. What is meant by incorrect data ? Specify a way to correct them?
6. What is meant by data integration & transformation?
7. Explain data integration issues?
8. Explain the methods of data transformation?
9. What is data reduction? Describe the strategies for data reduction?
10. Explain data cube aggregation?
11. Explain the methods of dimensionality reduction?
12. Explain the decision tree induction?
13. Explain the following methods?
 - a) Data complexion
 - b) Wavelet transforms
 - c) Principle component analysis
14. Explain the strategies of numorosity reduction?

Explain the methods of concept hierarchy generation for categorical data?
What are the various data-mining primitives?
17. What is meant by task relevant data? Explain how to drill task relevant data?
18. What are kinds of knowledge to be mined?
19. What is meant by background knowledge?
20. Explain the concept hierarchies & its types?
21. What are interestingness measures?
22. Explain presentation and visualization?
23. Explain DMQL?
24. Explain designing GUI based on DMQL?
25. Describe the architecture of data mining systems?

UNIT III

1. What is data generalization and summarization?
2. Explain characterization based on summarization?
3. Explain analytical characterization?
4. Write the description on analysis of attribute relevance?

5. Explain the mining class comparisons?
6. How can we discriminate between different classes?
7. Explain mining descriptive statistical measures in large databases?
8. Explain attribute oriented induction for data characterization?
9. Explain the presentation of both characterization and comparison?

UNIT IV

2. What is association rule mining?
3. Explain the process of mining 1-Dimensional Boolean association rules from transactional database?
4. Explain the mining of multidimensional association rules from relational database?
5. Explain the mining of multidimensional association rules from data warehouse?
6. Explain the correlation analysis from the association mining?
7. Explain constraint based association mining?
8. Explain the frequent item sets with association rules?

9. Explain the closed item sets with association rules?
10. Explain constraint pushing?
11. What is frequent pattern mining?
12. Explain apriori algorithm? How can we improve the efficiency of apriori?
13. Explain mining quantitative association rules?
14. Explain constraint based association mining using
 1. Meta rule
 2. Constraint pushing

UNIT V

1. What is classification? Explain the issues regarding classification?
2. Explain classification by decision tree induction
3. Explain the tree pruning?
4. Explain Bayesian classification?
5. Explain Bayels theorem?
6. What is back propagation? Explain classification by back propagation?
7. Explain the following classification methods
 - a. Genetic algorithms
 - b. Rough set approach
 - c. Fuzzy set approach
8. What is prediction? Issues regarding the prediction?
9. Explain the prediction by linear regression?
10. Explain the prediction by non-linear regression?
11. What is rule-based classification?
12. Explain the rules extraction from a decision tree?
13. Explain classification accuracy?
14. Describe the basic algorithm for inducing the decision tree from training couples?

15. Explain the following
 - a) Information gain
 - b) Gain ratio
 - c) Gini index
16. Evaluate the accuracy of a classifier or predictor with the following

- a) Cross validation
- b) Boot strap
- c) Hold out method and random sampling

UNIT VI

- 1. What is cluster analysis? What are the types of data in cluster analysis?
- 2. What are the categories of major clustering methods?
- 3. Explain the partitioning methods?
- 4. Explain the density-based methods?
- 5. Explain the grid-based methods?
- 6. Explain the following model based clustering methods?
 - a. Expectation –maximization.
 - b. Conceptual clustering
 - c. Neural network approach.
- 7. Explain statistical distribution Based outlier distribution?
- 8. Explain distance based outlier distribution?
- 9. Explain density based outlier distribution?
- 10. Explain deviation based outlier distribution?
- 11. Explain the K-mean partitioning algorithm?
- 12. Explain the hierarchical clustering algorithm for categorical attributes?
(ROCK)
- 13. Explain the following grid based methods?
 - a) STING
 - b) Wave cluster
- 14. Explain following
 - a) K-medoids
 - b) CLARA
 - c) Chameleon
 - d) DBSCAN



Code No: 3FC05

Date:2-Dec-16(FN)

B. TECH. IV-Year I-Semester Examinations, Nov/Dec 2016 (Regular/Supple.)

DATA WAREHOUSING AND DATA MINING (Common to CSE and ECM)

Time: 3 Hours

Max. Marks: 70

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

- ANSWER ALL QUESTIONS EACH QUESTION CARRIES 2 MARKS**

 - 1) Describe the three challenges to Data mining regarding Data mining methodology and user interaction issues.
 - 2) Differentiate operational databases and data warehouse.
 - 3) What is Concept Comparison?
 - 4) How to justify the generated association rules are strong?
 - 5) Describe the process of classification.
 - 6) How to measure the clustering quality?
 - 7) Enumerate data transformation strategies
 - 8) Why analysis of attribute relevance is required?
 - 9) How to evaluate the accuracy of classifier?
 - 10) Compare and contrast supervised and unsupervised learning.

Part – B **Max. Marks :50**

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) Explain the data reduction strategies. [6M]
b) In real world data, tuples with missing values are a common occurrence; describe the various methods to handle such problem.
[4M]
 2. a) What are the differences between three main types of data warehouse usage. [4M]
b) Write BUC algorithm for sparse or iceberg cube computation. [6M]
 3. Outline a data cube incremental algorithm for mining analytical class comparisons. [10M]
 4. a) Explain the apriori algorithm for finding frequent item sets [7M]
b) How can we further improve the efficiency of apriori based mining
? [3M]
 5. a) Briefly outline the major steps of decision tree induction classification.[6M]
b) What is information gain? Explain in detail. [4M]
 6. a) Explain the Chameleon hierachal clustering algorithm. [6M]
b) Why outlier analysis is important? [4M]
 7. a) Explain the process of knowledge discovery in databases. [6M]

- b) Describe the Three tier data warehousing architecture with neat sketch[4M]
8. a) Explain the classification by back propagation algorithm. [6M]
 b) How to define a neural network topology? [4M]



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Regulations:
A14

Code No: 4FC05

Date:19-Nov-16

B. TECH. III-Year I-Semester Examinations, Nov/Dec 2016 (Regular)
DATA WAREHOUSING AND DATA MINING (IT)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. What is descriptive and predictive data mining?
2. Write the difference between database and knowledge base?
3. What are the steps involved in data consolidation process?
4. List the contents of dimension table?
5. Compare clustering and classification?
6. Define spatial and temporal mining data items?
7. Name the association rules that can be mined from multimedia data?
8. What are different types of data in cluster analysis?
9. What are data mining primitives?
10. Write the issues regarding classification and prediction.

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) What is data mining functionality? Explain any one functionality with the help of example? [6M]
 b) Discuss the major issues of data mining? [4M]
2. a) Differentiate OLTP and OLAP?
 b) Enumerate schemas for defining modeling data warehouse?
3. Write the algorithm for attribute oriented induction? Give an example?
4. a) Define strong association rules?
 b) Suppose that the data for analysis includes the attribute age. The age values for the data types are 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 30, 33, 33, 35, 35, 35, 36, 40, 45, 52, 55. Give the five number summaries of the data?
5. a) Formulate the role of application and challenges in clustering?[4M]
 b) Describe in detail about what you learned to develop constraint and correlation based association mining? [6M]
6. a) Define outlier? Evaluate what information is used by outlier detection method?

- b) What is mean by spatial database? Give an example?
7. a) Design statistical approaches in outlier detection with neat design and with examples?
- b) Describe with suitable examples for the following
- Discretization and concept of hierarchy generation?
 - Data transformation?
8. a) Write about Bayesian classification?
- b) Illustrate 3-tier data warehouse architecture?

--00--00--



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Regulations:
A12

Code No: 3FC05

Date:25-Jun-16

B. Tech. III-Year I-Semester Examinations, June 2016 (Supplementary)
DATAWAREHOUSING AND DATA MINING (IT)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

- What are the steps in KDD process?
- Define Iceberg cube.
- Give any four statistical measures
- How to generate association rules from frequent item sets?
- Define the concept of classification.
- Define density based method.
- How a database design is represented in OLAP system?
- What are lattice of cuboids?
- What is data mart?
- List out any two techniques to improve the efficiency of Apriori algorithm.

Part – B

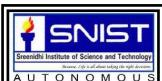
Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- Discuss Major issues in data mining.
 - Explain Architectures of Data Mining Systems.
- How do data warehousing and online analytical processing relate to data mining?
 - Explain slice, dice, pivot operations on data cube with suitable examples.
- Explain Data Cube Approach for Data Generalization.
 - Explain the need to performance Attribute Relevance Analysis. Discuss Briefly the various methods of Attribute Relevance Analysis.
- Explain Apriori Algorithm with suitable example.
 - Discuss mining of multilevel association rules from transactional databases.
- What is Back propagation? Explain with example.

- b) State Bayes theorem and discuss briefly how Bayesian classifier works.
- 6 a) Explain K-means clustering with an example.
- b) How do hierarchical clustering methods work? Describe two types of hierarchical clustering methods.
- 7 a) List and describe five primitives in DMQL for specifying data mining tasks.
- b) Write short notes on Fact constellations.
- 8 a) Explain rule based classification.
- b) Explain briefly about various data cleaning methods.

-- 00 -- 00 --



Sreenidhi Institute of Science and Technology
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A10

Code No: 101IT05/111IT05

**B. TECH. IV – Year I – Semester Examinations, December 2015
(Supplementary)**

DATA WAREHOUSING AND DATA MINING (CSE & ECM)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. How is Data Warehouse different from a database?
2. Explain about data transformation.
3. What is characterization?
4. Explain the procedure of generation of Association rules from frequent Itemsets.
5. Write short notes on Bayesian classification.
6. Write about Outlier Analysis.
7. What are data mining task primitives?
8. List out the techniques used for improving efficiency of Apriori Algorithm.
9. Write the differences between classification and prediction.
10. Write the applications of cluster Analysis.

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) Describe the various issues in Data mining. [7M]
b) Discuss Knowledge Discovery in Databases v/s Data Mining. [3M]
2. a) Explain in detail about Schemas of Multidimensional Databases. [7M]

b) List the distinguishing features between OLTP and OLAP. [3M]
3. a) Attribute oriented induction generates one or a set of generalized description. How can these descriptions be visualized. [5M]
b) Discuss about the methods of Attribute Relevance Analysis. [5M]

4. a) Explain Apriori algorithm used for finding frequent itemset mining with an example. [7M]
 - b) Discuss the issues related to Association Rule Mining. [3M]
 5. a) Describe the ID3 algorithm for constructing a Decision Tree. [7M]
 - b) Distinguish Classification and Prediction. [3M]
 6. a) Write algorithms for K-Means and K-Medoids methods. [5M]
 - b) Explain the categories of major clustering methods. [5M]
 7. a) Write the syntax for the following primitives.
 - i) Task- Relavent data
 - ii) The kind of knowledge to be mined [5M]
 - b) With a neat diagram give a brief explanation of the various components of a dataware house architecture. [5M]
 8. a) Discuss about the various types of data in Cluster Analysis. [7M]
 - b) Discuss about Association Rule Mining. [3M]
- 00 -- 00 --



Sreenidhi Institute of Science & Technology
(An Autonomous Institution)

A10

Code No: 101IT05/111IT05

**B. TECH. III – Year I – Semester Examinations, December 2014
(Supplementary)**

DATAWAREHOUSING AND DATA MINING (IT)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS.

11. Name some databases on which data mining functionalities can be implemented.
12. Discuss Rollup & Drill Down OLAP operations.
13. What is Data Generalization?
14. Define Support and Confidence.
15. Define Prediction.
16. Define Interval Scale Variables.
17. What are fact and dimension tables of a Schema?
18. Give an example for Association Rule Mining.
19. What is Classifier Accuracy?
20. What is a)Spatial Database b) Temporal Database?

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- 1 a) Explain the evolution of database technology.
b) Briefly Explain Data Preprocessing Techniques.
- 2 a) Explain three tier architecture of a Data Warehouse.
b) What are the different types of OLAP Servers? Explain the differences between them.

3 a) Explain Data Cube Approach for Data Generalization.

b) Explain the statistical measures in large Database.

4 a) How can we improve the efficiency of Apriori based mining?

b) Explain FP-growth algorithm with an example.

5 a) Explain Classification by Decision Tree Induction algorithm.

b) Implement Straight Line Regression using the method of least squares for the following data

X(years of experience) 3 8 9 13 3 6 11 21 1 16

Y(Salary in \$1000s) 30 57 64 72 36 43 59 90 20 83

6 a) Explain DBSCAN algorithm with suitable example.

b) Explain Statistical Distribution based Outlier Detection.

7 a) Discuss about major issues in Data Mining.

b) Explain Star, Snowflake, Fact Constellation with example.

8 a) Explain K-Means Algorithm.

b) Explain Back Propagation algorithm.

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reenidhi Institute of Science and Technology
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Regulations:
A12

Code No: 3FC05

Date: 2-Dec-16(FN)

B. TECH. IV-Year I-Semester Examinations, Nov/Dec 2016

(Regular/Supple.)

DATA WAREHOUSING AND DATA MINING (Common to CSE and ECM)

Time: 3 Hours

Max. Marks: 70

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

11) Describe the three challenges to Data mining regarding Data mining methodology and user interaction issues.

12) Differentiate operational databases and data warehouse.

13) What is Concept Comparison?

14) How to justify the generated association rules are strong?

15) Describe the process of classification.

- 16) How to measure the clustering quality?
- 17) Enumerate data transformation strategies
- 18) Why analysis of attribute relevance is required?
- 19) How to evaluate the accuracy of classifier?
- 20) Compare and contrast supervised and unsupervised learning.

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- a) Explain the data reduction strategies. [6M]
- b) In real world data, tuples with missing values are a common occurrence; describe the various methods to handle such problem. [4M]
2. a) What are the differences between three main types of data warehouse usage. [4M]
b) Write BUC algorithm for sparse or iceberg cube computation.
3. Outline a data cube incremental algorithm for mining analytical class comparisons. [10M]
4. a) Explain the apriori algorithm for finding frequent item sets [7M]
b) How can we further improve the efficiency of apriori based mining ? [3M]
5. a) Briefly outline the major steps of decision tree induction classification. [6M]
b) What is information gain? Explain in detail. [4M]
6. a) Explain the Chameleon hierachal clustering algorithm. [6M]
b) Why outlier analysis is important? [4M]
7. a) Explain the process of knowledge discovery in databases. [6M]
b) Describe the Three tier data warehousing architecture with neat sketch. [4M]
8. a) Explain the classification by back propagation algorithm. [6M]
b) How to define a neural network topology? [4M]

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Sreenidhi Institute of Science and Technology
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Regulations:
A15

Code No: 5PC23

Date: 06-Feb-2018 (TUE)

M.Tech I-Year II-Semester External Examination, Feb - 2018 (Supplementary)
DATA WAREHOUSING AND DATA MINING (CSE)

Time: 3 Hours

Max.Marks:75

- Note:**
- a) No additional answer sheets will be provided.
 - b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
 - c) Missing data can be assumed suitably.

Part - A

Max.Marks:25

ANSWER ALL QUESTIONS.

1. What is Data Mining? [3]
2. What is multi-Dimensional Data model? [3]
3. What is Data Characterization? [3]
4. Define Association rule mining. [3]
5. Define Classification. [3]
6. Define Cluster Analysis. [2]
7. What is Data Integration? [2]
8. What is Data generalization? [2]
9. Define Machine Learning. [2]
10. What is Data Warehouse? [2]

Part – B **Max.Marks:50**
ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) Explain the Data mining Functionalities in brief? [5]
- b) What is the need for Data Pre-Processing? Explain. [5]
2. Discuss a Three-Tier Data Warehouse Architecture with neat diagram. [1]
3. Explain about Data summarization-Based characterization. [1]
4. Explain about Mining Single-Dimensional Boolean Association Rules from Transaction Databases. [1]
5. Discuss the Classification by Decision Tree Induction. [1]
6. a) Write about Types of Data in Cluster Analysis. [5]
- b) Write about Partitioning Methods. [5]
7. a) Explain about Data Mining Primitives. [5]
- b) Write notes on Outlier Analysis. [5]

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Sreenidhi Institute of Science and Technology
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Regulations:
A12

Code No: 3FC05

Date: 13-May-17 (AN)

B. Tech. IV-Year I-Semester Examinations, May 2017 (Supplementary)

DATA WAREHOUSING AND DATA MINING (CSE and ECM)

Time: 3 Hours

Max. Marks: 70

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

- 1) Describe the data mining functionalities.
- 2) Differentiate Data warehouse and Data mart.
- 3) What is Concept Characterization?
- 4) What is the role of support and confidence in association rules?
- 5) Why tree pruning is required in Decision tree induction?
- 6) Specify the essential requirements for cluster analysis.
- 7) How to handle the missing values in data cleaning process?
- 8) What is data generalization and summarization based characterization?
- 9) Outline the techniques to improve the classifier accuracy.
- 10) How to confirm the exact number of clusters before initiating the clustering process?

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) Explain the major tasks in data preprocessing. [6M]
b) Describe the various methods for generation of concept hierarchies for nominal data. [4M]
2. a) Explain typical OLAP operations on multi dimensional data. [4M]
b) Write BUC algorithm for sparse or iceberg cube computation. [6M]
3. Outline the method for parallel and distributed mining of statistical measures of data Dispersion in a data cube environment
4. a) What is mining of multi level association rules?
b) How mining of multi level association rules can be done?
5. a) Given a decision tree ,if you have an option i) converting the decision tree to rules and then
Pruning the resulting rules or ii) pruning the tree and then converting the pruned tree to rules,
What advantages does (i) have over (ii) [6M]
b) Explain the working of simple naïve Bayesian classifier. [4M]
6. a) Explain K-means algorithm with an example. [6M]
b) Compare agglomerative and divisive hierarchical clustering. 4M
7. a) Explain the OLAP Server architectures.
b) Explain the process of knowledge discovery in databases.
8. a) Illustrate the strength and weakness of k-means algorithm in comparison with k-medoids Algorithm [6M]
b) What are the essential requirements of clustering? [4M]

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SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION UNDER JNTUH)
(Approved by AICTE & Aided by World Bank under TEQIP)
Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301.

COURSE FILE

For

SOFTWARE AUTOMATION AND TESTING

For

B. Tech. IV year - I Semester CSE BRANCH



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

Mission of the Department

- I. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- II. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- III. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development.

a	b	c	d	e	f	g	h	i	j	k	l
				x							

**Syllabus for B. Tech. IV Year I semester
Computer Science and Engineering
SOFTWARE AUTOMATION AND TESTING**

Code: 5EC11

C

L T P/D

3 - - 3

UNIT I

What is Testing, Characteristics of Test Engineers, Software Testing Life Cycle, Levels of Testing, Testing Approaches, Test Cases: Format for Writing Test Case, Test plan: Format to prepare Test plan
Purpose of testing, Dichotomies, Consequences of bugs

UNIT II

Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, application of path testing.
Data Flow Testing: Basics of Data flow Testing
Logic Based Testing : Decision Tables

UNIT III

Software testing strategy and Environment, Establishing testing policy, structured approach to testing, Test factors, Economics of SDLC testing.
Software Metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

UNIT IV

Software Testing Methodology, Defects hard to find, Verification and validation, Functional and structural, Defects and Failures, Testing that parallels the software Development process, Workbench concept, Eight Consideration of software testing methodology, testing tactics checklist. Importance of Agility, Building an Agile Testing Process

UNIT V

Software Testing Techniques, Black-box, Boundary value, Branch coverage, Cause Effect graphing, CRUD, Database, Histogram, Gray box, Inspections, JADs, Pareto Analysis , Prototyping , Random Testing, Risk based testing , Regression Testing, Structured walkthroughs, Thread testing , Performance testing, Stress Testing, Accepting Testing, White box testing, Alpha and Beta Testing.

UNIT VI

Graph matrices and application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm.
Need for Automated testing tools, Taxonomy of Testing Tools, Exposure to Software Testing Tools: Load Runner, UFT and QTP.

TEXT BOOKS

1. Software testing techniques – Boris Beizer, Dreamtech, second edition.(Unit 1,2,6)
2. Software testing tools – by Dr. K.V.K.K Prasad Dreamtech (Unit 1,6)
3. Effective Methods for Software Testing, 2nd Edition by William E.Perry, Wiley publications.(Unit 3,4)
4. Software Testing and continuous Quality Improvement, by William E.Lewis,Gunasekaran,2nd Edition Auerbach publications (Unit 5,Refer Internet)
5. Software Engineering A practitioner's Approach, Roger S Pressman, 6th edition. McGrawHill International Edition (Unit 3)

REFERENCES

1. Software Testing Techniques ,by Bories Beizer, Second Edition,Dreamtech Press
2. Testing and Quality Assurance for Component based software ,by Gao,Tsao and Wu,Artech House Publishers
3. Managing the Testing Process,by Rex Black,Wiley.
4. Handbook of Software Quality Assurance, by G.Gordon Schulmeyer,James I.McManus,2nd Edition,International Thomson Computer Press

Department of Computer Science & Engineering

Teaching Schedule

SOFTWARE AUTOMATION AND TESTING

Lecture Schedule		
Unit – 1		
S.N o.	No. of Lectures	Name of the Topic
1	1	Introduction, What is Testing
2	1	Characteristics of Test Engineers
3	2	Software Testing Life Cycle, Levels of Testing.
4	1	Testing Approaches
5	2	Test Cases: Format for Writing Test Case
6	1	Test plan: Format to prepare Test plan
7	2	Purpose of testing
8	2	Dichotomies, Consequences of bugs
Unit – 2		
9	1	Basics concepts of path testing,
10	3	Predicates, path predicates and achievable paths, application of path testing
11	3	Data Flow Testing: Basics of Data flow Testing
12	3	Logic Based Testing : Decision Tables
Unit - 3		
13	2	Software testing strategy and Environment, Establishing testing policy
14	1	Structured approach to testing
15	2	Test factors, Economics of SDLC testing.
16	1	Software Metrics :Software Quality, Metrics for Analysis Model
17	3	Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance
Unit – 4		
18	1	Software Testing Methodology: Defects hard to find, Verification and validation.
19	1	Functional and structural, Defects and Failures
20	1	Testing that parallels the software Development process
21	1	Workbench concept, testing tactics checklist

22	3	Eight considerations in developing testing methodologies,
23	2	Importance of Agility, Building an Agile Testing Process
Unit - 5		
24	1	Black-Box, Boundary value,
25	1	Bottom-up, Branch coverage
26	1	Cause-Effect graphing, CRUD,
27	1	Database, Gray-Box,
28	2	Inspections, JADs, Alpha and Beta testing
29	1	Prototyping, Random Testing
30	1	Histograms, Pareto Analysis
31	1	Structured Walkthroughs, Thread Testing
32	1	Performance Testing, Regression Testing
33	1	White-Box Testing, Risk based Testing
Unit -6		
34	2	Graph Matrices and Application: Motivational Overview
35	1	Matrix of Graph
36	2	Relations and Power of Matrix
37	2	Node Reduction Algorithm
38	3	Exposure to SoftwareTesting Tools: Load Runner
39	3	WinRunner and QTP

Total No. of classes : 64
 Available Classes : 65

SOFTWARE AUTOMATION AND TESTING

Course Objectives:

To Understand the Basic concepts in Software testing, concepts of **Flow graphs**, **Path testing and** Data Flow Testing, understand the concept of metrics and their types. Understand and implement various testing techniques and to make a thorough study on various testing tools. Set a strategy for testing environment and to learn the testing methodologies in detail.

Course Outcomes: After completing this course, student shall be able to

1. Describe concepts of Software testing
2. Describe and apply the concepts **Flow graphs**, **Path testing and Data Flow Testing**.
3. Practice Software testing strategy and Environment with economics and apply Software Metrics useful in software development and maintenance.
4. Software Testing Methodology, finding defects hard to find, Verification and validation, Functional and structural, Workbench concept, Eight Consideration of software testing methodology, checklist. Describe Agile computing with agile testing
5. Demonstrate Software Testing Techniques such as JADs, Pareto Analysis , Regression Tasting, Structured walkthroughs, Thread testing , Performance testing and White box testing.
6. Describe Graph matrices and applications, and practice and apply automated testing tools such load Runner, UFT and QTP.

SOFTWARE AUTOMATION AND TESTING

Unit-1

Short Questions

1. Define Testing ?
2. Explain the characteristics of Testing ?
3. Who are involved in Testing ?
4. Define Test Case ?
5. What is the Test Plan?
6. Give the Levels of Testing?
7. In Requirement phase, what are the different validation activities to be performed?
8. What is the difference between the Testing and Debugging?
9. In Test phase, what are the different validation activities to be performed?
10. In Program phase, what are the different validation activities to be performed
11. In Maintenance phase, what are the different validation activities to be performed?
12. Give the IEEE format to prepare the test cases?
13. Define bug?
14. What is the difference between normal SDLC and SDLC Testing?
15. What are the goals of Testing
16. What are Different phases of Testing?

Essay Questions

1. What is the purpose of testing? List out the various dichotomies and explain.
2. List out the nightmares and explain when to stop testing.
3. What are the principles of test case design? Explain.
4. What is meant by Software Testing? Discuss clearly the purpose of testing.
5. Discuss in detail various phases in a Tester's Mental life.
6. Explain the importance of bugs.
- 7 . Write the test plan document for known application.
8. What is test case? Write the test cases to Validate the ATM CARD.
9. Discuss in detail how the consequences of bugs are measured?
10. What are the possible consequences of bugs?

11. Explain in details the factors on which the importance of bugs depend
12. Explain Software Testing Life Cycle(STLC)

Software Testing

Unit-II

Short Questions

1. Define Path Testing.
2. What is Statement Coverage?
3. Define Branch Coverage?
4. What is Data flow Testing
5. What is Decision Tables?
- 6 Define Predicate and Path Predicate?
7. Define the term Module.
8. What is the accumulated cost for normal SDLC and SDLC testing? Which one is preferable?

Essay Questions

1. Compare and contrast between control flow graphs and flow charts.
2. Give a detailed note on path testing.
3. Explain applications of paths, path products and regular expressions.
4. What is meant by statement coverage and branch coverage?
5. Discuss the role of decision table in a test case design.
6. Explain in Details about Data flow testing with neat sketch
7. Explain the expansion of the immaterial cases in the decision table. ?

Software Testing

Unit-III

Short Questions

1. What are the two purposes of Testing Policy ?
2. What is the criteria for a Testing Policy ?
3. How many people involved in preparing Testing Policy?

4. How many methods are there to establish a policy?
5. What is the disadvantage of Organizational policy?
6. User Meeting is a what type of policy?
7. In Requirement phase, what are the different verification activities to be performed?
8. In Design phase, what are the different verification activities to be performed?
9. Give the examples for the Factors that can be directly measured?
10. Give the examples for the Factors that can be indirectly measured?
11. Define the terms metric, measurement and measure?
12. Abbreviate FP?
13. Who proposed FP?
14. What are the different parameters for computing FP?
15. Give the formula for FP?
16. What are the different value adjustment factors?
17. Compute the formula for Structural complexity?
18. Compute the formula for Data complexity?
19. Compute the formula for System complexity?
20. Compute the formula for Shape complexity?
21. Abbreviate DSQI?
22. Give the formula for DSQI?
23. Give the formula to compute Overall program length N ?
24. How Program Volume may be defined?
25. Who Proposed the Metrics for source code?
26. Give the formula for Program Level and Effort?
27. Give the formula for Product metric for maintenance?
28. Abbreviate SMI? And give the formula for SMI?
29. What is mean by LOC and KLOC?
30. Formula for DRE?
31. Abbreviate DRE?

Essay Questions

1. Explain how to establish the Testing Policy?
2. Explain various ways to establish a Testing Policy?
3. Explain the Criteria and methods used to establish a Testing Policy?
4. Explain Structured Approach to testing?

5. Explain the Economics of System Development Life Cycle testing?
6. What are the different Test Factors and explain in detail?
7. Explain in detail about Products metrics for Analysis, design, coding, testing and maintenance?
8. Explain Process Measurements? And give the reasons for measurements?
9. Explain Size oriented Metrics with suitable example?
10. Define FP? And explain the computation of FP?
11. Explain in detail about Metrics for software Quality?
12. Compute the Cyclomatic Complexity with suitable example?
13. Explain how to establish the software quality requirements? And explain how to implement the collected data?

Software Testing

Unit-IV

Short Questions

1. Give two reasons for defect go undetected?
2. What is mean by user specify the wrong requirements? Justify it
3. What is V & V?
4. Requirement review is performed by whom?
5. Design review is performed by whom?
6. Code inspection review is performed by whom
7. Unit testing is performed by whom?
8. Integration Testing is performed by whom?
9. System Testing is performed by whom?
10. User Acceptance Testing is performed by whom?
11. Functional testing takes whose point of view?
12. What are the components of Workbench?

Essay Questions

1. Explain in detail why Defects hard to find?.
2. Give the differences between below terms
 - i) Verification Vs Validation

ii) Functional Vs Structural Testing

3. Explain the below terms?
 - a) Code Walkthrough
 - b) Code inspection
 - c) Unit Testing
 - d) Integration testing
 - e) System testing
 - f) Formal Review
 - g) Technical Review
4. Explain in detail about Workbench concept?
5. Explain the Programmer's workbench concept and list the steps involved in it?
6. Explain the Eight Considerations in Developing Testing Methodology
7. With neat sketch explain Agile Testing process

Software Testing

Unit-V

Short questions

1. What is black box testing?
2. What are the advantages of Black box testing?
3. Black box testing is done by whom?
4. What is white box testing?
5. What is the differences between white box and black box testing ?
6. Black box testing also known as?
7. What is gray box testing?
8. What is white box testing?
9. What is Sandwich testing?
10. What is performance testing?
11. Abbreviate BVA and EP?
12. What is incremental integration testing?
13. What is Regression Testing?
14. What is Alpha and Beta Testing?
15. What is bottom-up integration testing?
16. What is top-down integration testing?
17. what is thread testing?
18. what is Random testing
19. What is Risk based testing?
20. Define the term 'UNIT TESTING'.
21. Define the term 'COMPONENT TESTING'.

22. Define the term ‘INTEGRATION TESTING’.
23. Define the term ‘SYSTEM TESTING’

Essay Questions

1. Explain different software testing techniques?
2. Explain the below terms
 - i) White box testing ii) Black box testing iii) Gray box testing
3. Explain Cause Effect Graphing with suitable example?
4. What is integration testing? And explain the different types of integration testing?
5. Abbreviate CRUD and explain?

6. Give the brief note for the following
 - a) Histograms
 - b) Pareto Analysis
7. What is system testing? And explain different techniques used to perform system testing?

Software Testing

Unit-VI

Short Questions

1. What is a graph matrix?
2. Write the node reduction algorithm.
3. What is partitioning algorithm?
4. What are matrix operations?
5. What are partial order relations?
6. What is Ad-hoc testing?
7. What is usability testing?
8. What is User-Acceptance testing?
9. What is Automation?
10. What does a predicate calculator do ?
11. What does a logic analyzer do ?
12. What does a domain processor do ?
13. Advantages of Automation testing?

14. Differences between Manual and Automation testing?
15. What are the different bug tracking tools?
16. What are the different test management tools?
17. What is SRS?

Essay Questions

1. Explain in detail the node reduction algorithm.
2. Explain all the relations that exist in matrix of a graph.
3. Explain partitioning algorithm.
4. Explain the different categories of testing tools available in market?.
5. Explain the Methodology to evaluate automated testing tools?
6. Majority of testing is done manually why? What is the difference between manual testing
and Automation testing?
7. Write the node-by-node removal algorithm for converting a flow graph into path expression

SIX SIGMA

Standards for Quality Improvement of Software's

Applying Six Sigma in Software Companies for Process Improvement

1. INTRODUCTION

In recent years, the companies and organizations around the world are showing great interests in quality. Six Sigma approach is a structured quantitative method which is invented by Motorola in 1986 for improving the product quality. Its aim is to enhance organization's performance by using statistical analytic techniques. After two decades of successful implementation in manufacturing, Six Sigma is approved as an effective methodology for improving quality.

Nowadays, some researchers believe that Six Sigma can bring large benefits for software companies. Furthermore, software companies have already started to implement Six Sigma approach, like Ericsson, Tata Consultancy Service, etc. However, there are still some problems and misconceptions existed about the applicability of Six Sigma in software companies.

Our work can help to debunk the misconceptions about the applicability of Six Sigma in software companies. And provide steps for software companies to implement Six Sigma. The scope of this paper is demonstrated in below Figure which shows the relationship between Quality and Six Sigma.

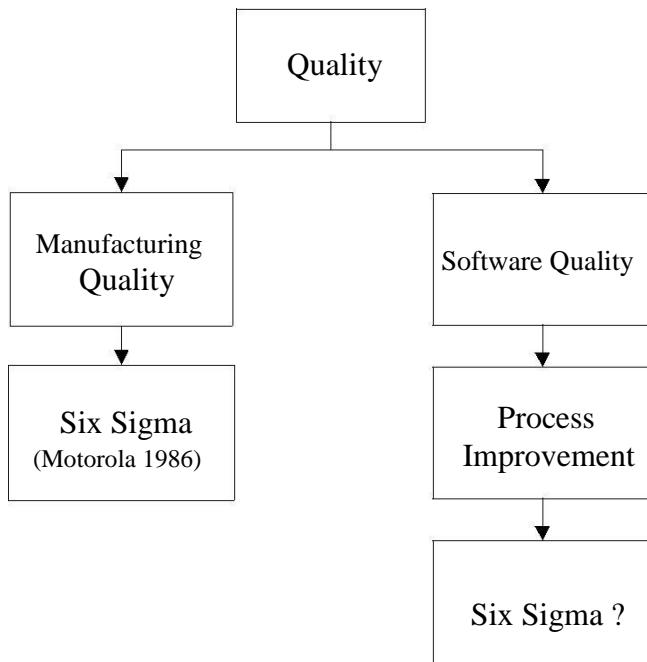


Figure: Relationships between Six Sigma and Quality.

INTRODUCTION TO QUALITY AND SIX SIGMA

In recent decades, the companies and organizations around the world are showing great interests in quality. Especially in 1970s and 1980s, the success of Japanese industry stimulates the whole world to focus on quality issues . The experience from them proved that the requirements and expectations of customers are the key factors which decide the quality.

Definition

The word “quality” comes from the Latin “qualitas”, and Cicero (a roman orator and politician, 106-43 B.C.) is believed to be the first person who used the word. Until the a few decades before, the concept of quality has been significantly extended as we know it today. There were many popular definitions for quality concept. Table 2.1 lists some of them.

Year	Definer	Definition of quality concept
1931	Walter Shewhart	<i>“...there are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of man. The other has to do with what we think, feel or sense as a result of the objective reality. In other words, there is a subjective side of quality”.</i>
1951	Joseph Juran	<i>“Fitness for use”.</i>
1979	Philip Crosby	<i>“Conformance to requirements”.</i>
1979	Genichi Taguchi	<i>“The losses a product imparts to the society from the time the product is shipped”.</i>
1985	Edwards Deming	<i>“Quality should be aimed at the needs of the customer, present and future”.</i>
1990	Myron Tribus	<i>“Quality is what makes it possible for a customer to have a love affair with your product or service.”</i>
2000	ISO 9000: 2000	<i>“The degree to which a set of inherent characteristics fulfills the requirements, i.e. needs or expectations that are stated, generally implied or obligatory”.</i>
2004	Bengt Klefsjöand Bo Bergman	<i>“The quality of a product is its ability to satisfy, and preferably exceed, the needs and expectations of the customers”.</i>

Table 2.1 Definitions of quality concept.

From the definitions above, we can find some interesting common points. Firstly, almost all factors are conducted around customers. In another word, it can be said as *customers decide the quality* (e.g. Juran in 1951, Deming in 1985, and Tribus in 1990). Secondly, according to customer, two things are commonly considered as which shall be fulfilled – customer requirements and customer expectations. The requirements are what customers request and demand. These are the basics of the quality. The expectations are what the customers expect and look forward to. Sometimes, the customers do not know what they really need. So that demands developers to have a good understanding about the customer’s minds.

Although the definitions in the above Table are similar, they also have distinctions which make them different. For example, “*fitness to use*” (Joseph Juran, 1951) is defined from end user’s view. In contrast, Philip Crosby (1979) defined the quality as “*Conformance to requirements*” from producer’s view. The reason is their backgrounds are different.

A further identification of these differences is conducted by Gavin in 1984. Five approaches to the quality concept are claimed which include transcendent-based, product-based, user-based, manufacturing-based, and value-based, see above Figure. From transcendent-based view, the quality can be identified by experience. Mostly is very successful. But from this point of view, the quality is not defined very clearly. This problem can be solved by product-based approach. The quality can be exactly defined and measured. However, the cost for quality cannot be judged by customer. User-based approach’s opinion is that the quality is decided by customer. Customer’s satisfaction is the only scale which reflects product quality. Manufacturing-based perspective relates to accomplish the requirement specification. Reducing defects is the main task of quality improvement. According to value-based approach, the quality relates to cost and price. Generally price is decided by cost. A high quality product means that the customers are willing to pay for it. In Gavin’s view, an organization cannot have just one approach for the quality concept, but that different parts of organization need different approaches.

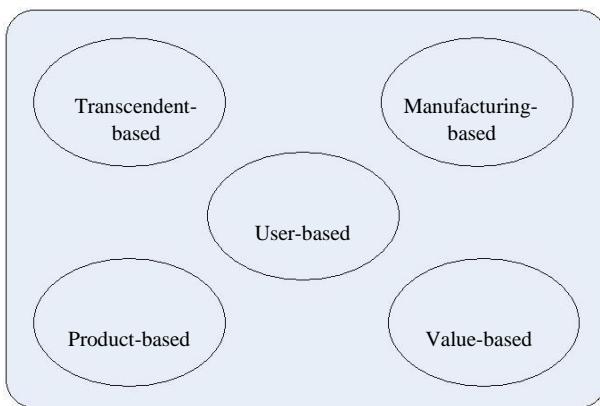


Figure 2. Five approaches of quality concept from Gavin (1984).

In quality issues, customer plays one of most important roles. A high quality product shall fulfill customers’ requirements, and satisfy their expectations. Due to Gavin’s theory, there are several approaches for quality concept. An organization cannot have just one approach, but it uses different approaches in different parts.

Why Quality Improvement

“Quality is free. It is not a gift, but it is free. What costs money are in-quality things - all the actions that involve not doing jobs right the first time.” – Philip Crosby

Many companies pay a lot in correction, i.e. 80% of the cost in a Software Engineering (SE) project is commonly related to after-delivery corrections. And we also found:

- Unsatisfied customers tell in average 10 persons about their bad experiences. 12% tells up to 20 other persons.
- Satisfied customers tell in average 5 persons about their positive experiences.
- It costs 5 times as much to gain new customers than keeping existing ones.
- Up to 90% of the unsatisfied customers will not make business with you again, and they will not tell you.

- 95% of the unsatisfied customers will remain loyal if their complaints are handled fast and well.

All above motivate us to improve quality. Improved quality can affect the success in many different ways :

- More satisfied and loyal customers
- Lower employee turnover and sick leave rates
- A stronger market position
- Shorter lead times
- Opportunities for capital release
- Reduced costs due to waste and rework
- Higher productivity

The above Figure demonstrates the importance of quality which expressed by Deming in 1986. In this figure, Deming connects improved quality with company prosperity.

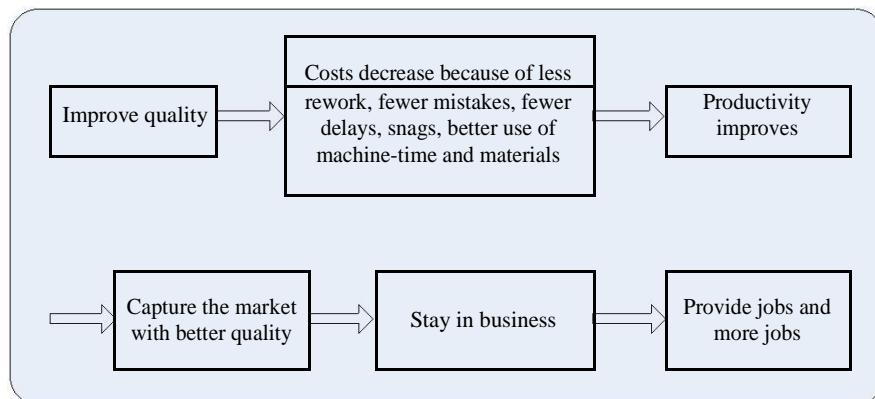


Figure The importance of quality from Deming.

As we seen, improving quality does not mean losing money in business. Proper improvement will bring organizations much more benefits.

Software Quality

Modern society is highly dependent on software products, i.e. bank system, telephone network, supermarket system, etc. “the general public usually blamed „the computer”, making no distinction between hardware and software”. However, millions of facts of software failures alert us to focus on software quality in everyday lives. Today, software customers are demanding higher quality and are willing to pay a higher price for it. Improving quality has become the common goal of each software development phase.

Similar with general quality concept ,high quality software shall have following factors :

- Developing in the right way.
- Matching the requirement specification.
- Good performance meeting customer's expectations.
- Fitness for use.

Combining with Gavin's five approach of quality concept, Kitchen ham and Pfleeger describe software quality in another way:

- *Transcendental view* – Software quality is thought as an ideal, but may never implement completely.
- *User view* – High quality software shall meet the user's needs, and have a good reliability, performance and usability.
- *Manufacturing view* – This view focuses on product quality during production and after delivery to avoid rework. Adopted by ISO 9001 and the Capability Maturity Model, the manufacturing approach advocates conformance to process rather than to specification. Hence, to enhance product quality, improving your process is very much essential.
- *Product view* – Be different with above views, product view assesses quality by measuring internal product properties. Software metrics tools are frequently used.
- *Value-based view* – High quality product always means a high cost. Different product purchasers always have the different value view. So that this approach puts much more efforts on considering the trade-offs between cost and quality.

Different views can be held by different groups involved in software development, i.e. customers or marketing groups have a user view, researchers have a product view, and the production department has a manufacturing view. It is not enough that only one view is identified explicitly. All views influence each other. Measuring each view clearly is one of assurances for high quality.

Software Process Improvement

Based on five approach of quality concept, process improvement aims to have a better control in software development. Managers or organizations generally divide the whole project into smaller phases, such as requirement analysis, planning, coding, testing, releasing, etc. These phases are known as the Software Project Life Cycle (SPLC). Within each project phase, we use iterative processes to achieve phase's deliverables. Figure

The below figure shows a typical iterative of project processes. Project processes are distributed into five groups – initiating process group, planning process group, executing process group, monitoring and controlling process group, and closing process group.

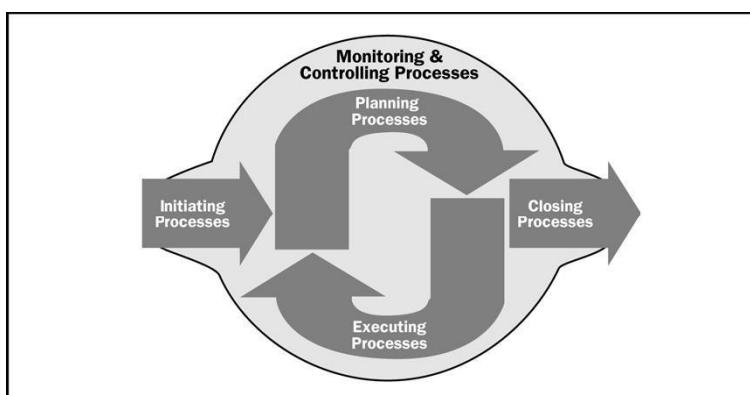


Figure 2.3 A typical project processes cycle.

Quality in a software product can be improved by process improvement, because there is a correlation between processes and outcomes. As defined by IEEE, process is “a sequence of steps performed for a given purpose.” It provides project members a regular method of using the same way to do the same work. Process improvement

focuses on defining and continually improving process. Defects found in previous efforts are fixed in the next efforts . There are many models and techniques for process improvement, such as CMMI, ISO9000 series, SPICE, Six Sigma, etc.

Six Sigma

History

In 1980s, Bob Galvin the CEO of Motorola was trying to improve the manufacturing process. The Senior Sales Vice President Art Sundry at Motorola found that their quality is extremely bad. They both decided to improve the quality. Quality Engineer Bill Smith at Motorola in 1986 invented Six Sigma. It was applied to all business processes. In 1988 Motorola Won the Malcolm Baldrige Quality Award, as a result other organizations were also interested to learn Six Sigma. Motorola leaders started teaching Six Sigma to other organizations. Initially Six Sigma was invented to improve the product quality by reducing the defects, but later Motorola reinvented it. The new Six Sigma is beyond defects, it focuses on strategy execution. It became a management system to run the business. It was invented for an improvement in manufacturing industry but now it is applied in almost every industry i.e. Financial Services, Health care and Hospitality. Originally Six Sigma was introduced in United States but now it is applied in many countries around the world.

Definition

Six Sigma is a structured quantitative method which is originally invented for reducing defects in manufacturing by Motorola in 1986. Its aim is using statistical analytic techniques to enhancing organization's performances, and to improving quality. Since Six Sigma has evolved over the last two decades, its definition is extended to three levels:

- Metric
- Methodology
- Management System

Six Sigma approach satisfies all the three levels at the same time. Those levels are discussed in the following sections.

As a Metric

“Sigma” is the Latin symbol “ σ ”. Here we use it to symbolize how much deviation exists in a set of data, and that is what we called *standard normal distribution*, or the *bell curve*. The normal distribution, also called the *Gaussian distribution*, is used for continuous probability distributions, see curves in Figure 2.4 [32]. The probability density function is shown as below – “ μ ” is the mean and “ σ^2 ” is the variance.

$$\frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right)$$

The standard normal distribution is “the normal distribution with a mean of zero and a variance of one”. From the figure, we can see that in a standard normal distribution, 50% of the values are under the mean and 50% of the values are above the mean.

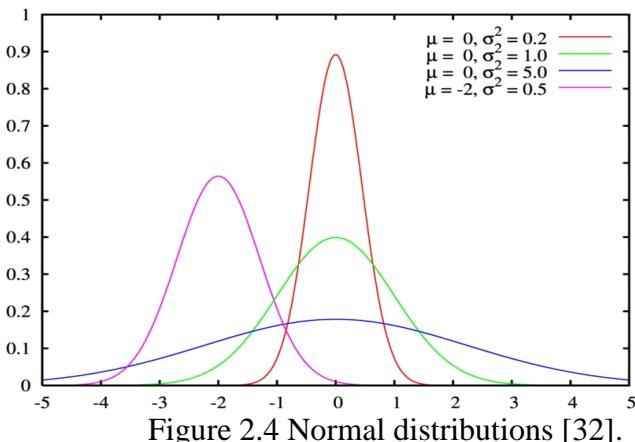


Figure 2.4 Normal distributions [32].

In Six Sigma approach, “Sigma” is used as a scale for levels of process capability or quality. According to that, “Six Sigma” equates to 3.4 Defects Per Million Opportunities (DPMO) Therefore, as a metrics, Six Sigma focuses on reducing defects.

Figure 2.5 demonstrates how Six Sigma measures quality. In the figure, if we achieve 68% of aims, then we are at the 1 Sigma level. If we achieve 99.9997% of aims, then we are at the 6 σ level which equates to 3.4 DPMO [36]. From this point of view, Sigma level is to show how well the product is performing. It seems this level can never be achieved. However, the Sigma level is not our purpose, the real purpose is to improve quality continually. The higher Sigma level we have reach, the higher quality we get.

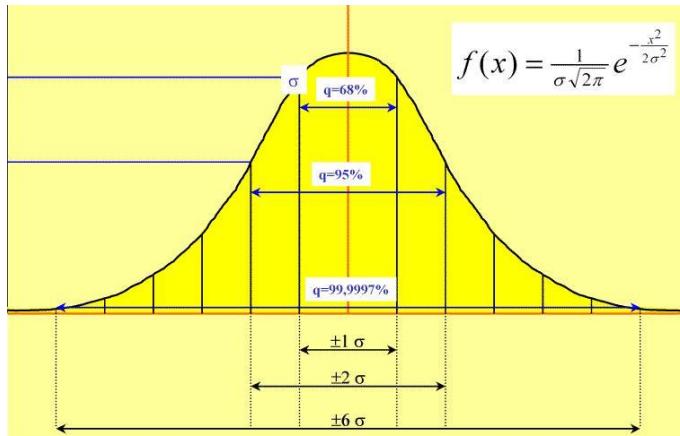


Figure 2.5 How Six Sigma measures quality [35].

Sigma Level Calculation

The calculation of Sigma level is based on the number of defects per million opportunities (DPMO). The formula is

$$\text{DPMO} = 10^6 * \frac{D}{N*O}$$

Where D means the number of defects, N means number of units produced, and O is the number of opportunities per unit. For example, a software company wants to measure their software product's Sigma level. In their product, there are 200,000 lines of code (LOC). For each LOC, the company performs one check to test the quality.

During the testing, 191 defects are detected. Then we have $DPMO = 10^6 * 191 / (200,000 * 1) = 955$.

A [4]), we can find the sigma level is 4.60. You can also find the free calculators on the website [38].

DPMO	Sigma Level
1,144	4.55
986	4.60
816	4.65

Table 2.2 A part of DPMO to sigma conversion table.

As a Methodology

Six Sigma approach is not just counting defects in a process or product, but it is a methodology to improve processes. The Six Sigma methodology focuses on :

- Managing the customer requirements.
- Aligning the processes to achieve those requirements.
- Analyzing the data to minimize the variations in those processes.
- Rapid and sustainable improvement to those processes.

When we look at Six Sigma as a methodology, there are many models available for process improvement like DMAADV, DMAIC, Breakthrough strategy, Roadmap, New Six Sigma, Eckes method, Six Sigma Roadmap, IDOV, and DMEDI [39]. The most widely used models are DMAIC and DMAADV. The DMAIC model is used when a process or product is in existence but is not meeting the customer requirements. And the DMAADV model is used when a process or product is not in existence or is needed to be developed.

DMAIC Model

Motorola implemented the first Six Sigma model called as MAIC (Measure, Analyze, Improve and Control). It was developed by Dr. Michael Harry. This model was used to solve the already known quality problems. GE, unlike Motorola was unaware of their quality problem. They needed a model that can firstly map the real quality problems and then to solve them. Dr. Michael Harry took advantage of his experience at Motorola and developed a new model DMAIC (Define, Measure, Analyze, Improve and Control). Nowadays this model is mostly in Six Sigma implementation. The phases of DMAIC model are explained as follows:

- Define phase is to define the customer's requirements and their expectations for product or services. To align the project goals with business goals. To define the project scope, the start and stop of the process.
- Measure phase is to develop a data collection plan for the current process. To collect data for the current process and to develop a measurement system. The measurement system is used to calculate the current performance of the process.
- Analyze phase is to find out the gap between the current performance and the goal performance. To analyze the collected data of current process and to determine the main factors of the poor performance. To find out the source of

- variation in the current process.
- Improve phase is to identify and select the right design solutions to fix the problems. The set of solutions to improve the sigma performance are selected on the basis of root causes identified in Analyze phase.
 - Control phase is to finally implement the solutions. To provide the maintenance of the improved process so that the improved Six Sigma process can run for a long time.

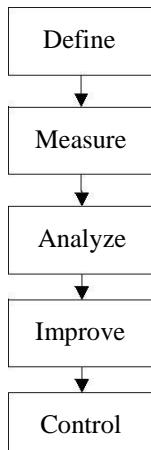


Figure Phases of DMAIC model.

DMADV Model

DMADV (Define, Measure, Analyze, Design and Verify) model was developed by Thomas Pyzdekis. This model is applied to the development of new processes or products. The phases of DMADV are described below:

- Define phase is to find out the customer needs and expectations and to define the project scope.
- Measure phase is to identify the CTQs (critical to qualities), process capability and risk assessment.
- Analyze phase is to develop the high level design concepts and design alternatives. To select the best design.
- Design phase is to develop plans for test verification, this may require simulations.
- Verify phase is to implement the process in operational scale.

As a Management System

Through experience, Motorola has found that using Six Sigma as a metric and as a methodology are not enough to drive the breakthrough improvements in an organization. Motorola ensures that Six Sigma metrics and methodology are adopted to improve opportunities which are directly linked to the business strategy. Now Six Sigma is also applied as a management system for executing the business strategy.

Six Sigma approach provides a top-down solution to help the organization. It put the improvement efforts according to the strategy. It prepares the teams to work on the highly important projects. It drives clarity around the business strategy.

TOOLS AND TECHNIQUES IN SIX SIGMA

we mainly describes the tools and techniques which are used in Six Sigma process improvement projects. By using those tools and techniques, Six Sigma projects become easier and effective.

Introduction

Since the Six Sigma approach is invented, many old quality tools are adopted in Six Sigma process improvement project. At the same time, some new specific tools and techniques are introduced. In the chapter, those tools and techniques are distributed in two parts.

The first part is related to the most popular 7 Quality Control (QC) tools. They are Cause-effect Diagram, Pareto Chart, Flow Chart, Histogram, Check Sheet, Control Chart, and Scatter Plot. Those tools are original gathered by Kaoru Ishikawa in 1960s. After these years' evolution and their easy-to-use property, 7 QC tools are applied in every quality improvement projects in various fields. In Six Sigma, they are extensively used in all phases of the improvement methodology.

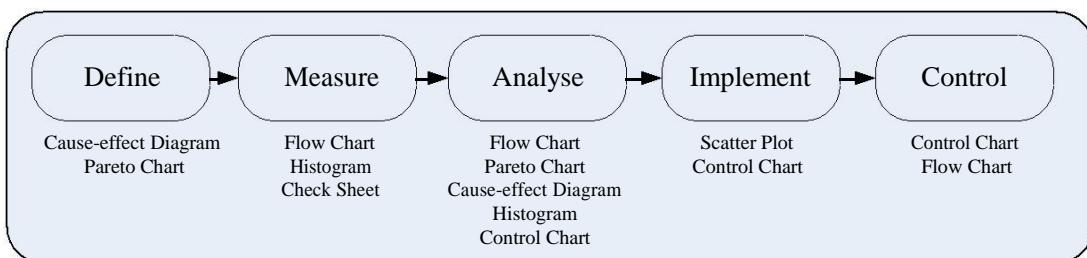


Figure 3.1 The distribution of 7 QC tools in Six Sigma.

Another part is a collection of special tools which are frequently used in Six Sigma projects. We also associate them with the five phases of DMAIC methodology

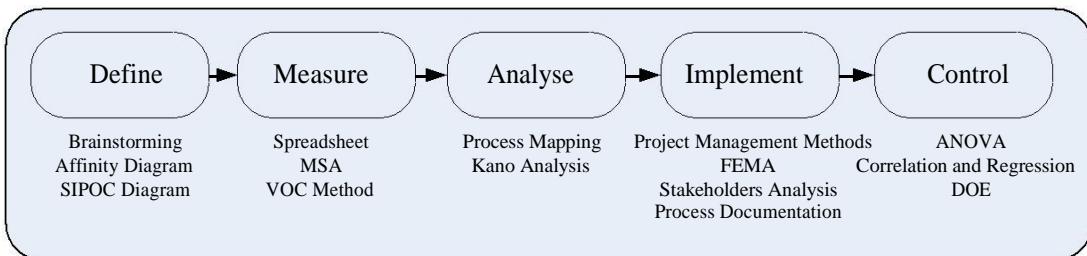


Figure 3.2 The distribution of other special tools in Six Sigma.

Seven Quality Control Tools

Seven quality control tools frequently used in Six Sigma projects are introduced in the following sections.

Check Sheet

The check sheet is used to collect data of the desired characteristics of a process that should be improved. If the collected data is incorrect, most efficient methods will result in a failure. In Six Sigma methodology it is used in the measure phase. The check sheet is represented in

a tabular form. The check sheet should be simple and aligned with the characteristics that are to be measured.

Histogram

Histogram is used in Six Sigma in the analyze phase. It is used to learn about the distribution of the data collected in the measure phase. Often we have huge data and each observation cannot be represented in figure. With the help of histogram the collected data is divided into different classes or intervals. The area of each rectangle in the histogram is proportional to the number of observations within each interval or class. So if we sum the areas of all rectangles it is equal to total number of observations.

When applying a histogram there should be at least 50 readings to get a good understandable shape of distribution. The number of intervals or classes should be between 6 and 12. To get the intervals it's good to take the difference of highest and lowest value in the data. If there are too many or too less data values or intervals then the histogram will be of a flat or peaked shape.

Pareto Chart

The Pareto chart was introduced by Joseph M. Juran in 1940s. Juran named it after the Italian statistician and economist Vilfredo Pareto (1848-1923). There are several quality problems to be addressed in a project. Often the problems are solved one by one. The Pareto chart helps in deciding the order of problems in which they should be solved. Pareto chart is related to the 80/20 rule found in business economics. The 80% of problems are because of 20% of causes

In the Six Sigma methodology Pareto chart has two main functions. Firstly in the define phase it helps in the selection of the appropriate problem. Secondly in analyzes phase it helps in identifying the few causes that lead to many problems.

Cause and Effect Diagram

The cause and effect diagram is also known as fishbone diagram or an Ishikawa diagram. It was introduced by Dr Kaoru Ishikawa in 1943, while working in a quality program at Kawasaki Steel Works in Japan [10, 47]. Once we have a quality problem its causes must be found. Cause and effect Diagram helps to find out all the possible causes of an effect (problem). It is the first step in solving a quality problem, by listing all the possible causes. In Six Sigma it is used in the define phase and analyze phase [10, 47, 49].

The reason that Cause and Effect Diagram is also called Fishbone Diagram is that it looks like a skeleton of a fish. The main problem is the head of the fish, the main causes are Ribs and the detailed causes are the small bones.

Stratification

Stratification is used to divide the collected data into subgroups. These subgroups help in finding the special cause of variation in the data. It provides an easy way to analyze the data from different sources in a process. It is used very less as compare to other quality tools but it is beneficial. In the Six Sigma methodology it is used in the improve phase. The collected data is usually stratified in the following groups: machines, material, suppliers, shifts, age and so on. Usually stratification is done in two areas but if the data is large than further stratification is also possible [10, 47].

Scatter plot

Scatter plot is used to define the relationship between two factors. Its main function is to identify the correlation pattern. The correlation pattern helps in understanding the relationship between two factors. In Six Sigma methodology it is used in the improve phase. Once you know the relationship between the factors then the input factor values are set in a way so that the process is improved.

While constructing the Scatter plot the input variable is placed on the x-axis and the output variable is placed on the y-axis. Now the values of the variables are plotted and the scattered points appear on the figure. These points provide the understanding of the variables and the process can be improved. Often there are many variables affecting the process, in this situation a series of scatter plots should be drawn [10, 47].

Control chart

The Control chart was introduced by Walter A. Shewhart in 1924. Industry is using Control chart since the Second World War. It is also known as Statistical Process Control (SPC). In Six Sigma methodology it is used in analysis, improve and control phase. In analyze phase Control chart is helpful to identify that the process is predictable or not. In improve phase it identifies the special cause of variation. And in control phase it verifies that the process performance is improved. It shows graphically the outputs from the process in different time intervals.

There are two main purposes of Control chart. First is the creation of a process with a stable variation. The second is to detect the change in the process i.e. alteration in mean value or dispersion.

Special Tools

Any technique which can improve process quality can be a Six Sigma tool. As said in above section, only seven QC tools are not enough for the whole Six Sigma projects. By investigating, we found many other tools which can also significantly help to improve process (Further information is provided in the website: <http://www.isixsigma.com>). Some of them are listed below.

Brainstorming

As defined by Alex Osborn [50], Brainstorming is "a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously by its members". It is designed to obtain ideas related to a specific problem as many as possible. It motivates people to generate new ideas based on their own judgments. If the environment is comfortable and participants feel free to announce their minds, it will produce more creative ideas. To organize an effective and successful brainstorming, you shall follow steps below:

- Define the problem which you want to solve. Only well defined problem could generate the best ideas. In contrast, an unclear defined problem will mislead participants.
- Set down a time limit and an idea limit. Generally the meeting is around 30 minutes to generate 50 to 100 ideas. It depends on the size of groups and the type of problem.
- There should be absolutely no criticism for any ideas. Everyone's ideas need to be written down even they are such impossible or silly. Try to keep everyone involved to develop ideas, including the quietest members.
- Once upon the limited time is over, select the best five ideas which everyone

- involved in the brainstorming agreed.
- Write down five criteria for judging which idea is the best one for the defined problem.
- Give each idea a score of 0 to 5 points which depends on how well the idea meets each criterion. Add up the scores when all ideas have been evaluated.
- The idea which gets the highest score is the best solution for the problem. At the same time, the other ideas shall be recorded as the alternatives in case the best one is not workable.

Brainstorming is a great way to generate ideas. During the brainstorming process there is no criticism of ideas which is to motivate people's creativity. Individual brainstorming can generate many ideas, but it is less effective for each one's development. This problem can be solved by group brainstorming which tends to produce fewer ideas for further development.

Affinity Diagram

The affinity diagram is developed by Kawakita Jiro [52], so it is also called KJ method. It is used to organize large number of data into logical categories. Generally, we use affinity diagram to refine the ideas generated in brainstorming which is uncertain or need to be clarified. To create an affinity diagram, we need to sort the ideas and move them from the brainstorm into affinity sets, and creating groups of related ideas. Below issues should be followed:

- Group ideas according to their common ground. The reason can be ignored.
- Using questions to clarify those ideas.
- If an idea has several characteristics, we should copy it into more than one affinity set.
- Combine the similar small affinity sets into one, and break down the complex sets.

The final result of affinity diagram shows the relationship between the ideas and the category, which can help brainstorming to evaluate ideas. And it is also considered the best method for the ideas without speaking.

High-Level Process Map (SIPOC Diagram)

SIPOC diagram is a Six Sigma tool which is used to identify all process related elements before we start to work. Predefine those factors can avoid we forget something which may influence the process improvement, especially in complex projects.

SIPOC is the logograms for "Suppliers, Inputs, Processes, Outputs, and Customers". All your works are to

- Identify suppliers and customers who will influence the projects.
- Obtain the inputs for processes from suppliers.
- Add value through processes.
- Provide outputs to meet customer's requirements.

Measurement System Analysis (MSA)

Measurement System Analysis (MSA), or called Measurement Capability Analysis (MCA), is used to assess the capability of process measurement systems by using experimental and mathematical methods. The purpose is to improve your measurement system, to ensure the system provides the unbiased results with little variations.

Because every project has the different background, so that needs we modify our measurement system to meet customer's needs. For example in tolerance measurement, it can be measured in millimeter, centimeter, decimeter and meter. MSA's job is to analyze customer's needs, and select the appropriate measurement scale. Other factors which influence the measurement system are :

- Cycle time
- Cost
- Stability
- Bias
- Linearity
- Response-to-Control (RtC) Variable Correlation and Autocorrelation
- Gage R&R (Repeatability and Reproducibility)

Voice of the Customer (VOC) Method

Voice of the customer method is a process to identify customer's requirements for high quality product. The customers come from different fields. External customers usually are common customers, suppliers, product users, partners, etc. And internal customers include employees from market department, product development department, and so on.

There are several ways to capture the voice of the customer – individual or group interviews, surveys, observations, customer specifications, complaint logs, etc. Through these methods, we can get the stated or unstated needs from the customer. By assessing and prioritizing those collected requirements, it provides ongoing feedbacks to the organization.

Kano Analysis

Kano analysis is developed by Dr. Noritaki Kano, it is a quality tool which help to prioritize customer requirements based on their satisfaction. That is because all identified requirements are not equally importance. The result can help us to rank the requirements and identify the few critical ones which have the highest impact. Furthermore, it can help us to make the decision.

In Kano analysis model, there are three types of customer needs.

- *Must-Be*. Must-be needs are the requirements that have to be met. The customers believe must-be needs are very basic which even do not have any necessary to discuss. For example, in a bank system, the deposit function and draw-out function are must-be needs.
- *Delighters*. Delighters are the needs which the customers do not expect. When those needs are met, the customers will be very happy. When user login the bank system, there are some bright music played in the background. However, he will still be angry when he cannot find any function related to the deposit. The delighters can only have the effects if and only if the must-be needs are met.
- *One Dimensional*. One-dimensional needs are the ones which need to be discussed and negotiated, such as the price. The customers will be more satisfied when the price falls. But on the other hand, the development company will be much unhappier.

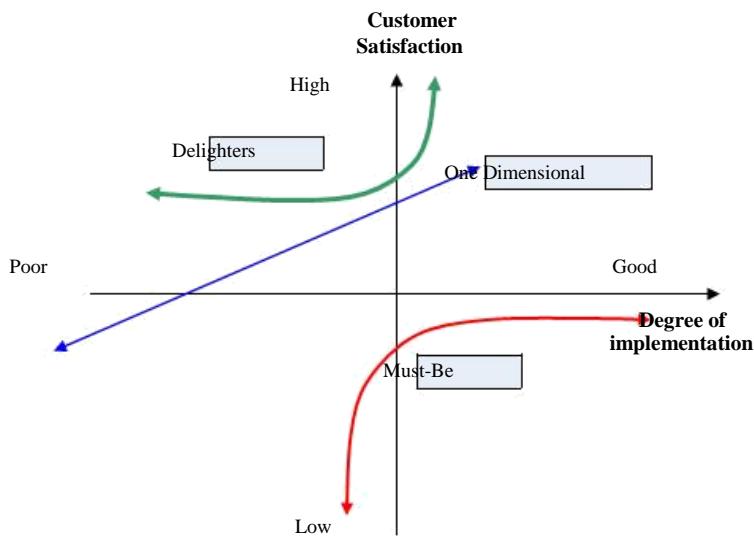


Figure 3.3 The Kano Analysis Model with three customer needs.

Using Kano Analysis in Six Sigma project to understand customers’ needs can help you to create more value for customers and make them satisfy with your products and services. Furthermore, priorities of requirements are assessed. This can help the company to figure out what are the customers most concerned which close the relationship with customers.

The Others

The other methods are seldom used, but still very helpful. They are

- *Project Management Methods* – The project management skills can significantly help the Six Sigma improvement projects, such as project planning, project charter, scheduling, communication, HR management, and project management tools.
- *Failure, Effect and Mode Analysis (FEMA)* – The main work of FEMA is to assess risks and put efforts on controlling and minimizing risks. Before you work with those risks and identify their causes and effects, using flow chart to prioritize them in the timely sequence is a nice choice.
- *Stakeholders Analysis* – Identifying the people who have a stake on the Six Sigma process improvement project. Those people will directly or indirectly influence the projects or results. The ones who are not satisfied will insist to changes.
- *Process Documentation* – Effective, clear, comprehensive process documentation is very helpful for the Six Sigma projects, such as process maps, task instructions, measures, etc.
- *Analysis of Variance (ANOVA)* – It is a collection of statistical models which analyzes the variations presented in the project. It is used to assess the differences between groups of data.
- *Correlation and Regression* – These tools assess the relationships (presence, strength and nature) among variables in process.
- *Design of Experiments (DOE)* – It is used to assess the performance of a process. Generally, it tests two or more characteristics under the different conditions. By comparing, the causes of a problem will be identified. It also can be used to optimize results.

SIX SIGMA IN MANUFACTURING

This chapter firstly analyzes the corporate framework of Six Sigma in manufacturing from academic view. After that, successful experiences from Company 1 and ABB are described. The aim is to identify what is the condition of Six Sigma in manufacturing. And it will help us to implement Six Sigma in software.

Manufacturing Corporate Framework

The corporate framework of Six Sigma has been launched by Motorola for many years. Lots of companies like GE, ABB, and AlliedSignal have enlarged during the implementation. Nowadays Six Sigma approach has become more pragmatic [60].

In [47], Magnusson and his copartners have make a comprehensive and deep analysis with this corporate framework. Figure 4.1 shows that there are four factors and one methodology (DMAIC) within the framework. Four factors are top management commitment, stakeholder involvement, training scheme, measurement system. Among them, top management commitment and stakeholder involvement is the base of the framework. Without them, the other factors and methodology are meaningless. All four factors support the core methodology which is used in every improvement projects [47, 61, 62].

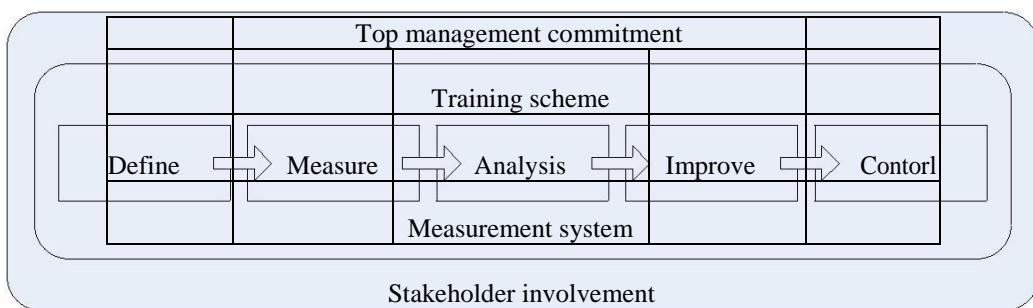


Figure 4.1 The corporate framework for Six Sigma.

Top Management Commitment

Top management commitment can be break down into three parts – top management, personal belief and commitment, and set a tough goal. Below we will discuss them separately.

- *Top management* – For a company, implementing Six Sigma is a strategic decision which aim to save cost and increase revenue. It needs to be taken by top management. Actually in many companies, Six Sigma is given the top priority [60]. The members of top management generally are the company owners, project sponsors and advocates. Those people shall be open-mind and hear the Six Sigma report frequently.
- *Commitment* – Top management needs a high degree of personal belief and commitment. When launching Six Sigma, any confusion or doubts about the top management will slow down the progress. Just like John F. Welch (CEO of GE) have said in his speech at the GE 1996 Annual Meeting in Charlottesville, “... we have selected, trained and put in place the key people to lead this Six Sigma effort, ... we have the balance sheet that will permit us

to spend whatever is requirement to get to our goal” and “... the return on this investment will be enormous”.

- *Set a tough goal* – It is the responsibility of top management. A clear goal can motivate people and lead them to success. At the same time, the tough goal should be achievable. Some companies set their goal for process performance to 3.4 DPMO (equals to 6σ). That is not impossible, but we can set it more intelligently. For example, we set the goal to reduce DPMO by 50% for each year. In reality this number is even higher. ABB have set the goal to be 68% for a yearly reduction, while GE’s goal is 80%.

From all above, we can say top management commitment is to select the right person to lead the Six Sigma effort, trust them and support their decisions, and set a smart tough goal which improves process performance continuously.

Stakeholder Involvement

Only top management commitment is not enough to reach the goal which is set for improving process performance. The companies also need stakeholders’ help. Stakeholders are people or organizations who will be affected by the product and who have a direct or indirect influence on the product [64]. Stakeholder involvement is to show the improvement methodology and tools of Six Sigma to stakeholders and get their support. The stakeholders can be employees, suppliers, customers, etc.

Stakeholder involvement can shorten the distance of companies with their suppliers and customers. They could give many precious opinions from their view, and those opinions can help to improve process performance or modify our Six Sigma activities. Supplier involvement is essential. That is because the variation in their products will be transferred to the company's processes. Sharing the Six Sigma information and process performance data can help them to improve their product quality, which indirectly improves the company's process. The Six Sigma can only become the success when tied with customers. They shall be allowed to join the process improvement, share the responsibility. Later on, they will be happy and proud since they are involved.

However, training for stakeholders is necessary. Some courses can help them to understand process improvement and Six Sigma comprehensively. And that can also help to improve their processes.

Training Scheme

Training in Six Sigma includes the knowledge of process performance, methodology, statistical tools, deployment, frameworks, etc. The experience from Motorola, GE, Dow Chemical, etc has proved the training can extremely be cost saving. In Motorola, the reported return on investment ratio was 29:1. In GE, the investment on Six Sigma increased from US\$ 250 million in 1996 to US\$ 450 million in 1998. They believe the high investment in Six Sigma training is towards to a rapid revenue growth and cost reductions.

Figure 4.2 demonstrates the Six Sigma training scheme. From the figure, we can see that there are five roles in Six Sigma – White Belts, Green Belts, Black Belts, Master Black Belts and Champions. According to the roles, Six Sigma training courses are divided into three levels – Basic level for White Belts, Medium level for Green Belts and Comprehensive level for Black Belts. In some companies, they have Yellow Belts between White Belts and Green Belts:

- *The Basic level course for White Belt* – provides a basic introduction of Six Sigma including some basic experiments, variations introduction, cost of poor quality, etc. Generally, it only spends one day and is offered to front-line

employees.

- *The Medium level course for Green Belt* – is the advanced version of Basic level. The participants are selected to learn some Six Sigma tools, measurement, process management, and how to use improvement methodology in the real projects.
- Comprehensive level course for Black Belt – is more comprehensive and aims to create full-time improvement experts. In the course, the participants are required to perform an improvement project to save a specific cost.
- Two additional course – Six Sigma engineering and Six Sigma management focus on process design and interaction management separately.

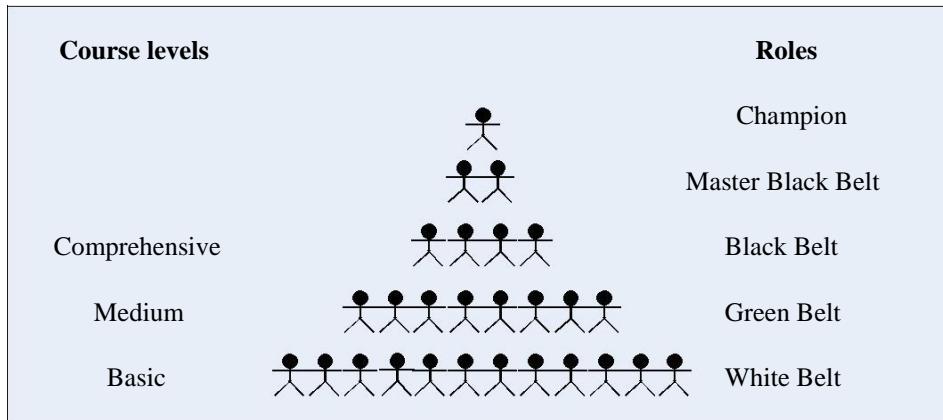


Figure 4.2 The Six Sigma training scheme with course levels and roles.

Two other roles are Master Black Belts and Champions. Master Black Belts are selected from the people who have Black Belt qualifications. Their job is to teach Six Sigma courses within Six Sigma training scheme. Champions who are on the top of organizations drive the whole process. Those people have extra experienced knowledge of Six Sigma, take part in selections of improvement projects, and make decisions.

The number of people play different roles depends on the size of company. For example, in a 2,000 employees company, it should have one Master Black Belt at least. There should be 20 Black Belts for every Master Black Belt and 20 Green Belts for every Black Belts.

Measurement System

Measuring process performance can help us to identify problems from poor process performance, which is good at solving problems in the early stage. A simply metric – DPMO (Defects Per Million Opportunities) – is used to evaluate the variation in critical-to-customer characteristics of processes and products.

There are two types of characteristics that can be included in the measurement system – continuous characteristics and discrete characteristics. Discrete characteristics are number-related, which provides attribute data. Generally, most of observations are applied for it. Measuring continuous characteristics can provide continuous data which could assist all observations. Although two types of characteristics are measured and analyzed differently, the results shall be combined into one number (the average of all individual characteristic results) for the whole company's process performance. This combined DPMO value is simple and easy, and it can make the attention of whole company on the process performance.

Improvement Methodology

After the foundation is settled, a specific Six Sigma project can be started. Six Sigma approach provides a formalized improvement methodology – DMAIC model. This model starts with a define phase, and other four specific phases are followed – measure, analysis, improve, and control.

Define

This phase is to select the proper improvement projects and identify process to be improved. One of most valuable source is Six Sigma measurement system. The DPMO value has indicated the poor performance process. Other valuable sources are customer complaints, competitor analysis, employee suggestions, etc. In general, only poor performance processes or characteristics need improvement. Otherwise, the whole product shall be improved.

Among a number of potential improvement projects, the Pareto chart and the cause-effect diagram can be used for prioritization. The criteria are:

- Benefits for customers.
- Benefits for company.
- The complexity of the process.
- Cost saving potential.

With the help of above criteria and statistical tools, a characteristic or process will be identified for improvement. At the same time, a team shall be organized for the improvement project. In this team, a project sponsor from top management shall be appointed, which is to ensure that the project gets top management's focus. Other members like Black Belts who is responsible for management and making decision, Green Belts and White Belts who assist Black Belts' work. It is obviously that all the team members shall have a great understanding with Six Sigma. Several Six Sigma training courses are essential.

Measure

There are mainly two jobs in measure phase. The first one is to assist define phase for improvement project selection. Before the improvement project is defined, several characteristics or processes shall be measured. Most of Six Sigma companies apply the mental model (i.e. „Y is a function of X“). Y is selected from variation results through Six Sigma measurement system, while X factors which influence Y need to be identified for each Ys. The relationship is demonstrated in Figure 4.3.

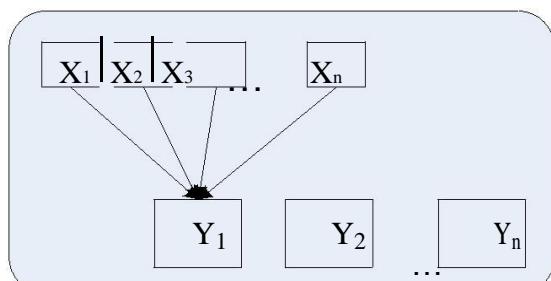


Figure 4.3 Relationships between Ys and Xs.

The other job of the measure phase is to collect the data for the selected Ys and Xs. Before the selection decision is made, related data such as types, sizes, measurement

intervals, and how to record the data are needed. Be different with the measurement of process performance, measurement of Ys and Xs are more detailed and project related.

Analyze

Analyze phase assesses the data which is collected for Ys and Xs. By assessment, the performance of Ys can be calculated in terms of DPMO values or sigma values. After comparing those values, similar processes can be discerned. Based on those analyses, a goal for improvement can be set.

Improve

All of activities within improve phase are included in below Figure. It starts from deciding if the selected Y or Ys need to be improved. Then we need to identify and measure Xs which associate with the decided Y or Ys. A group of statistical tools and experiments are applied to find out the improvement opportunities. We can also identify the special causes for variations among the Xs. If the result is that those variations can be improved, then they should be removed or their impacts reduced. On the other hand, if there are no special causes which are identified or those variations cannot be improved, we shall reapply statistical tools and redesign experiments. If the results do not change after several iterative, we shall consider that might be the design problems of process or product. Then, the process or product is designed with the aim of improvement.

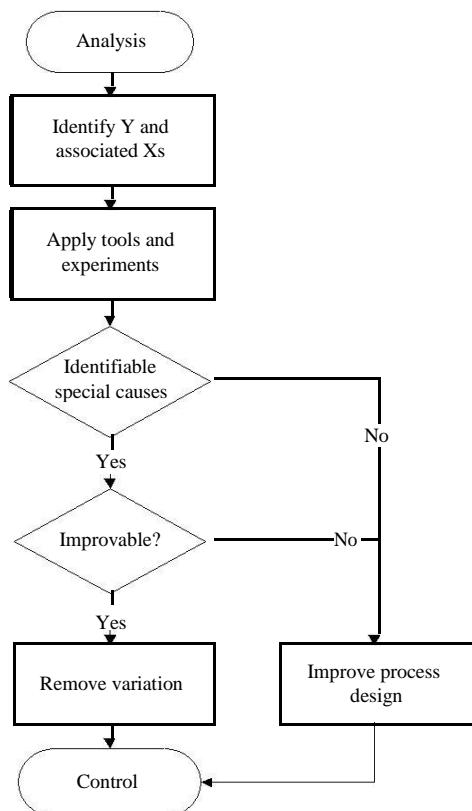


Figure The flow of activities in improvement phase.

Control

There are also two activities in control phase. After improvement phase has been carried out, the planned improvements shall be verified. Improper or incorrect improvements will be discovered and corrected in the next improvement project. Control Chart and DPMO Track Chart are highly recommended to verify the long-term effects of improvements.

Another important activity in this phase is to formalize the results. The results which only match a single process or product will be reorganized and reanalyzed to match the whole company. Both successful and failed cases shall be formalized, reported and stored. The companies should gain experience from those cases for further improvements. Based on that,

THE ACCEPTANCE AND MOTIVATION OF SIX SIGMA IN SOFTWARE COMPANIES

This chapter discusses the different views on applying Six Sigma in Software companies and the differences between manufacturing and software processes. Furthermore two questions are addressed. First one is the acceptance of Six Sigma in software companies. Second one is why software companies should adopt Six Sigma approach.

Different Views on Applying Six Sigma in Software Companies

Since Six Sigma approach was successfully applied to manufacturing industry for more than two decades, it is considered as a new star in the world of quality. There is a common misconception that Six Sigma is only applicable for manufacturing industry. The application of Six Sigma in software companies has faced many controversies. There are many different views on applying Six Sigma in software companies.

Binder's View

Binder has pointed out three main difficulties. Based on the three difficulties, Binder claimed that Six Sigma is not applicable in software companies. The three difficulties are:

- *Processes* - Software processes are fuzzy as compare to the manufacturing processes. So the application of Six Sigma is easily established and documented in manufacturing, not in software.
- *Characteristics* - There are difficulties in meaningful measurements of software characteristics. Software cannot be measured as weight, distance, width, etc. Total number of faults cannot be measured in software.
- *Uniqueness* - Manufacturing products are generally mass produced but software products are one-off.

Binder's view is doubtful because only on the basis of three differences, he denied the applicability of Six Sigma in software. In order to identify the real situation, we need a comprehensive understanding about the differences between manufacturing and software.

Two Misconceptions Debunked by Tayntor

Managers cannot deny the importance of reducing defects, increasing customer satisfaction and operating more efficiently. Many software companies are now adopting Six Sigma. Claimed by Tayntor, there are two misconceptions associated with Six Sigma in software companies. The first is that, Six Sigma is a statistical analysis, so it is applicable for manufacturing and engineering processes and it has very little or no relevance to software. The second is that Six Sigma cannot be

adopted in just a few areas of the company. It should be applied to the entire company. Both these misconceptions should be debunked.

Six Sigma Has No Relevance in Software

There is some misconception that Six Sigma applies to manufacturing processes but not to software. The truth is that the tools and techniques of Six Sigma can help software companies by ensuring that the “three rights” are in place.

- *The right people are involved* – Many software projects fail because of poor requirements. Poor requirements are caused because all stakeholders are not represented or they participate very late in defining the requirements. Six Sigma approach solves this problem by focusing on teamwork and clearly identifying the customer's requirements.
- *The right problem is solved* – Six Sigma tools not just clearly identify the customer's requirements but also impact on the proposed solution. Proper use of Six Sigma tools helps in focusing on the high value system components.
- *The right method is employed* – Six Sigma tools helps the software companies by evaluation the processes and finding the variation in them, finding the causes of defects and ways to prevent them. Example if a project is over budget Six Sigma techniques finds out the main causes and the ways to correct them.

Six Sigma Is Applied in Whole Company

The second misconception is that the Six Sigma is only helpful if the whole software company has adopted it. This is a fact that it is easier for a software company to implement Six Sigma if the whole company adopts its philosophy. But there are benefits of adopting Six Sigma tools and incorporating the processes into software development, even if the whole company is not using Six Sigma.

So Six Sigma has applicability to software companies. The reasons for adopting Six Sigma are clear – fewer defects, faster delivery and increased customer satisfaction.

Cost Misunderstanding

There is a misconception that designing a system to Six Sigma is very expensive [36]. Since Six Sigma focuses on the quality from the beginning of a project so it has minimal cost to improve quality. On the other hand if we wait up to the testing phase in finding the defects then the cost to fix the defects is very high. A cost and benefit analysis should be done in the Six Sigma program to determine the actual gains.

Why Software Companies Choose Six Sigma Approach?

After the above discussion there is a question that does Six Sigma make sense in software companies. The answer is yes, Six Sigma is good for software companies especially for the following situations.

- *Legal Responsibility* – Six Sigma approach helps to fulfill the legal responsibility. Now-a-days if something goes wrong people go to the lawyers according to Human Rights Act. Up to now disasters are not blamed on software's but software's can cause huge disasters. Software has many identical copies. These copies are installed in different companies. If there is some defect in the software then all the companies are at great risk of failure. Even the most powerful companies like Microsoft are fearful to such failures.
- *Mission Critical Systems* – Now a day's software's are developing for mission

critical systems. The failure of a mission critical results in a great loss to society. Here comes Six Sigma which means 3.4 defects per million opportunities, it can prevent the software from failing. In 1988, American Airlines lost 59 million dollars in ticket sales. The problem was the discount ticket was mistakenly blocked in the ticket reservation system. As a result travelers moved to their competitors. These weaknesses can be removed by Applying Six Sigma which provides near defect free performance.

- *Complex Systems* – The application of Six Sigma is very effective in case of complex systems. For example there a complex system with like 1000 modules if all the parts are designed according to Six Sigma than there is a higher probability of getting a defect free system.
- *Software Company* – Software companies have a bad reputation of buggy and late. Today software size is very large like more than thousands of lines. It has more probability of having many defects. In this situation Six Sigma can help us to get a near defect free product.

STEPS TOWARDS APPLYING SIX SIGMA IN SOFTWARE COMPANIES

we presented a method by steps for applying Six Sigma in software companies. It is conducted by integrating all previous research findings.

The method which will be presented contains two main parts – environment establishment and an enhanced methodology. The first part is the foundation for conducting process improvement projects, while the other part is the main way to direct the project. Those two parts are presented separately as below.

Environment Establishment

Before we apply the methodology to development process, the Six Sigma environment shall be established first. We know a good Six Sigma environment not only support the implementation of Six Sigma project, but also continually cultivates Black Belts as the main force for Six Sigma team.

Magnusson and his partners have recommended twelve steps for introducing Six Sigma to manufacturing companies. Magnusson uses many evidences and real cases to prove his method's functionality. And we believe it really can help to establish Six Sigma environment. However, all cases and evidences point to manufacturing field. And Magnusson also has said "Black Belts themselves may find it difficult to drive improvements in non-manufacturing process". About applying Six Sigma approach to other field of process, for example software company, we are very sorry to say there is no answer in Magnusson's book.

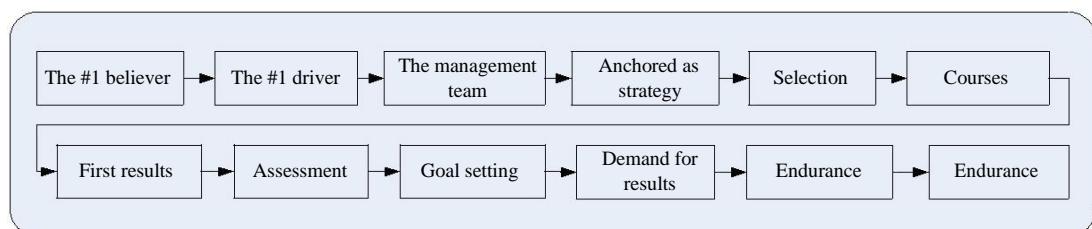


Figure Twelve steps for introducing Six Sigma to manufacturing company.

However, Magnusson and his partners have shown us a way to solve the problem. If we integrate his method with software specific attributes, a specific method for software Six Sigma environment establishment is conducted.

Reform Superstructure

As we know, Six Sigma is a top-down approach. In software, generally there is a Project

Management Office (PMO) which controls all company's projects. So the superstructure of company shall be reformed first. Everyone within the PMO shall have a good understanding about Six Sigma approach, especially for CEO/CTO, Master Black Belt, human resource manager and financial manager.

CEO/CTO is the most importance person who supports the Six Sigma projects. Their work is resource allocation, task deployment, budget works, etc. In some sense, the success of implementation depends on how well the CEO/CTO knows the Six Sigma approach.

Master Black Belt (MBB) is the person who takes Champion position in Six Sigma projects. He/she is the coach who drives the whole process improvement project. In software companies, the special attributes require that MBB should have not only the excellent Six Sigma knowledge, but also the expert software project knowledge. CTO or Chief Software Architect (CSA) is the best options. Otherwise, a project manager with the Black Belt certificate can also be promoted as the Champion. A Champion's work can be summarized as identifying improvement opportunities, developing action plan, leading to apply Six Sigma tools, communicating, and coaching.

Human resource manager and financial manager are also important roles within Six Sigma projects, which we have not mentioned before. Human resource manager need to help Black Belts selection, while financial manager is responsible for the cost reduction calculation.

Six Sigma is not only a methodology, but also a business strategy. If we want to have a successful Six Sigma project, top management's support is very essential. That is why reforming the superstructure is needed.

To reform the superstructure, company can invite Six Sigma specialists as the consultant, or launch a specific Six Sigma course for top management. However, above options can only solve the problem temporary. The best way is to establish a Six Sigma education system which conducts a long-term effect.

Establish Six Sigma Education System

A grouped Six Sigma course is very necessary for companies from top to down. A well-designed education system can continuous cultivate talents for Six Sigma projects. Six Sigma approach will not conduct long-term improvement without education system's support. That is why establishing an education system is so much essential.

Six Sigma course shall include both high-level which aims to Black Belts, and low-level which cultivate Green Belts (some companies may need a middle-level for Yellow Belts). Different levels share a same weightiness. A great number of full-time Black Belts are the guarantee for Six Sigma projects. They lead each single Six Sigma project, create project plan, communicate between project team members, and be responsible to report project status to top management. Generally, the selection of

Black Belts is among project managers within the software company. Because in software, Black Belts shall not only need a great Six Sigma knowledge, but also own an expert software knowledge. Generally, candidates shall also have following attributes:

- Good education background – this is an education course. Good education background means learn fast.
- Young enough – young project managers can easily accept new concepts.
- Full-time work – Black Belts require the people put all his time and focuses on Six Sigma projects.

Green Belts are the main force for Six Sigma activities. They are the actual workers who carry out project plan. Without them, the Six Sigma projects are just papers. The candidates of Green Belts can be selected among common employees within the company.

Generally, the Black Belt courses are lead by MBB. And the selected Black Belts are responsible for Green Belt courses. In courses, a Six Sigma project must be run as a homework assignment for all participates. As the first project, successful cases will be recorded and shared within the whole company. By using this, the employees will be encouraged and motivated for learning Six Sigma.

Continuous Improvement

Why continuous improvement? That is because the quality will not be improved in just one single process improvement project. Continuous improvement focuses on a long-term performance. Numbers of improved processes and Six Sigma projects may lead a visible quality effect. It is not an easy job. On the other hand, if we do not keep continuous improvement, the performance of processes may turn back to the original or even worse. So, continuous improvement is necessary and important to company.

Continuous improvement is not just banners which catch people's eyes. Indeed, it is made up by numbers of actual activities. For example, spread the successful improvement results to the similar processes, build up a common software development standard, provide some specific training to new group members, etc.

The Six Sigma environment will not improve quality and bring profits immediately. In contrast, it costs lots of resources and time. However, the environment is the foundation for all Six Sigma projects. Without that, the result of improvement will not last too long, and finally the improved process will back to before. To keep a long-term performance, environment establishment is very essential, and the cost will come back due to the improvement of quality.

An Enhanced Methodology

Methodology Selection

After the Six Sigma environment is established, we can start the real improvement projects. There are a number of methodologies can be used. Two main methodologies are recommended by Six Sigma approach – DMAIC model and DMADV model. The first one is used in existing process improvement. And the DMADV model is used in new process development.

Since all cases in Chapter 6 use DMAIC model, so in this section we decide to introduce this most popular model. The criteria for the proposed steps in the most used activities within each phase of the DMAIC model.

Enhancing DMAIC Model

DMAIC model is named by its five phases – Define, Measure, Analyze, Improve and Control. By analyzing previous cases, this methodology is enhanced by integrating with what have been learned from research. Authors describe those five phases separately in below sections.

Steps in Define Phase

In first phase, project members shall have a “big picture” of the process, which needs to be improved. To achieve that, process, problems, related customers and their requirements shall be identified first. After that, several properties shall be developed, such as project goal, scope, team, project plan, etc. From all cases which are introduced in Chapter 6, a comparison is conducted to identify differences and similarities (see Table 7.1).

Case Name	Activities	Tools
Company 1	• Identify problem.	• SAP Method
	• Define project goal, project scope, and project plan.	
	• Organize project team.	
	• Create project charter.	
Company 2	• Project charter.	• SIPOC Diagram
	• Critical to quality.	• As-Is process
	• A process map.	
Case A	• Create project charter.	• SIPOC Diagram
	• Identify problem.	• Kana Analysis
	• Collect voice from customers.	• VOC
	• Define project scope.	• Quick Wins
Case B	• Define project goal.	• As-Is Process
	• Process Breakdown.	• Process Metrics
	• Identify problem.	• KSAP
	• Organize project team.	
Case C	• Create project charter.	
	• Define project goal.	• Process Mapping
	• Define quality critical factors.	
	• Organize project team.	
	• Identify problem.	
	• Define measurement system.	

Table Activities comparison for measure phase between four cases.

Steps in Measure Phase

Case C To discover the variations, the input data associated to the selected initial problem shall be measured, and then exports measure results to the following analysis phase. Below is the measure phase comparison for all cases

Case Name	Activities			Tools
Company 1	• Measure main problems and its causes.			• Process Mapping • XY Matrix
	• Prioritize causes and get the top six causes.			
	• Reported defects with severity level.			
Company 2	• Time spent on correcting defects. • Lead time of defect correction. • Amount of overdue invoices.			
Case A	• Identify what to measure. • Evaluate the measurement system • Data collection. • Identify sources of variation. • Calculate Sigma level. • Set software reliability goal.			SIPOC Diagram COQUALMO
Case B	• Measure problem related data. • Collect information. • Check errors. • Determine process baseline.			
Case C	Measure the critical of quality Histogram factors Assess poor input variables			

Table: Activities comparison for measure phase between four cases.

Steps in Analyze Phase

By analyzing the measure results from the above phase, we can identify the sources of the variations and develop the methods to reduce them. Following table is the comparison of all cases' activities in analyze phase.

Case Name	Activities			Tools
Company 1	• Analyze problem sources. • Conduct solutions. • Ask why until root cause			• 2-Proportion • Regression Analysis • Two-Sample Test • Kruskal-Wallis Test • Cause and Effect Diagram

Company 2	found.	• Pareto diagrams
	• Process map analysis.	
	• Analyze sources of variations.	• Pareto Analysis • GO Model
Case A	Identify the correlations between software factors and defects.	
Case B	• Identify problem sources. • Refine process.	• Cause and Effect Diagram

	• Conduct solutions.		
	• Identify key problem sources.	• Cause and Effect Diagram	• FMEA
Case C	• Identify relationship between variables.		
	• List defect causes.		

Table Activities comparison for analyze phase between four cases.

Steps in Improve Phase

When the project moves to this phase, the problem and its root causes are clearly identified and discovered. Additionally, the best solution and its backups are also ready. Now it is time to make the proposal come true.

Case Name	Activities	Tools
Company 1	Design experiments to verify solution. • Apply improvements.	• Pareto Chart
Company 2	• Cost/benefit analysis. • Solution alternatives.	
Case A	• Identify solution alternatives • Implement improvements.	
Case B	• Apply improvements	
Case C	• Apply improvements. • Get customer feedbacks.	• Check List

Table: Activities comparison for improve phase between four cases.

Steps in Control Phase

The project will never close without this phase. The last phase aims to long term performance. Without this phase, the process will turn back to its original status, and the improvement result will not last too long.

Case Name	Activities		Tools
Case C			
Company 1	• Develop strategy to avoid problem		
	happen again.		
	• Document project experience.		
Company 2	• Apply Improvements.	• Check list	
	• Store lessons learnt during project.		
Case A	• Assign responsibilities.		
	• Performance view.		
Case B	• Assess performance.		
	• Conduct new goal for further improvement.		

- Calculate Sigma level.
- Spread success to other Six Sigma projects.

Table : Activities comparison for control phase between four cases.

What are the definitions of Six Sigma?

A detailed literature study is carried out to find out the definitions of Six Sigma. The literature study consist of articles, web materials books. The Six Sigma has definitions at three levels i.e. matrix, methodology and strategy. At matrix level Six Sigma is 3.4 defects per million opportunities which means 99.9997% defect free product. Six Sigma approach at methodology level is not just counting defects in a process or product, but it is used to improve processes. When we look at Six Sigma as a methodology, there are many models available for process improvement like DMADV, DMAIC etc. At strategy level, through experience, Motorola has found that using Six Sigma as a metric and as a methodology are not enough to drive the breakthrough improvements in an organization. Motorola ensures that Six Sigma metrics and methodology are adopted to improve opportunities which are directly linked to the business strategy. Now Six Sigma is also applied as a management system for executing the business strategy.

What is the condition of Six Sigma in manufacturing?

An interview 1 is conducted with company 1 in China to see the condition of Six Sigma in manufacturing. Also a real case study is conducted with company 1 to understand how Six Sigma is used to improve a process. We found that Six Sigma approach has been successfully applied in manufacturing for two decades. From the successful experiences, a successful Six Sigma project must base on at least four foundational activities. They ensure the progress of projects from top management to human resources. They are

- Top management
- Stakeholder involvement
- Training scheme
- Measurement system

When the foundation is well settled, a specific Six Sigma project can be started. From the successful cases, some models can be borrowed to help us to run the project.

DMAIC model is a formalized improvement methodology which is the most popular one from successful cases. It contains five phases – define, measure, analyze, improve, control. Each phase has a clear defined aim and an outcome. It is not very hard to follow this sequence and achieve the project goal.

The applicability of Six Sigma in software's and why software companies choose Six Sigma?

Six Sigma approach can be applied in software companies if we involve the right people, solving the right problem, and using the right method. At the same time, although using Six Sigma approach for process improvement costs a lot, it worth. Few defects, faster delivery and increased customer satisfaction will generate more potential profits than you think.

The differences between software and manufacturing are obvious and unavoidable. The main distinct factors of software are non-repetitiveness, unique input and output, cognition, visualization, and some external factors such as employee's skill and knowledge. These differences are reflected on the software product and software process. Still applying Six Sigma approach in software companies is beneficial. Firstly, all deny opinions and misconceptions are built on the misunderstanding of Six Sigma approach and unfamiliar with the software. Secondly, we never say applying Six Sigma approach in software is just the copy of manufacturing's method. The differences do exist. According to them, we need to modify the Six Sigma approach, as the same time with the software process. Change them to fit for software's processes. And that demands further research and more experiments. It can help software companies to reduce defects, improve quality, increase customer's satisfaction, and enhance market-share. That is also the answer of why software companies choose Six Sigma, especially for complex systems, mission critical systems, and legal responsibility.

What kind of tools and techniques are used in Six Sigma? Which of them are suitable for process improvement in software companies?

There is no a specific tool or technique for one specific phase in Six Sigma. Any tool that is helpful for the process improvement can be applied in Six Sigma project. However seven quality tools are most widely used in all kinds of quality improvement. They are Cause-effect Diagram, Pareto Chart, Flow Chart, Histogram, Check Sheet, Control Chart, and Scatter Plot. The other special tools are gathered from successful Six Sigma cases which include Brainstorming, Affinity Diagramming, SIPOC Diagram, MSA, VOC Method, Kano Analysis, and so on. Using the proper tool in the right place is the key factor which influences success.

What is the state-of-art for the implementation of Six Sigma in software?

Interview 2 is conducted to analyze the current state of Six Sigma in software's. Furthermore different case studies are reviewed to find out the state-of-art for the implementation of Six

Sigma in software's. In each case, the Six Sigma project starts from defining the project goal and the problem which needs to be solved, then project team. The team members are selected from all levels inside or outside of company, for instance, CEO who comes from the top of company, Team Leaders who lead the project, customers

involved from outside of company, and other members come from different departments within the company.

DMAIC model divides Six Sigma project into five phases. In each phase, there is a clearly define input and output. The output of the previous phase normally is the input of the next phase. In each phase, there are several steps to achieve phase goal. Numbers of quality tools are introduced to each step. There is only one criterion for quality tool selection – fitness for use. When the Six Sigma project is terminated, gained experiences will be documented and applied in other Six Sigma projects. Sometimes the project goal cannot be achieve by only one Six Sigma project. Then more Six Sigma projects can be organized according to situation. The spirit of Six Sigma approach is towards a long-term improvement.

Steps towards applying Six Sigma in software companies for process improvement?

We have provided a method for the implementation of Six Sigma in software companies. The method was divided into two parts – environment establishment and an enhanced methodology.

The Six Sigma environment is the basis for all Six Sigma improvement projects. It provides fully support and guarantee (financial, strategy, human resources, top management, etc.) to keep project towards success. Environment establishment step contains three activities. The first one is to reform organization's superstructure. In some place, it was called top management. The main purpose is to gain top management's trust and commitment. If a Six Sigma project loses top's focus, it won't last to the end. Meanwhile, the principle of Six Sigma approach is continuous quality improvement. It needs continuous support from the superstructure. The second important activity is to establish Six Sigma education system. Long-term improvements need numbers of quality specialists. This system is built for this aim. Finally, company needs to establish some necessary standards or rules to keep continuous improvement.

DMAIC has been selected as the main model for organizing Six Sigma project. Research findings and software properties have been integrated with the selected model. Its functionality has been enhanced to meet software company requirements. Activities and quality tools were blended with each step in each model phase. By the purpose of practicability and authenticity, most of them came from interviews and case study reviews. Authors anchor their hopes on using this method to help software companies for quality improvement, and also supporting quality researcher's further research

What is the further work for Six Sigma in software?

We found a few areas during our research. These areas are related to Six Sigma and are very interesting for further research. Below is provided a list of topics.

- Comparing Six Sigma with other quality techniques.
- Blending Six Sigma with CMMI.
- Six Sigma for small sized companies.
- Lean Six Sigma.

Contributions

- Analysis of the applicability of Six Sigma in Software's.
- The state-of-art for the implementation of Six Sigma in software.
- Steps towards applying Six Sigma in software companies for process improvement.

Six Sigma and Agile Software Development

Agile software development and Six Sigma both focuses on satisfying the customer requirements. Their end goal is same. Both focus on reducing the failure rates and improving the customer satisfaction. The way an agile software development project runs, it closely parallels the way Six Sigma DMAIC approaches the project.

Agile principles align with Six Sigma

The Table below shows the Agile principles align with Six Sigma.

Agile Principles	Six Sigma Alignment
The main focus is to satisfy customer through timely quality software.	Six Sigma provides strong tools to gather requirements and measure customer values.
Business people and developers both are involved throughout the project development.	Six Sigma provides clear or more visible requirements and design so that they can be discussed between business and development people.
Attention to technical issues and good design throughout the development.	Six Sigma compares different design choices based on technical issues which drive continuous attention.
Provides simplicity means maximizing the kind of work that should not be done.	Six Sigma clarify that what is important and what is not.
Agile processes provide sustainable development.	Six Sigma helps in sustainable and long term pace development.
The most suitable method for information sharing is face-to-face conversation.	Six Sigma also subscribes to this.
Frequent delivery of working software i.e. weeks, months.	Six Sigma also stay away from the bigger deliveries.

Table Agile principles align with Six Sigma.

Requirements understanding

The most common reason behind the failure of a software project is misunderstanding the user requirements. Agile methods use an iterative approach for requirements understanding. In Agile software development the customer is very much involved which make it easier to understand the requirements. In Six Sigma one of the primary objectives is to align business goals with the customer requirements. The DMAIC phases focus on customers' expectations and its tools help to achieve this goal.

After the above discussion we can conclude that Six Sigma tools together with Agile development can help in understanding the real needs of the customer. In next section, the use of some Six Sigma tools with Agile projects is presented.

Agile software project and Six Sigma tools

In an Agile software development project Six Sigma tools can bring large benefits i.e. improved quality. Following are some Six Sigma tools and their application with Agile software development projects. The examples are from the two popular methodologies Scrum and Extreme Programming.

- **Using Voice of the Customer:** In Six Sigma voice of the customer (VOC) is used to understand the customer's needs. Using this technique the customer is identified and the data is collected. In Agile software development project the customer is present in the team meetings. However, in huge projects with large organizations there are many direct and indirect customers. It is unfeasible to have everyone and discuss all the issues in the sprint review meeting (in the Scrum methodology). Using VOC before coming to the sprint review meeting will make the meeting more useful.
- **Building a Critical-to-quality Tree:** In Six Sigma a critical-to-quality (CTQ) tree is used to convert the customer requirements into specific features in the final product. It will be useful to draw the CTQ tree in the sprint review meeting.
- **Failure Mode and Effects Analysis for Design:** Failure mode and effects analysis (FMEA) design is used to keep track of the design failures with the project progress. Agile projects are iterative projects. To the iteration, design decision based on requirements can be a risk for the next iteration due to new requirements. Here FMEA can be useful. By maintaining a FMEA for iterations, the development team can analyze the failure points ahead of time.



**B.Tech III-Year I-Semester External Examination, Nov - 2017 (Regular)
SOFTWARE AUTOMATION AND TESTING (ECM)**

Time: 3 Hours

Max.Marks:75

Max.Marks:25

**Part - A
ANSWER ALL QUESTIONS.**

- 1 Write the characteristics of Test engineers. [3M]
- 2 Explain elements of Flow graph. [3M]
- 3 What are the factors, to pick the best testing strategy for success? [3M]
- 4 Write the importance of Agility. [3M]
- 5 Explain Alpha and Beta Testing. [3M]
- 6 Explain symmetric Relations. [2M]
- 7 What is Bug? [2M]
- 8 Explain Black-box Testing. [2M]
- 9 Write the metrics for maintenance. [2M]

- 10 Write the goals of testing. [2M]

Part – B Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- 1 a) Discuss about features and functionality of bugs. [5M]
b) Explain the levels of Testing. [5M]
- 2 a) Explain the various loops with examples. [5M]
b) Discuss various flow graph elements with their notations. [5M]
- 3 a) What are the software quality metrics? [5M]
b) What are the Economics of SDLC testing? [5M]
- 4 a) What are the different types of testing methods? [5M]
b) Explain in detail about workbench concept. [5M]
- 5 a) Explain below terms.
i) Thread testing ii) Performance Testing [5M]
b) Explain CRUD testing. [5M]
- 6 a) How can a relation matrix are represented. [5M]
b) What are the properties of relations? [5M]
- 7 a) Explain white box testing. [3M]
b) Explain Data flow testing. [3M]
c) What are the software testing metrics? [4M]
- 8 Explain below terms.
a) Verification and validation. [3M]
b) Gray box testing. [3M]
c) QTP. [4M]

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
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(Accredited by NAAC with ‘A’ Grade, Accredited by NBA of AICTE and
Recipient of World Bank under TEQIP-I and II)
Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301.

COURSE FILE
FOR
INFORMATION SECURITY
FOR
B. Tech. IV year - I Semester
CSE Branch



DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
JUNE-2018

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

Mission of the Department

- I. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- II. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- III. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development.

a	b	c	d	e	f	g	h	i	j	k	l
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**Syllabus for B. Tech. IV Year I semester
Computer Science and Engineering
INFORMATION SECURITY**

Code: 5FC11
P/D C

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Course Objectives:

At the end of the course, the students have firm understanding on basic terminology and concepts related to network and system level security, basics of computers and networking including Internet Protocol, routing, Domain Name Service, and network devices. They are also exposed to basic cryptography, security management, and network security techniques. They also look at policies as a tool to effectively change an organization's culture towards a better secure environment. In the end, the students put it all together in the form of a case study for designing and auditing a security system at conceptual level.

Course Outcomes: After completing this course, student shall be able to

1. Explain various security attacks and security services.
2. Describe encryption using cryptographic techniques and key elements of cryptographic principles for confidentiality of data.
3. Explain and comprehend privacy to emails using PGP and S/MIME.
4. Discuss IP security Architecture and its role in security framework.
5. Discuss SSL and compare SSL with TLS, explain how to secure credit card details in online transactions.
6. Describe design issues of Firewall and concepts of Intrusion Detection Systems

UNIT - I

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs.

UNIT - II

Conventional Encryption Principles, Conventional encryption algorithms: DES, TDES, AES, cipher block modes of operation, location of encryption devices, key distribution, Approaches of Message Authentication, Secure Hash Functions: SHA1 and HMAC.

UNIT - III

Public key cryptography principles, public key cryptography algorithms: RSA, DIFFIE HELL MAN, digital signatures, digital Certificates, Certificate Authority and key management

Kerberos, X.509 Directory Authentication Service.
Email privacy: Pretty Good Privacy (PGP) and S/MIME.

UNIT - IV

IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT - V

Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).

Intruders, Viruses and related threats.

UNIT - VI

Firewall Design principles, Trusted Systems. Intrusion Detection Systems.

TEXT BOOKS:

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permeh, Wiley Dreamtech

REFERENCES:

1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press)
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
4. Principles of Information Security, Whitman, Thomson.
5. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
6. Introduction to Cryptography, Buchmann, Springer.

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5. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
6. Introduction to Cryptography, Buchmann, Springer.

LECTURE SCHEDULE

Sl. No.	Unit No.	Number of Periods	Topics to be covered
1	I	10	Security Attacks (Interruption, Interception, (Modification and Fabrication)
2			Security Services (Confidentiality, Authentication, Integrity, Non-Repudiation, Access Control and Availability)
3.			Mechanisms, A model for Inter network security
4.			Internet Standards and RFCs
5	II	15	Conventional Encryption Principles,
6			Conventional encryption algorithms,
7			cipher block modes of operation,
8			location of encryption devices,
9			key distribution Approaches of Message Authentication,
10			Secure Hash Functions
11			HMAC
12	III	20	Public key cryptography principles
13			Public key cryptography algorithms
14			digital signatures
15			digital Certificates
16			Certificate Authority
17			key management Kerberos
18			X.509 Directory Authentication Service
19			Email Privacy
20			Pretty Good Privacy(PGP)
21			S/MIME
22			IP Security Overview
23			IP Security Architecture
24			Authentication Header

25	IV	10	Encapsulating Security Payload
26			Combining Security Associations
27			Key Management
28	V	15	Web Security Requirements
29			Secure Socket Layer (SSL) and
30			Transport Layer Security (TLS)
31			Secure Electronic Transaction (SET)
32			Intruders
33			Viruses
34			related threats
35	VI	8	Firewall Design principles,
36			Trusted Systems
37			Intrusion Detection Systems

UNIT I

1. What is the difference between threat and attack?
2. What is the difference between passive attacks and active attacks?
3. Define the terms: Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability?
4. What is Inter network security model?
5. Explain Security Services.
6. Illustrate model for Network Security.
7. Differentiate between Specific Security mechanisms and Pervasive security mechanisms.

UNIT-II

1. Explain DES algorithm. Write notes on Cryptanalysis and Brute Force attack.
2. Write notes on Cipher Block Chaining (CBC) mode and Cipher Feedback Mode (CFB) of operation
3. Explain the operations of AES in detail with neat sketch.
4. Explain SHA algorithm. Also deliberate on SHA compression function.

UNIT-III

1. Mention the principles/requirements of Public key cryptography
2. Explain public key cryptography algorithms of RSA or Diffie-Hellman with examples.
3. Write notes on X.509 Directory Authentication Service.
4. Write notes on Digital Signatures.
5. a) Explain the five principal services provided by PGP.
b) Discuss the functions provided by S/MIME.

Unit IV

1. What parameters identify an SA and what parameters characterize the nature of a particular SA?
2. Explain IPSec Authentication Header with a neat diagram.
3. Explain IPSec ESP Header with a neat diagram.
4. Explain the benefits of IPSec.
5. Explain the routing applications of IPSec.
6. Explain IPSec Document Overview with a neat diagram.
7. What are the services provided by IPSec? Explain.

- 8 Briefly explain Transport mode and Tunnel mode.
- 9 What parameters identify SA and what parameters characterize the particular nature of SA?
- 10 Write short notes on
 - a. ISAKMP
 - b. OAKLEY

UNIT V

1. Explain the Handshake protocol of SSL.
2. What are the various services provided by SSL? Explain.
3. Explain SSL Architecture?
4. What is the difference between Connection and Session?
5. Explain SSL record protocol with operation (diagram)?
6. What is a dual signature and what is its purpose?
7. Write notes on TLS.
8. Compare SSL and TLS.
9. Write short note on SET.
10. Explain how payment is processed with the help of dual signature in SET.
11. Describe the components of SET.
12. List the key features of SET and explain the same.
13. What are two common techniques used to protect a password file?
14. What are the typical phases of operation of a Virus?

UNIT-VI

1. Explain the measures that may be used for intrusion detection for the following activities:
 - a) Login and session activity
 - b) Command or program execution activity
 - c) File access activity.
2. List and briefly define three classes of Intruders.
3. Write short notes on Intrusion Detection Techniques.
4. Briefly explain Rule-Based Intrusion detection.
5. Explain circuit-level gateway firewall.
6. Write short notes on Data Access Control of a Trusted System.
7. What are the design goals of a firewall?
8. Explain Firewalls and its types.
9. What four techniques used by the firewalls to control access and enforce a security policy?
10. Explain Configuration of Firewall.
11. Explain trusted systems.
12. Explain Trojan Hores Defense system?

Exercises:

- 1) a) Perform Encryption & Decryption of RSA algorithm for the following
i) $p=3, q=11, e=7, M=5$

- ii) $p = 5, q = 11, e = 3, M = 9$
 iii) $p = 7, q = 11, e = 17, M = 8$
 b) In a public-key system using RSA, you intercept the ciphertext $C = 10$ sent to a user whose public key is $e = 5, n = 35$. What is the plaintext M ?
 c) In RSA system, the public key of a given user is $e = 31, n = 3599$. What is the private key of this user?
- 2) a) If user A has private key $X_A = 5$, use Diffie-Hellman key exchange algorithm where
 $\alpha = 7$ & common prime $q = 71$. Find A's public key.
 b) If user B has private key $X_B = 12$. Use above α & q and find B's public key.
 c) Use above (a) & (b) and find shared secret key.
- 3) Use Diffie-Hellman key exchange algorithm with $\alpha = 2, q = 11$, show that 2 is a primitive root of 11.
 If $Y_A = 9$ What is X_A ?
 If $Y_B = 3$ What is X_B & find secret key.
- 4) Explain Digital Certificate.
 5) Explain Kerberos version 4 dialogue.
 6) End-to-End Authentication & Encryption are desired between two hosts. Draw figures showing Headers and packets for the following.
 a) Transport SA bundle inside a Tunnel SA, with Encryption applied before Authentication.
 b) Transport SA bundle inside a Tunnel SA, with Authentication applied before Encryption.
 c) Transport adjacency with Encryption applied before Authentication.
 7) What is Dual Signature?
 8) What is the purpose of Dual Signature? Explain sequence of operations in SET.



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A12

Code No: 3FC11

B. TECH. III – Year II – Semester Examinations, May 2015 (Regular)
INFORMATION SECURITY (CSE)

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS.

1. What is Authentication?
2. What do you mean by Encryption?
3. What is Cryptography?
4. What are the different fields of authentication header?
5. List the four protocols in SSL.
6. What is an intrusion detection system?
7. What are the approaches of message authentication?

8. What is a digital certificate?
9. What are the different types of viruses?
10. Explain RFC?

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. What are the different security attacks and services? Explain them.
2. (a) How the hash function is generated using SHA-1?
(b) Explain the various steps involved in the HMAC algorithm.
3. (a) Compare and contrast between Cryptography and Cryptology.
(b) Discuss the services of PGP with neat figures.
4. (a) Explain briefly about encapsulating security payload.
(b) Explain the key management in IP security.
5. (a) Explain the different intruders in detail?
(b) What are the features of SET? Show diagrammatically how the customer makes a purchase request to the merchant.
6. (a) What is a firewall? Explain the capabilities that are within the scope of a firewall.
(b) What are the measures that may be used for intrusion detection?
7. Discuss in detail the process of encryption and decryption in AES algorithm.
8. (a) Explain briefly about Trusted systems.
(b) How web security is provided by SSL and TLS?

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Sreenidhi Institute of Science and Technology
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Regulations:
A14

Code No: 4F711

Date: 18-Dec-2017 (TUE)

B.Tech IV-Year I-Semester External Examination, Dec - 2017 (Regular)
INFORMATION SECURITY (IT)

Time: 3 Hours

Max.Marks:70

Note: a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
c) Missing data can be assumed suitably.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS.

1. What are the standard categories of internet?

[2M]

- | | | |
|----|------------------------------------------------------------------------------------------------------------------------------|------|
| 2 | Write about authentication using conventional encryption. | [2M] |
| 3 | Suppose that $n=p \cdot q$ with p, q different primes. Suppose also that $n=4386607$ and $\phi(n)=4382136$. Find p, q . | [2M] |
| 4 | Describe Routing Applications. | [2M] |
| 5 | Define hackers with example. | [2M] |
| 6 | Define counter. | [2M] |
| 7 | Explain AES evaluation. | [2M] |
| 8 | Define Public key authorities. | [2M] |
| 9 | Define rule based detection. | [2M] |
| 10 | Write short notes on man-in-the middle attacks. | [2M] |

Part – B **Max.Marks:50**
ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- | | | |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1 | a) Explain Security Attacks.
b) Explain Security Services. | [5M]
[5M] |
| 2 | a) Describe Approach's of Message Authentication.
b) Explain cipher block modes of operation. | [5M]
[5M] |
| 3 | a) Given an integer $n=p_1 \cdot p_2 \cdot p_3$ where p_1, p_2 and p_3 are prime numbers larger than 2 , prove that there are exactly 8 integers $x \in [1,n]$ satisfying, $x^2 = 1 \pmod n$.
b) Brief about X.509 Authentication service. | [5M]
[5M] |
| 4 | a) Explain transport and tunnel modes.
b) Explain IP Security Architecture. | [5M]
[5M] |
| 5 | a) Describe about handshake protocol.
b) Explain SSL Record Protocol. | [5M]
[5M] |
| 6 | a) Describe Trusted Systems.
b) Give short note on Trojan Horse Defense. | [5M]
[5M] |
| 7 | a) Explain Fabrication with at least 2 Examples.
b) Write brief note on hash functions.
c) Differentiate between Kerberos and Kerberos (version 5). | [3M]
[3M]
[4M] |
| 8 | a) Explain the ESP header format and discuss the outbound and inbound processing of IPSec
b) Explain how Cryptographic computation is performed in TLS.
c) Explain Firewalls, Characteristics of firewalls with examples. | [3M]
[3M]
[4M] |

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Sreenidhi Institute of Science and Technology
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**Regulations:
A14**

Code No: 4FC11

Date: 06-Nov-2017 (AN)

B.Tech III-Year II-Semester External Examination, Nov - 2017

(Supplementary)

INFORMATION SECURITY (CSE)

Time: 3 Hours

Max.Marks:70

Note: a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
c) Missing data can be assumed suitably.

Part - A
Max.Marks:20
ANSWER ALL QUESTIONS.

- | | | |
|----|---------------------------------------------------------------|------|
| 1 | Distinguish Active attacks and passive attacks. | [2M] |
| 2 | List and explain the components of Symmetric cipher. | [2M] |
| 3 | Explain the major benefits of Using Public Key Crypto system. | [2M] |
| 4 | Differentiate between transport and tunnel mode. | [2M] |
| 5 | List the parameters that define SSL session state. | [2M] |
| 6 | What are the design goals of Firewalls? | [2M] |
| 7 | What is Key size and Block Size of AES & DES? | [2M] |
| 8 | What is the function of a nonce? | [2M] |
| 9 | Define Logic bomb. | [2M] |
| 10 | What are the key algorithms used in S/MIME? | [2M] |

Part – B
Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- | | | |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1 | a) With a neat diagram Explain network security model.
b) Explain in detail about security mechanisms. | [5M]
[5M] |
| 2 | Illustrate the steps involved in AES with a neat diagram. | [10M] |
| 3 | a) Write a brief outline about X.509 Certificate.
b) What is the function of PGP? Explain its general message format. | [5M]
[5M] |
| 4 | Design the scope of ESP encryption and authentication in both IPV4 and IPV6 | [10M] |
| 5 | a) Illustrate the significance of dual signature in Secure Electronic Transaction(SET).
b) What is SSL session? Can a session be shared among multiple connections?
What are the parameters that define a session state? | [5M]
[5M] |
| 6 | Discuss about Various types of Intrusion detection approaches. | [10M] |
| 7 | a) Explain the purpose of One way Hash Function.
b) What is the need of Public certificate and how it can be Distributed? | [5M]
[5M] |
| 8 | a) What is a fire wall? Discuss about various firewalls.
b) Describe about trusted systems. | [5M]
[5M] |



Code No: 3FC11

Date: 1-May-17 (FN)

B.Tech III-Year II-Semester End Examination, May- 2017
(Supplementary)
INFORMATION SECURITY (CSE)

Time: 3 Hours

Max.Marks:70

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. Define Interruption and Interception attacks. [2M]
2. List out the requirements of Message Authentication Code (MAC). [2M]
3. State the algorithm used in compression process of PGP. [2M]
4. List different combinations of Security Associations [2M]
5. List out participants in a SET. [2M]
6. What are Packet Filters? [2M]
7. List out the parameters of AES. [2M]
8. What is the process for revocation of a Digital Certificate? [2M]
9. What is the use of TLS Handshake Protocol? [2M]
10. State the difference between Triple DES and DES Encryption Standard. [2M]

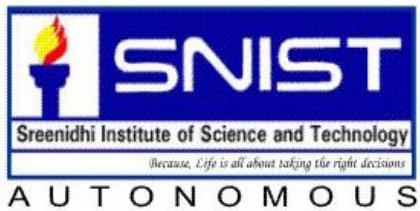
Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

3. 1 a) Discuss about Internet Standards.
b) Explain various types of Security Attacks.
4. 2 Write a short notes on
a) Block Cipher Modes of Operation.
b) Explain the location of encryption devices.
3. a) Enlist the 5 header fields defined in MIME [2M]
b) Explain the process of Secret key distribution using KERBEROS . [8M]
4. Explain in detail about the following in IPSec
a) Authentication Header.
b) Encapsulating Security Payload (ESP).
5. a) Write about the steps involved in the SSL record protocol transmission? [6M]
b) With a neat figure, explain SET transaction process. [4M]
c)]6 a) With a neat figure, explain Firewall Configuration process. [6M]
b) Briefly write about the types of Firewalls. [4M]
7. a) What is Radix-64 format? Explain how both PGP and S/MIME perform the Radix-64 conversion. [7M]
b) Describe the five principal services that Pretty Good Privacy (PGP) provides. [3M]
8. a) Explain various approaches to Intrusion Detection. b)
Write a short note on virus structure and phases of a virus.

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Yamnampet, Ghatkesar, Hyderabad – 501 301.



Agile Software Development

Course File

B.Tech (CSE) - IV Year I Semester

Academic Year 2018-19

Subject code: 5EC24

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

I. Mission of the Department

- II. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- III. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- IV. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development

a	b	c	d	e	f	g	h	i	j	k	l
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B.Tech.(Computer Science and Engineering) - IV Year I semester

AGILE SOFTWARE DEVELOPMENT

Syllabus

Code: 5EC24

L	T	P	C
3	1	-	3

UNIT – I:

Why Agile? Understanding success, Beyond deadlines, The importance of organizational success, Enter agility, **How to be Agile?** Agile methods, Don't make your own method, The road to mastery, Find a mentor.

UNIT – II:

Understanding XP: The XP lifecycle, The XP team, XP concepts, **Adopting XP:** Is XP right for us? Assess your agility.

UNIT – III:

Practicing XP. *Thinking:* Pair programming, Energized work, Informative workspace, Root-Cause analysis, Retrospectives, *Collaborating:* Trust, Sit together, Real customer involvement, Ubiquitous language, Stand-up meetings, Coding standards, Iteration demo, reporting, *Releasing:* “Done Done”, No bugs, Version control, Ten-minute build, Continuous integration, Collective code ownership, documentation.

UNIT – IV:

Planning: Vision, Release planning, The planning game, Risk management, Iteration planning, Slack, Stories, Estimating. *Developing:* Incremental requirements, Customer tests, Test-driven development, Refactoring, Simple design, Incremental design and architecture, Spike solutions, Performance optimization, Exploratory testing.

UNIT – V:

Mastering Agility. *Values and Principles:* Commonalities, About values, principles, and practices, *Improve the process:* Understand your project, Tune and Adapt, Break the Rules, *Rely on People:* Build effective relationships, Let the right people do the right things, Build the process for the people, *Eliminate Waste:* Work in small, Reversible steps, Fail fast, Maximize work not done, Pursue throughput.

UNIT – VI:

Deliver Value: Exploit your agility, Only releasable code has value, Deliver business results, Deliver frequently, *Seek Technical Excellence:* Software doesn't exist, Design is for understanding, Design tradeoffs, Quality with a name, Great design, Universal design principles, Principles in practice, Pursue mastery.

Text Books:

1. James Shore and Shane Warden, "The Art of Agile Development", O'REILLY, 2007.

Reference Books:

2. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices", PHI, 2002.
3. Angel Medinilla, "Agile Management: Leadership in an Agile Environment", Springer, 2012.
4. Bhuvan Unhelkar, "The Art of Agile Practice: A Composite Approach for Projects and Organizations", CRC Press.
5. Jim Highsmith, "Agile Project Management", Pearson education, 2004.
6. Elisabeth Hendrickson, "Agile Testing" Quality Tree Software Inc., 2008.

Legend

7. T1: James Shore and Shane Warden, "The Art of Agile Development", O'REILLY, 2007.

Course Objectives:

To understand how an iterative, incremental development process leads to faster delivery of more useful software.

Course Outcomes:

1. To understand the essence of agile development methods
2. To apply the principles and practices of extreme programming in real world problems.
3. To incorporate proper coding standards and guidelines in an agile process.
4. To optimize an agile process by exploring the possible risks and threats in the software process
5. To improve the process by eliminating waste
6. To design an agile process for a business application and deal with appropriate trade-off.

Lesson Plan

S. No.	UNIT	TOPIC	No of Lectures	BOOK
1	Unit-I	Introduction to Agile Software Development	1	T1
2		Why Agile? Understanding success, Beyond deadlines, The importance of organizational success, Enter agility	1	T1
3		How to be Agile? Agile methods	1	T1
4		Agile Principles, Agile manifesto	1	T1
5		Don't make your own method, The road to mastery, Find a mentor	1	T1
		Revision of concepts	1	
Sub-Total			6	
6	Unit - II	Understanding XP: The XP lifecycle	1	T1
7		XP Lifecycle: Planning, Analysis, Design, Coding, Testing	2	T1
8		The XP team, The Project Community	1	T1
9		XP concepts	1	T1
10		Adopting XP: Is XP right for us? Prerequisites, Recommendations, Assess your agility	2	T1
		Revision of concepts	1	
Sub-Total			8	
11	Unit -III	Practicing XP. <i>Thinking</i> : Pair programming,	2	T1
12		Energized work	1	T1
13		Informative workspace,	1	T1
14		Root-Cause analysis, Retrospectives	1	T1
15		<i>Collaborating</i> : Trust	1	T1
16		Sit together	1	T1
17		Real customer involvement, Ubiquitous language, Stand-up meetings	1	T1
18		Coding standards, Iteration demo, reporting	1	T1
19		<i>Releasing</i> : “Done Done”, No bugs,	1	T1
20		Version control, Ten-minute build	1	T1
21		Continuous integration,	1	T1
22		Collective code ownership, documentation	1	T1
		Revision of concepts	2	
Sub-Total			15	

23	Unit-IV	<i>Planning:</i> Vision, Release planning,	2	T1	
24		The planning game	1	T1	
25		Risk management	2	T1	
26		Iteration planning	1	T1	
27		Slack, Stories, Estimating	2	T1	
28		<i>Developing:</i> Incremental requirements	1	T1	
29		Customer tests	1	T1	
30		Test-driven development	2	T1	
31		Refactoring	1	T1	
32		Simple design, Incremental design and architecture	2	T1	
33		Spike solutions, Performance optimization, Exploratory testing	1	T1	
		Revision of concepts	2		
Sub-Total			18		
34	Unit-V	<i>Mastering Agility. Values and Principles:</i> Commonalities, About values, principles, and practices	1	T1	
35		<i>Improve the process:</i> Understand your project, Tune and Adapt, Break the Rules	1	T1	
36		<i>Rely on People:</i> Build effective relationships	1	T1	
37		Let the right people do the right things, Build the process for the people	1	T1	
38		<i>Eliminate Waste:</i> Work in small, reversible steps, Fail fast	1	T1	
39		Maximize work not done, Pursue throughput	1	T1	
	Sub-Total			7	
35	Unit-VI	<i>Deliver Value:</i> Exploit your agility, Only releasable code has value	1	T1	
36		Deliver business results, Deliver frequently	1	T1	
37		<i>Seek Technical Excellence:</i> Software doesn't exist, Design is for understanding	1	T1	
38		Design trade-offs, Quality with a name, Great design,	1	T1	
39		Universal design principles, Principles in practice, Pursue mastery	1	T1	
		Revision of concepts	1		
Sub-Total			6		
Total Lectures			60		

6. REVIEW QUESTIONS

UNIT-I

1. What is Agile Software Development?
2. Briefly discuss the three areas that agile development focuses on for successful development of a project?
3. Comment on the statement: *Agile development isn't a silver bullet.*
4. What does it mean to “*be agile*”?
5. What are agile methods?
6. Enumerate the principles behind the agile manifesto.
7. Discuss the role of a *mentor* in agile development. List a few sources for identifying a mentor.
8. Identify two types of system development where agile methodology shall be very successful.

UNIT-II

1. Compare agile software development with traditional software development life cycle.
2. What is *Extreme Programming*?
3. Explain XP (eXtreme Programming) Lifecycle in detail with illustration.
4. Tabulate the principles and practices involved in Extreme Programming.
5. What should be the composition of the XP team? Analyze.
6. Justify the need of *Domain Experts* in an XP team.
7. What is the rule of thumb for including software testers in the XP team?
8. Discuss a situation in which customer involvement makes a huge difference in product success.
9. Typically, what is the length and frequency of iteration in XP? Justify.
10. List the important concepts in XP. Define an XP story.
11. Summarize the prerequisites that are to be met for effectively practicing XP.
12. What recommendations do you propose in order to achieve success in XP?
13. Develop a framework to assess your approach to XP (that is, are you properly applying agile practices in your project?).

UNIT-III

1. Define ‘Pair Programming’.
2. Summarize the roles of Driver and Navigator in Pair Programming.
3. Critically examine the practice of ‘Energized Work’.

4. What do you understand by the term ‘Informative Workspace’?
5. Discuss ways to find and fix *Root-Cause* in a project.
6. What are the different types of retrospectives in XP? Explain how ‘Iteration Retrospective’ is conducted.
7. Enumerate the eight practices that help the XP team and its stakeholders collaborate efficiently and effectively.
8. Suggest some strategies by which trust among team members can be built over time.
9. What are the secrets of ‘Sitting Together’?
10. Bring out the importance of ubiquitous language among XP team members.
11. How to hold a ‘Stand-Up Meeting’?
12. Discuss the type of reports and its intended persons.
13. Explain the term ‘Done Done’ in XP.
14. Summarize the techniques in XP to achieve nearly zero bugs in your code.
15. What are the benefits of collective code ownership?

UNIT-IV

1. What is a Vision Statement? Elaborate.
2. What are the approaches followed in Release Planning? Discuss.
3. Discuss the role of programmers and customers in a *planning game*.
4. Suggest ways to overcome disagreements during planning in XP.
5. Suppose your product manager doesn’t want to prioritize. He says everything is important. What will be your strategy in such a situation in agile development?
6. What do you mean by ‘miracle of collaboration’ with respect to planning?
7. Define the terms: transition indicators, mitigation activity, contingency activity, and risk exposure.
8. How do we plan an Iteration in XP?
9. If we don’t estimate stories during iteration planning, when do we estimate stories?
10. How do you reduce the need for Slack in XP?
11. What are ‘Story Cards’? Explain with an example.
12. How can we encourage stakeholders to use stories for requesting features?
13. Is it not a waste of time for all the programmers to estimate stories together?
14. Explain Test-Driven Development in detail.
15. Explain why test-first development helps the programmer to develop a better understanding of the system requirements. What are the potential difficulties with test-first development?
16. What do you mean by ‘Spike Solutions’?

UNIT-V

1. List XP's Values.
2. Suggest an easy way to reduce waste in software development.
3. Discuss the ways by which the agile process may be improved.
4. Comment on this agile principle: "Let the Right People Do the Right Things".
5. Elaborate on the agile concept: "Fail fast".
6. How do we minimize partially done work and wasted effort in agile development?

UNIT-VI

1. How does XP exploit agility? Give examples.
2. Do you agree with the statement "the most beautiful code in the world matters very little unless it does what the customer wants"?
3. Using an example, demonstrate delivery of business results.
4. Comment: 'Deliver small, deliver often'.
5. Briefly explain the following terms.
 - a. Software doesn't exist
 - b. Design is for understanding
6. Bring out the qualities of good design.

SIX SIGMA

Standards for Quality Improvement of Software's

Applying Six Sigma in Software Companies for Process Improvement

1. INTRODUCTION

In recent years, the companies and organizations around the world are showing great interests in quality. Six Sigma approach is a structured quantitative method which is invented by Motorola in 1986 for improving the product quality. Its aim is to enhance organization's performance by using statistical analytic techniques. After two decades of successful implementation in manufacturing, Six Sigma is approved as an effective methodology for improving quality.

Nowadays, some researchers believe that Six Sigma can bring large benefits for software companies. Furthermore, software companies have already started to implement Six Sigma approach, like Ericsson, Tata Consultancy Service, etc. However, there are still some problems and misconceptions existed about the applicability of Six Sigma in software companies.

Our work can help to debunk the misconceptions about the applicability of Six Sigma in software companies. And provide steps for software companies to implement Six Sigma. The scope of this paper is demonstrated in below Figure which shows the relationship between Quality and Six Sigma.

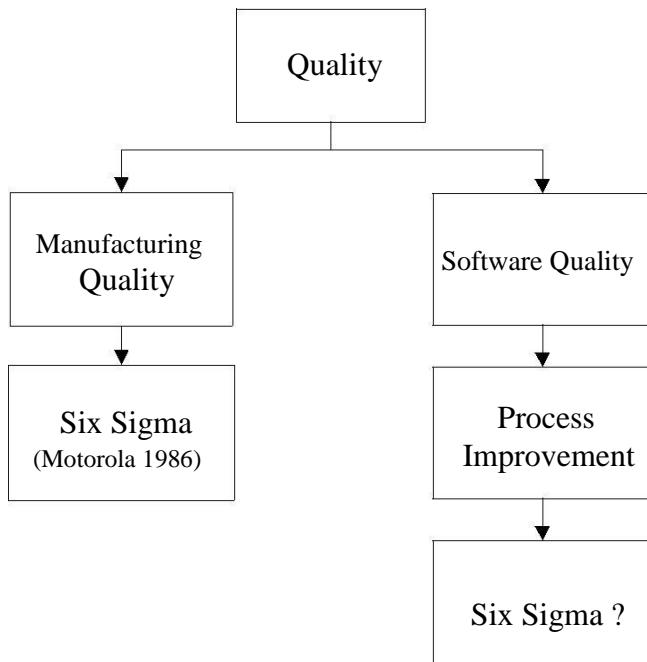


Figure: Relationships between Six Sigma and Quality.

INTRODUCTION TO QUALITY AND SIX SIGMA

In recent decades, the companies and organizations around the world are showing great interests in quality. Especially in 1970s and 1980s, the success of Japanese industry stimulates the whole world to focus on quality issues . The experience from them proved that the requirements and expectations of customers are the key factors which decide the quality.

Definition

The word “quality” comes from the Latin “qualitas”, and Cicero (a roman orator and politician, 106-43 B.C.) is believed to be the first person who used the word. Until a few decades before, the concept of quality has been significantly extended as we know it today. There were many popular definitions for quality concept. Table 2.1 lists some of them.

Year	Definer	Definition of quality concept
1931	Walter Shewhart	<i>“...there are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of man. The other has to do with what we think, feel or sense as a result of the objective reality. In other words, there is a subjective side of quality”.</i>
1951	Joseph Juran	“Fitness for use”.
1979	Philip Crosby	“Conformance to requirements”.
1979	Genichi Taguchi	“The losses a product imparts to the society from the time the product is shipped”.
1985	Edwards Deming	“Quality should be aimed at the needs of the customer, present and future”.
1990	Myron Tribus	“Quality is what makes it possible for a customer to have a love affair with your product or service.”
2000	ISO 9000: 2000	“The degree to which a set of inherent characteristics fulfills the requirements, i.e. needs or expectations that are stated, generally implied or obligatory”.
2004	Bengt Klefsjöand Bo Bergman	“The quality of a product is its ability to satisfy, and preferably exceed, the needs and expectations of the customers”.

Table 2.1 Definitions of quality concept.

From the definitions above, we can find some interesting common points. Firstly, almost all factors are conducted around customers. In another word, it can be said as *customers decide the quality* (e.g. Jura

in 1951, Deming in 1985, and Tribus in 1990). Secondly, according to customer, two things are commonly considered as which shall be fulfilled – customer requirements and customer expectation. The requirements are what customers request and demand. These are the basics of the quality. The expectations are what the customers expect and look forward to. Sometimes, the customers do not know what they really need. So that demands developers to have a good understanding about the customer's minds.

Although the definitions in the above Table are similar, they also have distinctions which make them different. For example, “*fitness to use*” (Joseph Juran, 1951) is defined from end user’s view. In contrast, Philip Crosby (1979) defined the quality as “*Conformance to requirements*” from producer’s view. The reason is their backgrounds are different.

A further identification of these differences is conducted by Gavin in 1984. Five approaches to the quality concept are claimed which include transcendent-based, product-based, user-based, manufacturing-based, and value-based, see above Figure. From transcendent-based view, the quality can be identified by experience. Mostly is very successful. But from this point of view, the quality is not defined very clearly. This problem can be solved by product-based approach. The quality can be exactly defined and measured. However, the cost for quality cannot be judged by customer. User-based approach's opinion is that the quality is decided by customer. Customer's satisfaction is the only scale which reflects product quality. Manufacturing-based perspective relates to accomplish the requirement specification. Reducing defects is the main task of quality improvement. According to value-based approach, the quality relates to cost and price. Generally price is decided by cost. A high quality product means that the customers are willing to pay for it. In Gavin's view, an organization cannot have just one approach for the quality concept, but that different parts of organization need different approaches.

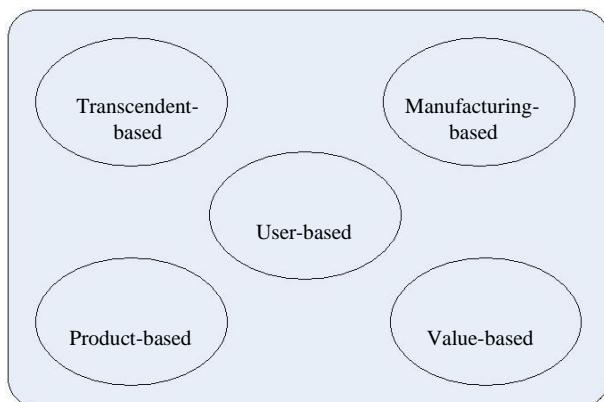


Figure 2. Five approaches of quality concept from Gavin (1984).

In quality issues, customer plays one of most important roles. A high quality product shall fulfill customers' requirements, and satisfy their expectations. Due to Gavin's theory, there are several approaches for quality concept. An organization cannot have just one approach, but it uses different approaches in different parts.

Why Quality Improvement

“*Quality is free. It is not a gift, but it is free. What costs money are in-quality things - all the actions that involve not doing jobs right the first time.*” – Philip Crosby

Many companies pay a lot in correction, i.e. 80% of the cost in a Software Engineering (SE) project is commonly related to after-delivery corrections. And we also found:

- Unsatisfied customers tell in average 10 persons about their bad experiences. 12% tells up to 20 other persons.
- Satisfied customers tell in average 5 persons about their positive experiences.
- It costs 5 times as much to gain new customers than keeping existing ones.
- Up to 90% of the unsatisfied customers will not make business with you again, and they will not tell you.
- 95% of the unsatisfied customers will remain loyal if their complaints are handled fast and well.

All above motivate us to improve quality. Improved quality can affect the success in many different ways :

- More satisfied and loyal customers
- Lower employee turnover and sick leave rates
- A stronger market position
- Shorter lead times
- Opportunities for capital release
- Reduced costs due to waste and rework
- Higher productivity

The above Figure demonstrates the importance of quality which expressed by Deming in 1986. In this figure, Deming connects improved quality with company prosperity.

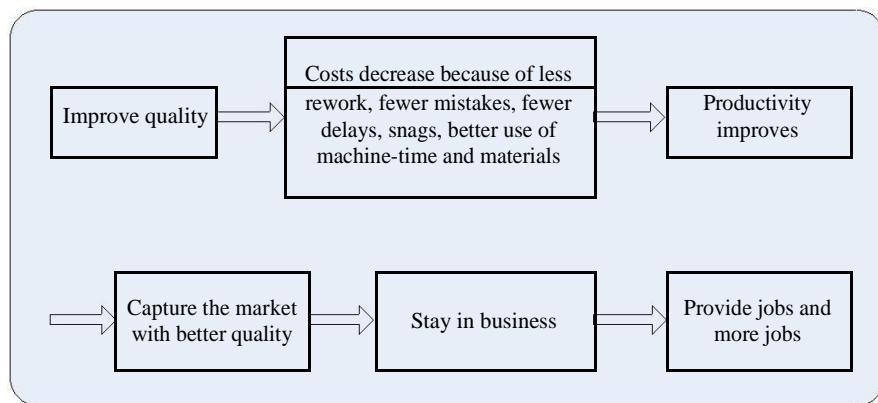


Figure The importance of quality from Deming.

As we seen, improving quality does not mean losing money in business. Proper improvement will bring organizations much more benefits.

Software Quality

Modern society is highly dependent on software products, i.e. bank system, telephone network, supermarket system, etc. “the general public usually blamed „the computer”, making no distinction between hardware and software”. However, millions of facts of software failures alert us to focus on software quality in everyday lives. Today, software customers are demanding higher

quality and are willing to pay a higher price for it. Improving quality has become the common goal of each software development phase.

Similar with general quality concept ,high quality software shall have following factors :

- Developing in the right way.
- Matching the requirement specification.
- Good performance meeting customer's expectations.
- Fitness for use.

Combining with Gavin's five approach of quality concept, Kitchen ham and Pfleeger describe software quality in another way:

- *Transcendental view* – Software quality is thought as an ideal, but may never implement completely.
- *User view* – High quality software shall meet the user's needs, and have a good reliability, performance and usability.
- *Manufacturing view* – This view focuses on product quality during production and after delivery to avoid rework. Adopted by ISO 9001 and the Capability Maturity Model, the manufacturing approach advocates conformance to process rather than to specification. Hence, to enhance product quality, improving your process is very much essential.
- *Product view* – Be different with above views, product view assesses quality by measuring internal product properties. Software metrics tools are frequently used.
- *Value-based view* – High quality product always means a high cost. Different product purchasers always have the different value view. So that this approach puts much more efforts on considering the trade-offs between cost and quality.

Different views can be held by different groups involved in software development, i.e. customers or marketing groups have a user view, researchers have a product view, and the production department has a manufacturing view. It is not enough that only one view is identified explicitly. All views influence each other. Measuring each view clearly is one of assurances for high quality.

Software Process Improvement

Based on five approach of quality concept, process improvement aims to have a better control in software development. Managers or organizations generally divide the whole project into smaller phases, such as requirement analysis, planning, coding, testing, releasing, etc. These phases are known as the Software Project Life Cycle (SPLC). Within each project phase, we use iterative processes to achieve phase's deliverables. Figure

The below figure shows a typical iterative of project processes. Project processes are distributed into five groups – initiating process group, planning process group, executing process group, monitoring and controlling process group, and closing process group.



Figure 2.3 A typical project processes cycle.

Quality in a software product can be improved by process improvement, because there is a correlation between processes and outcomes. As defined by IEEE, process is “a sequence of steps performed for a given purpose.” It provides project members a regular method of using the same way to do the same work. Process improvement focuses on defining and continually improving process. Defects found in previous efforts are fixed in the next efforts . There are many models and techniques for process improvement, such as CMMI, ISO9000 series, SPICE, Six Sigma, etc.

Six Sigma

History

In 1980s, Bob Galvin the CEO of Motorola was trying to improve the manufacturing process. The Senior Sales Vice President Art Sundry at Motorola found that their quality is extremely bad. They both decided to improve the quality. Quality Engineer Bill Smith at Motorola in 1986 invented Six Sigma. It was applied to all business processes. In 1988 Motorola Won the Malcolm Baldrige Quality Award, as a result other organizations were also interested to learn Six Sigma. Motorola leaders started teaching Six Sigma to other organizations. Initially Six Sigma was invented to improve the product quality by reducing the defects, but later Motorola reinvented it. The new Six Sigma is beyond defects, it focuses on strategy execution. It became a management system to run the business. It was invented for an improvement in manufacturing industry but now it is applied in almost every industry i.e. Financial Services, Health care and Hospitality. Originally Six Sigma was introduced in United States but now it is applied in many countries around the world.

Definition

Six Sigma is a structured quantitative method which is originally invented for reducing defects in manufacturing by Motorola in 1986. Its aim is using statistical analytic techniques to enhancing organization's performances, and to improving quality. Since Six Sigma has evolved over the last two decades, its definition is extended to three levels:

- Metric
- Methodology
- Management System

Six Sigma approach satisfies all the three levels at the same time. Those levels are discussed in the following sections.

As a Metric

“Sigma” is the Latin symbol “ σ ”. Here we use it to symbolize how much deviation exists in a set of data, and that is what we called *standard normal distribution*, or the *bell curve*. The normal distribution, also called the *Gaussian distribution*, is used for continuous probability distributions, see curves in Figure 2.4 [32]. The probability density function is shown as below – “ μ ” is the mean and “ σ^2 ” is the variance.

$$\frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

The standard normal distribution is “the normal distribution with a mean of zero and a variance of one”. From the figure, we can see that in a standard normal distribution, 50% of the values are under the mean and 50% of the values are above the mean.

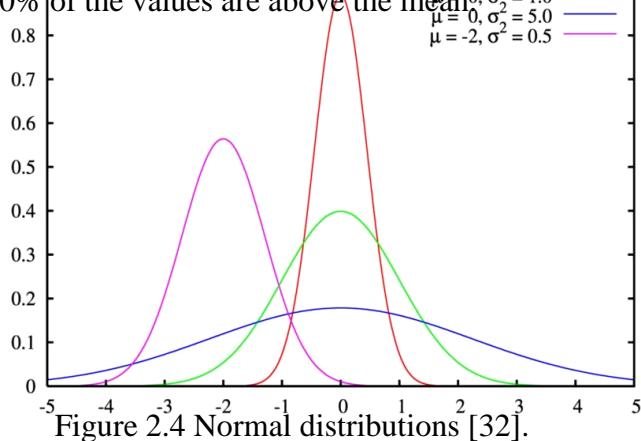


Figure 2.4 Normal distributions [32].

In Six Sigma approach, “Sigma” is used as a scale for levels of process capability or quality. According to that, “Six Sigma” equates to 3.4 Defects Per Million Opportunities (DPMO). Therefore, as a metrics, Six Sigma focuses on reducing defects.

Figure 2.5 demonstrates how Six Sigma measures quality. In the figure, if we achieve 68% of aims, then we are at the 1 Sigma level. If we achieve 99.9997% of aims, then we are at the 6σ level which equates to 3.4 DPMO [36]. From this point of view, Sigma level is to show how well the product is performing. It seems this level can never be achieved. However, the Sigma level is not our purpose, the real purpose is to improve quality continually. The higher Sigma level we have reached, the higher quality we get.

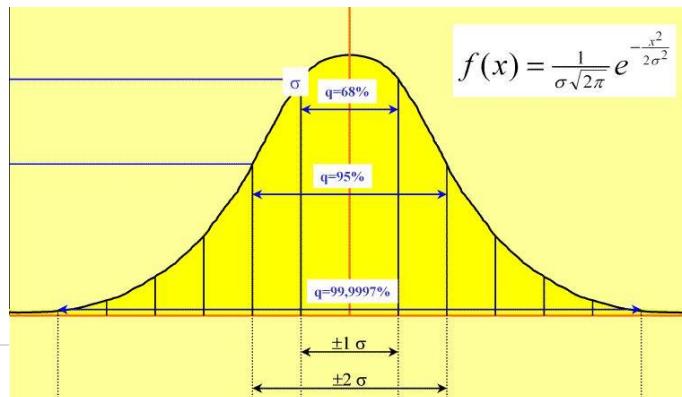


Figure 2.5 How Six Sigma measures quality [35].

Sigma Level Calculation

The calculation of Sigma level is based on the number of defects per million opportunities (DPMO). The formula is

$$DPMO = 10^6 * D / (N * O)$$

Where D means the number of defects, N means number of units produced, and O is the number of opportunities per unit. For example, a software company wants to measure their software product's Sigma level. In their product, there are 200,000 lines of code (LOC). For each LOC, the company performs one check to test the quality. During the testing, 191 defects are detected. Then we have $DPMO = 10^6 * 191 / (200,000 * 1) = 955$.

A [4]), we can find the sigma level is 4.60. You can also find the free calculators on the website [38].

DPMO	Sigma Level
1,144	4.55
986	4.60
816	4.65

Table 2.2 A part of DPMO to sigma conversion table.

As a Methodology

Six Sigma approach is not just counting defects in a process or product, but it is a methodology to improve processes. The Six Sigma methodology focuses on :

- Managing the customer requirements.
- Aligning the processes to achieve those requirements.
- Analyzing the data to minimize the variations in those processes.
- Rapid and sustainable improvement to those processes.

When we look at Six Sigma as a methodology, there are many models available for process improvement like DMADV, DMAIC, Breakthrough strategy, Roadmap, New Six Sigma, Eckes method, Six Sigma Roadmap, IDOV, and DMEDI [39]. The most widely used models are DMAIC and DMADV. The DMAIC model is used when a process or product is in existence but is not meeting the customer requirements. And the DMADV model is used when a process or product is not in existence or is needed to be developed.

DMAIC Model

Motorola implemented the first Six Sigma model called as MAIC (Measure, Analyze, Improve and Control). It was developed by Dr. Miakel Harry. This model was used to solve the already known quality problems. GE, unlike Motorola was unaware of their quality problem. They needed a model that can firstly map the real quality problems and then to solve them. Dr. Miakel Harry took advantage of his experience at Motorola and developed a new model DMAIC (Define, Measure, Analyze, Improve and Control). Nowadays this model is mostly in Six Sigma implementation. The phases of DMAIC model are explained as follows:

- Define phase is to define the customer's requirements and their expectations for product or services. To align the project goals with business goals. To define the project scope, the start and stop of the process.
- Measure phase is to develop a data collection plan for the current process. To collect data for the current process and to develop a measurement system. The measurement system is used to calculate the current performance of the process.
- Analyze phase is to find out the gap between the current performance and the goal performance. To analyze the collected data of current process and to determine the main factors of the poor performance. To find out the source of variation in the current process.
- Improve phase is to identify and select the right design solutions to fix the problems. The set of solutions to improve the sigma performance are selected on the basis of root causes identified in Analyze phase.
- Control phase is to finally implement the solutions. To provide the maintenance of the improved process so that the improved Six Sigma process can run for a long time.

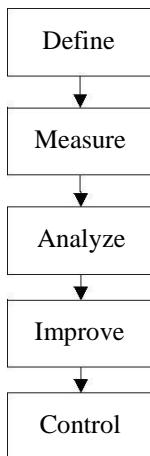


Figure Phases of DMAIC model.

DMADV Model

DMADV (Define, Measure, Analyze, Design and Verify) model was developed by Thomas Pyzdekis. This model is applied to the development of new processes or products. The phases of DMADV are described below:

- Define phase is to find out the customer needs and expectations and to define the project scope.
- Measure phase is to identify the CTQs (critical to qualities), process capability and risk

assessment.

- Analyze phase is to develop the high level design concepts and design alternatives. To select the best design.
- Design phase is to develop plans for test verification, this may require simulations.
- Verify phase is to implement the process in operational scale.

As a Management System

Through experience, Motorola has found that using Six Sigma as a metric and as a methodology are not enough to drive the breakthrough improvements in an organization. Motorola ensures that Six Sigma metrics and methodology are adopted to improve opportunities which are directly linked to the business strategy. Now Six Sigma is also applied as a management system for executing the business strategy.

Six Sigma approach provides a top-down solution to help the organization. It put the improvement efforts according to the strategy. It prepares the teams to work on the highly important projects. It drives clarity around the business strategy.

TOOLS AND TECHNIQUES IN SIX SIGMA

we mainly describes the tools and techniques which are used in Six Sigma process improvement projects. By using those tools and techniques, Six Sigma projects become easier and effective.

Introduction

Since the Six Sigma approach is invented, many old quality tools are adopted in Six Sigma process improvement project. At the same time, some new specific tools and techniques are introduced. In the chapter, those tools and techniques are distributed in two parts.

The first part is related to the most popular 7 Quality Control (QC) tools. They are Cause-effect Diagram, Pareto Chart, Flow Chart, Histogram, Check Sheet, Control Chart, and Scatter Plot. Those tools are original gathered by Kaoru Ishikawa in 1960s. After these years' evolution and their easy-to-use property, 7 QC tools are applied in every quality improvement projects in various fields. In Six Sigma, they are extensively used in all phases of the improvement methodology.

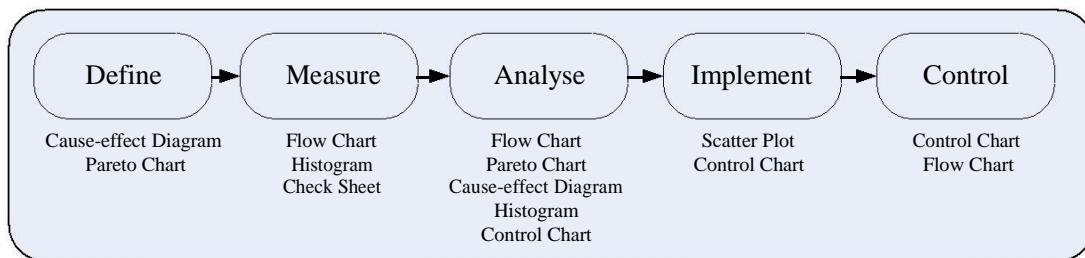
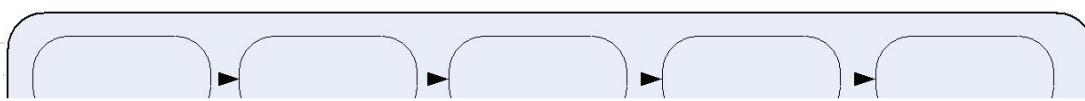


Figure 3.1 The distribution of 7 QC tools in Six Sigma.

Another part is a collection of special tools which are frequently used in Six Sigma projects. We also associate them with the five phases of DMAIC methodology



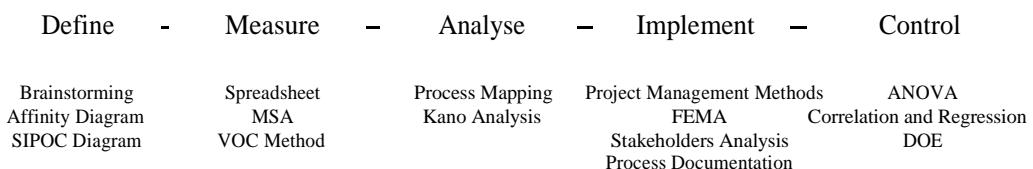


Figure 3.2 The distribution of other special tools in Six Sigma.

Seven Quality Control Tools

Seven quality control tools frequently used in Six Sigma projects are introduced in the following sections.

Check Sheet

The check sheet is used to collect data of the desired characteristics of a process that should be improved. If the collected data is incorrect, most efficient methods will result in a failure. In Six Sigma methodology it is used in the measure phase. The check sheet is represented in a tabular form. The check sheet should be simple and aligned with the characteristics that are to be measured.

Histogram

Histogram is used in Six Sigma in the analyze phase. It is used to learn about the distribution of the data collected in the measure phase. Often we have huge data and each observation cannot be represented in figure. With the help of histogram the collected data is divided into different classes or intervals. The area of each rectangle in the histogram is proportional to the number of observations within each interval or class. So if we sum the areas of all rectangles it is equal to total number of observations.

When applying a histogram there should be at least 50 readings to get a good understandable shape of distribution. The number of intervals or classes should be between 6 and 12. To get the intervals it's good to take the difference of highest and lowest value in the data. If there are too many or too less data values or intervals then the histogram will be of a flat or peaked shape.

Pareto Chart

The Pareto chart was introduced by Joseph M. Juran in 1940s. Juran named it after the Italian statistician and economist Vilfredo Pareto (1848-1923). There are several quality problems to be addressed in a project. Often the problems are solved one by one. The Pareto chart helps in deciding the order of problems in which they should be solved. Pareto chart is related to the 80/20 rule found in business economics. The 80% of problems are because of 20% of causes

In the Six Sigma methodology Pareto chart has two main functions. Firstly in the define phase it helps in the selection of the appropriate problem. Secondly in analyzes phase it helps in identifying the few causes that lead to many problems.

Cause and Effect Diagram

The cause and effect diagram is also known as fishbone diagram or an Ishikawa diagram. It was introduced by Dr Kaoru Ishikawa in 1943, while working in a quality program at Kawasaki Steel Works in Japan [10, 47]. Once we have a quality problem its causes must be found. Cause and effect Diagram helps to find out all the possible causes of an effect (problem). It is the first step in solving a quality problem, by listing all the possible causes. In Six Sigma it is used in the define phase and analyze phase [10, 47, 49].

The reason that Cause and Effect Diagram is also called Fishbone Diagram is that it looks like a skeleton of a fish. The main problem is the head of the fish, the main causes are Ribs and the detailed causes are the small bones.

Stratification

Stratification is used to divide the collected data into subgroups. These subgroups help in finding the special cause of variation in the data. It provides an easy way to analyze the data from different sources in a process. It is used very less as compare to other quality tools but it is beneficial. In the Six Sigma methodology it is used in the improve phase. The collected data is usually stratified in the following groups: machines, material, suppliers, shifts, age and so on. Usually stratification is done in two areas but if the data is large than further stratification is also possible [10, 47].

Scatter plot

Scatter plot is used to define the relationship between two factors. Its main function is to identify the correlation pattern. The correlation pattern helps in understanding the relationship between two factors. In Six Sigma methodology it is used in the improve phase. Once you know the relationship between the factors then the input factor values are set in a way so that the process is improved.

While constructing the Scatter plot the input variable is placed on the x-axis and the output variable is placed on the y-axis. Now the values of the variables are plotted and the scattered points appear on the figure. These points provide the understanding of the variables and the process can be improved. Often there are many variables affecting the process, in this situation a series of scatter plots should be drawn [10, 47].

Control chart

The Control chart was introduced by Walter A. Shewhart in 1924. Industry is using Control chart since the Second World War. It is also known as Statistical Process Control (SPC). In Six Sigma methodology it is used in analysis, improve and control phase. In analyze phase Control chart is helpful to identify that the process is predictable or not. In improve phase it identifies the special cause of variation. And in control phase it verifies that the process performance is improved. It shows graphically the outputs from the process in different time intervals.

There are two main purposes of Control chart. First is the creation of a process with a stable variation. The second is to detect the change in the process i.e. alteration in mean value or dispersion.

Special Tools

Any technique which can improve process quality can be a Six Sigma tool. As said in above section, only seven QC tools are not enough for the whole Six Sigma projects. By investigating, we found many other tools which can also significantly help to improve process (Further information is provided in the website: <http://www.isixsigma.com>). Some of them are listed below.

Brainstorming

As defined by Alex Osborn [50], Brainstorming is "a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously by its members". It is designed to obtain ideas related to a specific problem as many as possible. It motivates people to generate new ideas based on their own judgments. If the environment is comfortable and participants feel free to announce their minds, it will produce more creative ideas. To organize an effective and successful brainstorming, you shall follow steps below:

- Define the problem which you want to solve. Only well defined problem could generate the best ideas. In contrast, an unclear defined problem will mislead participants.
- Set down a time limit and an idea limit. Generally the meeting is around 30 minutes to generate 50 to 100 ideas. It depends on the size of groups and the type of problem.
- There should be absolutely no criticism for any ideas. Everyone's ideas need to be written down even they are such impossible or silly. Try to keep everyone involved to develop ideas, including the quietest members.
- Once upon the limited time is over, select the best five ideas which everyone involved in the brainstorming agreed.
- Write down five criteria for judging which idea is the best one for the defined problem.
- Give each idea a score of 0 to 5 points which depends on how well the idea meets each criterion. Add up the scores when all ideas have been evaluated.
- The idea which gets the highest score is the best solution for the problem. At the same time, the other ideas shall be recorded as the alternatives in case the best one is not workable.

Brainstorming is a great way to generate ideas. During the brainstorming process there is no criticism of ideas which is to motivate people's creativity. Individual brainstorming can generate many ideas, but it is less effective for each one's development. This problem can be solved by group brainstorming which tends to produce fewer ideas for further development.

Affinity Diagram

The affinity diagram is developed by Kawakita Jiro [52], so it is also called KJ method. It is used to organize large number of data into logical categories. Generally, we use affinity diagram to refine the ideas generated in brainstorming which is uncertain or need to be clarified. To create an affinity diagram, we need to sort the ideas and move them from the brainstorm into affinity sets, and creating groups of related ideas. Below issues should be followed:

- Group ideas according to their common ground. The reason can be ignored.
- Using questions to clarify those ideas.
- If an idea has several characteristics, we should copy it into more than one affinity set.

- Combine the similar small affinity sets into one, and break down the complex sets.

The final result of affinity diagram shows the relationship between the ideas and the category, which can help brainstorming to evaluate ideas. And it is also considered the best method for the ideas without speaking.

High-Level Process Map (SIPOC Diagram)

SIPOC diagram is a Six Sigma tool which is used to identify all process related elements before we start to work. Predefine those factors can avoid we forget something which may influence the process improvement, especially in complex projects.

SIPOC is the logograms for “Suppliers, Inputs, Processes, Outputs, and Customers”. All your works are to

- Identify suppliers and customers who will influence the projects.
- Obtain the inputs for processes from suppliers.
- Add value through processes.
- Provide outputs to meet customer's requirements.

Measurement System Analysis (MSA)

Measurement System Analysis (MSA), or called Measurement Capability Analysis (MCA), is used to assess the capability of process measurement systems by using experimental and mathematical methods. The purpose is to improve your measurement system, to ensure the system provides the unbiased results with little variations.

Because every project has the different background, so that needs we modify our measurement system to meet customer's needs. For example in tolerance measurement, it can be measured in millimeter, centimeter, decimeter and meter. MSA's job is to analyze customer's needs, and select the appropriate measurement scale. Other factors which influence the measurement system are :

- Cycle time
- Cost
- Stability
- Bias
- Linearity
- Response-to-Control (RtC) Variable Correlation and Autocorrelation
- Gage R&R (Repeatability and Reproducibility)

Voice of the Customer (VOC) Method

Voice of the customer method is a process to identify customer's requirements for high quality product. The customers come from different fields. External customers usually are common customers, suppliers, product users, partners, etc. And internal customers include employees from market department, product development department, and so on.

There are several ways to capture the voice of the customer – individual or group interviews, surveys, observations, customer specifications, complaint logs, etc. Through these methods, we

can get the stated or unstated needs from the customer. By assessing and prioritizing those collected requirements, it provides ongoing feedbacks to the organization.

Kano Analysis

Kano analysis is developed by Dr. Noritaki Kano, it is a quality tool which helps to prioritize customer requirements based on their satisfaction. That is because all identified requirements are not equally important. The result can help us to rank the requirements and identify the few critical ones which have the highest impact. Furthermore, it can help us to make the decision.

In Kano analysis model, there are three types of customer needs.

- *Must-Be*. Must-be needs are the requirements that have to be met. The customers believe must-be needs are very basic which even do not have any necessary to discuss. For example, in a bank system, the deposit function and draw-out function are must-be needs.
- *Delighters*. Delighters are the needs which the customers do not expect. When those needs are met, the customers will be very happy. When user logs in the bank system, there are some bright music played in the background. However, he will still be angry when he cannot find any function related to the deposit. The delighters can only have the effects if and only if the must-be needs are met.
- *One Dimensional*. One-dimensional needs are the ones which need to be discussed and negotiated, such as the price. The customers will be more satisfied when the price falls. But on the other hand, the development company will be much unhappier.

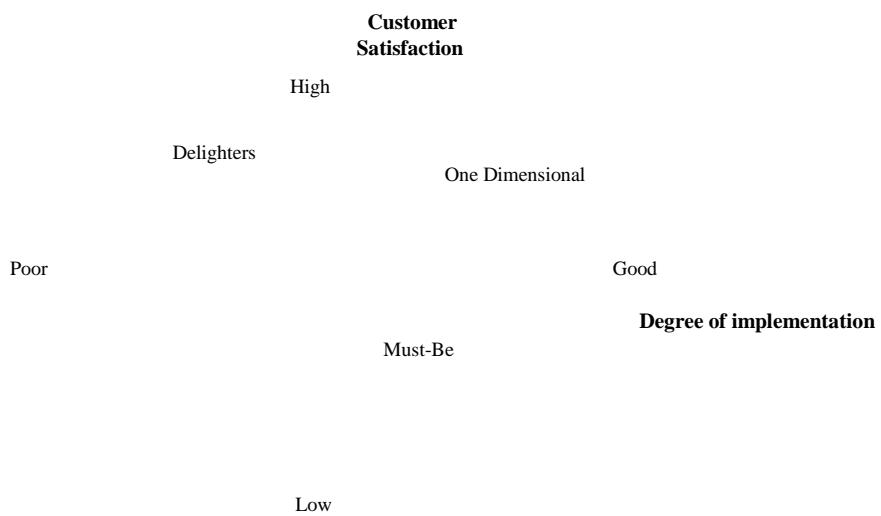


Figure 3.3 The Kano Analysis Model with three customer needs.

Using Kano Analysis in Six Sigma project to understand customers' needs can help you to create more value for customers and make them satisfy with your products and services. Furthermore, priorities of requirements are assessed. This can help the company to figure out what are the customers most concerned which close the relationship with customers.

The Others

The other methods are seldom used, but still very helpful. They are

- *Project Management Methods* – The project management skills can significantly help the Six Sigma improvement projects, such as project planning, project charter, scheduling, communication, HR management, and project management tools.
- *Failure, Effect and Mode Analysis (FEMA)* – The main work of FEMA is to assess risks and put efforts on controlling and minimizing risks. Before you work with those risks and identify their causes and effects, using flow chart to prioritize them in the timely sequence is a nice choice.
- *Stakeholders Analysis* – Identifying the people who have a stake on the Six Sigma process improvement project. Those people will directly or indirectly influence the projects or results. The ones who are not satisfied will insist to changes.
- *Process Documentation* – Effective, clear, comprehensive process documentation is very helpful for the Six Sigma projects, such as process maps, task instructions, measures, etc.
- *Analysis of Variance (ANOVA)* – It is a collection of statistical models which analyzes the variations presented in the project. It is used to assess the differences between groups of data.
- *Correlation and Regression* – These tools assess the relationships (presence, strength and nature) among variables in process.
- *Design of Experiments (DOE)* – It is used to assess the performance of a process. Generally, it tests two or more characteristics under the different conditions. By comparing, the causes of a problem will be identified. It also can be used to optimize results.

SIX SIGMA IN MANUFACTURING

This chapter firstly analyzes the corporate framework of Six Sigma in manufacturing from academic view. After that, successful experiences from Company 1 and ABB are described. The aim is to identify what is the condition of Six Sigma in manufacturing. And it will help us to implement Six Sigma in software.

Manufacturing Corporate Framework

The corporate framework of Six Sigma has been launched by Motorola for many years. Lots of companies like GE, ABB, and AlliedSignal have enlarged during the implementation. Nowadays Six Sigma approach has become more pragmatic [60].

In [47], Magnusson and his copartners have make a comprehensive and deep analysis with this corporate framework. Figure 4.1 shows that there are four factors and one methodology (DMAIC) within the framework. Four factors are top management commitment, stakeholder involvement, training scheme, measurement system. Among them, top management commitment and stakeholder involvement is the base of the framework. Without them, the other factors and methodology are meaningless. All four factors support the core methodology which is used in every improvement projects [47, 61, 62].

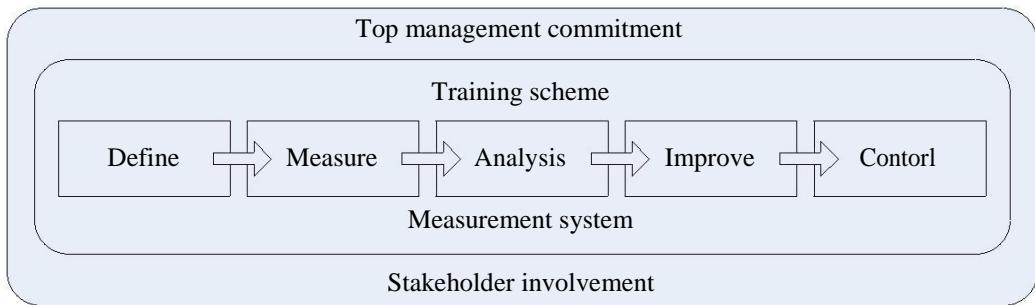


Figure 4.1 The corporate framework for Six Sigma.

Top Management Commitment

Top management commitment can be break down into three parts – top management, personal belief and commitment, and set a tough goal. Below we will discuss them separately.

- *Top management* – For a company, implementing Six Sigma is a strategic decision which aim to save cost and increase revenue. It needs to be taken by top management. Actually in many companies, Six Sigma is given the top priority [60]. The members of top management generally are the company owners, project sponsors and advocates. Those people shall be open-mind and hear the Six Sigma report frequently.
- *Commitment* – Top management needs a high degree of personal belief and commitment. When launching Six Sigma, any confusion or doubts about the top management will slow down the progress. Just like John F. Welch (CEO of GE) have said in his speech at the GE 1996 Annual Meeting in Charlottesville, “... we have selected, trained and put in place the key people to lead this Six Sigma effort, ... we have the balance sheet that will permit us to spend whatever is requirement to get to our goal” and “... the return on this investment will be enormous”.
- *Set a tough goal* – It is the responsibility of top management. A clear goal can motivate people and lead them to success. At the same time, the tough goal should be achievable. Some companies set their goal for process performance to 3.4 DPMO (equals to 6σ). That is not impossible, but we can set it more intelligently. For example, we set the goal to reduce DPMO by 50% for each year. In reality this number is even higher. ABB have set the goal to be 68% for a yearly reduction, while GE’s goal is 80% .

From all above, we can say top management commitment is to select the right person to lead the Six Sigma effort, trust them and support their decisions, and set a smart tough goal which improves process performance continuously.

Stakeholder Involvement

Only top management commitment is not enough to reach the goal which is set for improving process performance. The companies also need stakeholders’ help. Stakeholders are people or organizations who will be affected by the product and who have a direct or indirect influence on the product [64]. Stakeholder involvement is to show the improvement methodology and tools of Six Sigma to stakeholders and get their support. The stakeholders can be employees, suppliers, customers, etc.

Stakeholder involvement can shorten the distance of companies with their suppliers and customers. They could give many precious opinions from their view, and those opinions can help to improve process performance or modify our Six Sigma activities. Supplier involvement is essential. That is because the variation in their products will be transferred to the company's processes. Sharing the Six Sigma information and process performance data can help them to improve their product quality, which indirectly improves the company's process. The Six Sigma can only become the success when tied with customers. They shall be allowed to join the process improvement, share the responsibility. Later on, they will be happy and proud since they are involved.

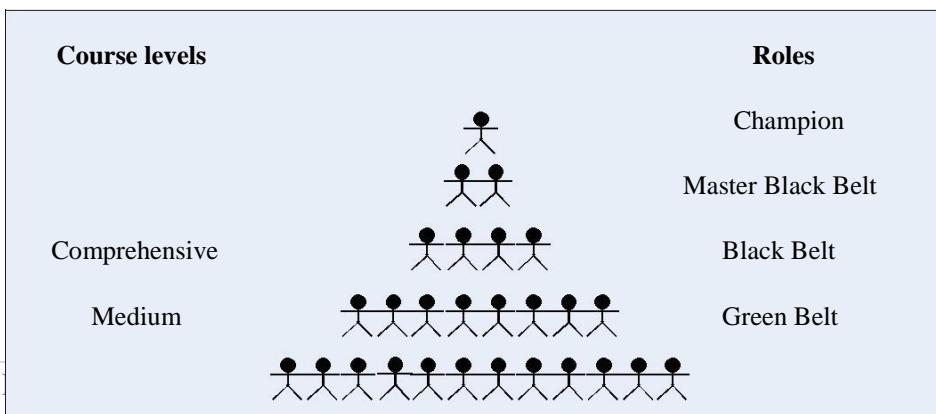
However, training for stakeholders is necessary. Some courses can help them to understand process improvement and Six Sigma comprehensively. And that can also help to improve their processes.

Training Scheme

Training in Six Sigma includes the knowledge of process performance, methodology, statistical tools, deployment, frameworks, etc. The experience from Motorola, GE, Dow Chemical, etc has proved the training can extremely be cost saving. In Motorola, the reported return on investment ratio was 29:1. In GE, the investment on Six Sigma increased from US\$ 250 million in 1996 to US\$ 450 million in 1998. They believe the high investment in Six Sigma training is towards to a rapid revenue growth and cost reductions.

Figure 4.2 demonstrates the Six Sigma training scheme. From the figure, we can see that there are five roles in Six Sigma – White Belts, Green Belts, Black Belts, Master Black Belts and Champions. According to the roles, Six Sigma training courses are divided into three levels – Basic level for White Belts, Medium level for Green Belts and Comprehensive level for Black Belts. In some companies, they have Yellow Belts between White Belts and Green Belts:

- *The Basic level course for White Belt* – provides a basic introduction of Six Sigma including some basic experiments, variations introduction, cost of poor quality, etc. Generally, it only spends one day and is offered to front-line employees.
- *The Medium level course for Green Belt* – is the advanced version of Basic level. The participants are selected to learn some Six Sigma tools, measurement, process management, and how to use improvement methodology in the real projects.
- Comprehensive level course for Black Belt – is more comprehensive and aims to create full-time improvement experts. In the course, the participants are required to perform an improvement project to save a specific cost.
- Two additional course – Six Sigma engineering and Six Sigma management focus on process design and interaction management separately.



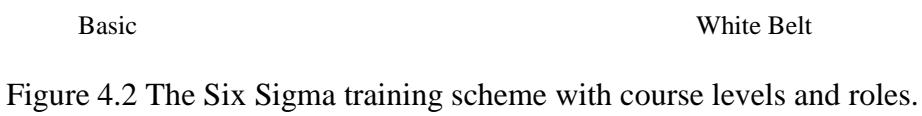


Figure 4.2 The Six Sigma training scheme with course levels and roles.

Two other roles are Master Black Belts and Champions. Master Black Belts are selected from the people who have Black Belt qualifications. Their job is to teach Six Sigma courses within Six Sigma training scheme. Champions who are on the top of organizations drive the whole process. Those people have extra experienced knowledge of Six Sigma, take part in selections of improvement projects, and make decisions.

The number of people play different roles depends on the size of company. For example, in a 2,000 employees company, it should have one Master Black Belt at least. There should be 20 Black Belts for every Master Black Belt and 20 Green Belts for every Black Belts.

Measurement System

Measuring process performance can help us to identify problems from poor process performance, which is good at solving problems in the early stage. A simply metric – DPMO (Defects Per Million Opportunities) – is used to evaluate the variation in critical-to-customer characteristics of processes and products.

There are two types of characteristics that can be included in the measurement system – continuous characteristics and discrete characteristics. Discrete characteristics are number-related, which provides attribute data. Generally, most of observations are applied for it. Measuring continuous characteristics can provide continuous data which could assist all observations. Although two types of characteristics are measured and analyzed differently, the results shall be combined into one number (the average of all individual characteristic results) for the whole company's process performance. This combined DPMO value is simple and easy, and it can make the attention of whole company on the process performance.

Improvement Methodology

After the foundation is settled, a specific Six Sigma project can be started. Six Sigma approach provides a formalized improvement methodology – DMAIC model. This model starts with a define phase, and other four specific phases are followed – measure, analysis, improve, and control.

Define

This phase is to select the proper improvement projects and identify process to be improved. One of most valuable source is Six Sigma measurement system. The DPMO value has indicated the poor performance process. Other valuable sources are customer complaints, competitor analysis, employee suggestions, etc. In general, only poor performance processes or characteristics need improvement. Otherwise, the whole product shall be improved.

Among a number of potential improvement projects, the Pareto chart and the cause-effect diagram can be used for prioritization. The criteria are:

- Benefits for customers.
- Benefits for company.
- The complexity of the process.
- Cost saving potential.

With the help of above criteria and statistical tools, a characteristic or process will be identified for improvement. At the same time, a team shall be organized for the improvement project. In this team, a project sponsor from top management shall be appointed, which is to ensure that the project gets top management's focus. Other members like Black Belts who is responsible for management and making decision, Green Belts and White Belts who assist Black Belts' work. It is obviously that all the team members shall have a great understanding with Six Sigma. Several Six Sigma training courses are essential.

Measure

There are mainly two jobs in measure phase. The first one is to assist define phase for improvement project selection. Before the improvement project is defined, several characteristics or processes shall be measured. Most of Six Sigma companies apply the mental model (i.e., "Y is a function of X"). Y is selected from variation results through Six Sigma measurement system, while X factors which influence Y need to be identified for each Ys. The relationship is demonstrated in Figure 4.3.

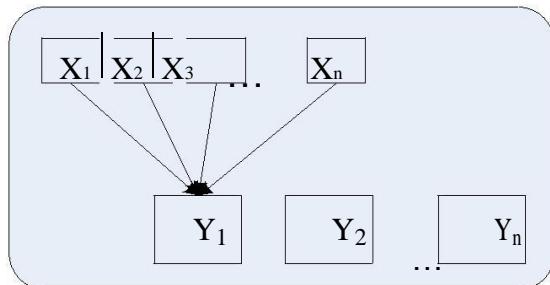


Figure 4.3 Relationships between Ys and Xs.

The other job of the measure phase is to collect the data for the selected Ys and Xs. Before the selection decision is made, related data such as types, sizes, measurement intervals, and how to record the data are needed. Be different with the measurement of process performance, measurement of Ys and Xs are more detailed and project related.

Analyze

Analyze phase assesses the data which is collected for Ys and Xs. By assessment, the performance of Ys can be calculated in terms of DPMO values or sigma values. After comparing those values, similar processes can be discerned. Based on those analyses, a goal for improvement can be set.

Improve

All of activities within improve phase are included in below Figure. It starts from deciding if the selected Y or Ys need to be improved. Then we need to identify and measure Xs which associate with the decided Y or Ys. A group of statistical tools and experiments are applied to find out the improvement opportunities. We can also identify the special causes for variations among the Xs.

If the result is that those variations can be improved, then they should be removed or their impacts reduced. On the other hand, if there are no special causes which are identified or those variations cannot be improved, we shall reapply statistical tools and redesign experiments. If the results do not change after several iterative, we shall consider that might be the design problems of process or product. Then, the process or product is designed with the aim of improvement.

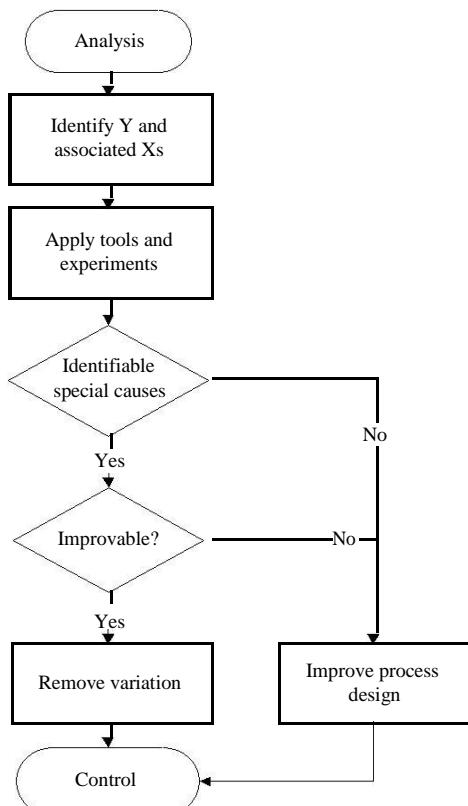


Figure The flow of activities in improvement phase.

Control

There are also two activities in control phase. After improvement phase has been carried out, the planned improvements shall be verified. Improper or incorrect improvements will be discovered and corrected in the next improvement project. Control Chart and DPMO Track Chart are highly recommended to verify the long-term effects of improvements.

Another important activity in this phase is to formalize the results. The results which only match a single process or product will be reorganized and reanalyzed to match the whole company. Both successful and failed cases shall be formalized, reported and stored. The companies should gain experience from those cases for further improvements. Based on that,

THE ACCEPTANCE AND MOTIVATION OF SIX SIGMA IN SOFTWARE COMPANIES

This chapter discusses the different views on applying Six Sigma in Software companies and the differences between manufacturing and software processes. Furthermore two questions are

addressed. First one is the acceptance of Six Sigma in software companies. Second one is why software companies should adopt Six Sigma approach.

Different Views on Applying Six Sigma in Software Companies

Since Six Sigma approach was successfully applied to manufacturing industry for more than two decades, it is considered as a new star in the world of quality. There is a common misconception that Six Sigma is only applicable for manufacturing industry. The application of Six Sigma in software companies has faced many controversies. There are many different views on applying Six Sigma in software companies.

Binder's View

Binder has pointed out three main difficulties. Based on the three difficulties, Binder claimed that Six Sigma is not applicable in software companies. The three difficulties are:

- *Processes* - Software processes are fuzzy as compare to the manufacturing processes. So the application of Six Sigma is easily established and documented in manufacturing, not in software.
- *Characteristics* - There are difficulties in meaningful measurements of software characteristics. Software cannot be measured as weight, distance, width, etc. Total number of faults cannot be measured in software.
- *Uniqueness* - Manufacturing products are generally mass produced but software products are one-off.

Binder's view is doubtful because only on the basis of three differences, he denied the applicability of Six Sigma in software. In order to identify the real situation, we need a comprehensive understanding about the differences between manufacturing and software.

Two Misconceptions Debunked by Tayntor

Managers cannot deny the importance of reducing defects, increasing customer satisfaction and operating more efficiently. Many software companies are now adopting Six Sigma. Claimed by Tayntor, there are two misconceptions associated with Six Sigma in software companies. The first is that, Six Sigma is a statistical analysis, so it is applicable for manufacturing and engineering processes and it has very little or no relevance to software. The second is that Six Sigma cannot be adopted in just a few areas of the company. It should be applied to the entire company. Both these misconceptions should be debunked.

Six Sigma Has No Relevance in Software

There is some misconception that Six Sigma applies to manufacturing processes but not to software. The truth is that the tools and techniques of Six Sigma can help software companies by ensuring that the "three rights" are in place.

- *The right people are involved* – Many software projects fail because of poor requirements. Poor requirements are caused because all stakeholders are not represented or they participate very late in defining the requirements. Six Sigma approach solves this problem by focusing on teamwork and clearly identifying the customer's requirements.
- *The right problem is solved* – Six Sigma tools not just clearly identify the customer's requirements but also impact on the proposed solution. Proper use of Six Sigma tools helps in focusing on the high value system components.

- *The right method is employed* – Six Sigma tools help software companies by evaluating processes and finding variation in them, identifying causes of defects and ways to prevent them. Example if a project is over budget Six Sigma techniques find out the main causes and the ways to correct them.

Six Sigma Is Applied in Whole Company

The second misconception is that Six Sigma is only helpful if the whole software company has adopted it. This is a fact that it is easier for a software company to implement Six Sigma if the whole company adopts its philosophy. But there are benefits of adopting Six Sigma tools and incorporating the processes into software development, even if the whole company is not using Six Sigma.

So Six Sigma has applicability to software companies. The reasons for adopting Six Sigma are clear – fewer defects, faster delivery and increased customer satisfaction.

Cost Misunderstanding

There is a misconception that designing a system to Six Sigma is very expensive [36]. Since Six Sigma focuses on quality from the beginning of a project so it has minimal cost to improve quality. On the other hand if we wait up to the testing phase in finding the defects then the cost to fix the defects is very high. A cost and benefit analysis should be done in the Six Sigma program to determine the actual gains.

Why Software Companies Choose Six Sigma Approach?

After the above discussion there is a question that does Six Sigma make sense in software companies. The answer is yes, Six Sigma is good for software companies especially for the following situations.

- *Legal Responsibility* – Six Sigma approach helps to fulfill legal responsibility. Now-a-days if something goes wrong people go to the lawyers according to Human Rights Act. Up to now disasters are not blamed on software's but software's can cause huge disasters. Software has many identical copies. These copies are installed in different companies. If there is some defect in the software then all the companies are at great risk of failure. Even the most powerful companies like Microsoft are fearful of such failures.
- *Mission Critical Systems* – Now a day's software's are developing for mission critical systems. The failure of a mission critical results in a great loss to society. Here comes Six Sigma which means 3.4 defects per million opportunities, it can prevent the software from failing. In 1988, American Airlines lost 59 million dollars in ticket sales. The problem was the discount ticket was mistakenly blocked in the ticket reservation system. As a result travelers moved to their competitors. These weaknesses can be removed by applying Six Sigma which provides near defect free performance.
- *Complex Systems* – The application of Six Sigma is very effective in case of complex systems. For example there a complex system with like 1000 modules if all the parts are designed according to Six Sigma then there is a higher probability of getting a defect free system.
- *Software Company* – Software companies have a bad reputation of buggy and late. Today software size is very large like more than thousands of lines. It has more probability of having many defects. In this situation Six Sigma can help us to get a near defect free

product.

STEPS TOWARDS APPLYING SIX SIGMA IN SOFTWARE COMPANIES

we presented a method by steps for applying Six Sigma in software companies. It is conducted by integrating all previous research findings.

The method which will be presented contains two main parts – environment establishment and an enhanced methodology. The first part is the foundation for conducting process improvement projects, while the other part is the main way to direct the project. Those two parts are presented separately as below.

Environment Establishment

Before we apply the methodology to development process, the Six Sigma environment shall be established first. We know a good Six Sigma environment not only support the implementation of Six Sigma project, but also continually cultivates Black Belts as the main force for Six Sigma team.

Magnusson and his partners have recommended twelve steps for introducing Six Sigma to manufacturing companies. Magnusson uses many evidences and real cases to prove his method's functionality. And we believe it really can help to establish Six Sigma environment. However, all cases and evidences point to manufacturing field. And Magnusson also has said "Black Belts themselves may find it difficult to drive improvements in non-manufacturing process". About applying Six Sigma approach to other field of process, for example software company, we are very sorry to say there is no answer in Magnusson's book.

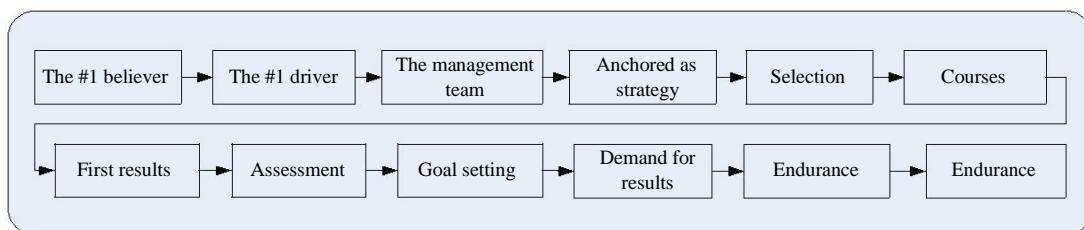


Figure Twelve steps for introducing Six Sigma to manufacturing company.

However, Magnusson and his partners have shown us a way to solve the problem. If we integrate his method with software specific attributes, a specific method for software Six Sigma environment establishment is conducted.

Reform Superstructure

As we know, Six Sigma is a top-down approach. In software, generally there is a Project Management Office (PMO) which controls all company's projects. So the superstructure of company shall be reformed first. Everyone within the PMO shall have a good understanding about Six Sigma approach, especially for CEO/CTO, Master Black Belt, human resource manager and financial manager.

CEO/CTO is the most importance person who supports the Six Sigma projects. Their work is resource allocation, task deployment, budget works, etc. In some sense, the success of implementation depends on how well the CEO/CTO knows the Six Sigma approach.

Master Black Belt (MBB) is the person who takes Champion position in Six Sigma projects. He/she is the coach who drives the whole process improvement project. In software companies, the special attributes require that MBB should have not only the excellent Six Sigma knowledge, but also the expert software project knowledge. CTO or Chief Software Architect (CSA) is the best options. Otherwise, a project manager with the Black Belt certificate can also be promoted as the Champion. A Champion's work can be summarized as identifying improvement opportunities, developing action plan, leading to apply Six Sigma tools, communicating, and coaching.

Human resource manager and financial manager are also important roles within Six Sigma projects, which we have not mentioned before. Human resource manager need to help Black Belts selection, while financial manager is responsible for the cost reduction calculation.

Six Sigma is not only a methodology, but also a business strategy. If we want to have a successful Six Sigma project, top management's support is very essential. That is why reforming the superstructure is needed.

To reform the superstructure, company can invite Six Sigma specialists as the consultant, or launch a specific Six Sigma course for top management. However, above options can only solve the problem temporary. The best way is to establish a Six Sigma education system which conducts a long-term effect.

Establish Six Sigma Education System

A grouped Six Sigma course is very necessary for companies from top to down. A well-designed education system can continuous cultivate talents for Six Sigma projects. Six Sigma approach will not conduct long-term improvement without education system's support. That is why establishing an education system is so much essential.

Six Sigma course shall include both high-level which aims to Black Belts, and low-level which cultivate Green Belts (some companies may need a middle-level for Yellow Belts). Different levels share a same weightiness. A great number of full-time Black Belts are the guarantee for Six Sigma projects. They lead each single Six Sigma project, create project plan, communicate between project team members, and be responsible to report project status to top management. Generally, the selection of Black Belts is among project managers within the software company. Because in software, Black Belts shall not only need a great Six Sigma knowledge, but also own an expert software knowledge. Generally, candidates shall also have following attributes:

- Good education background – this is an education course. Good education background means learn fast.
- Young enough – young project managers can easily accept new concepts.
- Full-time work – Black Belts require the people put all his time and focuses on Six Sigma projects.

Green Belts are the main force for Six Sigma activities. They are the actual workers who carry out project plan. Without them, the Six Sigma projects are just papers. The candidates of Green Belts can be selected among common employees within the company.

Generally, the Black Belt courses are lead by MBB. And the selected Black Belts are responsible for Green Belt courses. In courses, a Six Sigma project must be run as a homework assignment for all participates. As the first project, successful cases will be recorded and shared within the whole company. By using this, the employees will be encouraged and motivated for learning Six Sigma.

Continuous Improvement

Why continuous improvement? That is because the quality will not be improved in just one single process improvement project. Continuous improvement focuses on a long-term performance. Numbers of improved processes and Six Sigma projects may lead a visible quality effect. It is not an easy job. On the other hand, if we do not keep continuous improvement, the performance of processes may turn back to the original or even worse. So, continuous improvement is necessary and important to company.

Continuous improvement is not just banners which catch people's eyes. Indeed, it is made up by numbers of actual activities. For example, spread the successful improvement results to the similar processes, build up a common software development standard, provide some specific training to new group members, etc.

The Six Sigma environment will not improve quality and bring profits immediately. In contrast, it costs lots of resources and time. However, the environment is the foundation for all Six Sigma projects. Without that, the result of improvement will not last too long, and finally the improved process will back to before. To keep a long-term performance, environment establishment is very essential, and the cost will come back due to the improvement of quality.

An Enhanced Methodology

Methodology Selection

After the Six Sigma environment is established, we can start the real improvement projects. There are a number of methodologies can be used. Two main methodologies are recommended by Six Sigma approach – DMAIC model and DMADV model. The first one is used in existing process improvement. And the DMADV model is used in new process development.

Since all cases in Chapter 6 use DMAIC model, so in this section we decide to introduce this most popular model. The criteria for the proposed steps in the most used activities within each phase of the DMAIC model.

Enhancing DMAIC Model

DMAIC model is named by its five phases – Define, Measure, Analyze, Improve and Control. By analyzing previous cases, this methodology is enhanced by integrating with what have been learned from research. Authors describe those five phases separately in below sections.

Steps in Define Phase

In first phase, project members shall have a “big picture” of the process, which needs to be improved. To achieve that, process, problems, related customers and their requirements shall be identified first. After that, several properties shall be developed, such as project goal, scope, team, project plan, etc. From all cases which are introduced in Chapter 6, a comparison is conducted to identify differences and similarities (see Table 7.1).

Case Name	Activities	Tools
	• Identify problem.	• SAP Method
	• Define project goal, project scope, and project plan.	
Company 1	• Organize project team.	
	• Create project charter.	
	• Project charter.	• SIPOC Diagram
Company 2	• Critical to quality.	• As-Is process
	• A process map.	
	• Create project charter.	• SIPOC Diagram
	• Identify problem.	• Kana Analysis
Case A	Collect voice from customers.	• VOC
	• Define project scope.	• Quick Wins
	• Define project goal.	• As-Is Process
	• Process Breakdown.	• Process Metrics
Case B	• Identify problem.	• KSAP
	• Organize project team.	
	• Create project charter.	
	• Define project goal.	• Process Mapping
	• Define quality critical factors.	
Case C	• Organize project team.	
	• Identify problem.	
	• Define measurement system.	

Table Activities comparison for measure phase between four cases.

Steps in Measure Phase

To discover the variations, the input data associated to the selected initial problem shall be measured, and then exports measure results to the following analysis phase. Below is the measure phase comparison for all cases

Case C		
Case Name	Activities	Tools
Company 1	<ul style="list-style-type: none"> Measure main problems and its causes. Prioritize causes and get the top six causes. Reported defects with severity level. 	<ul style="list-style-type: none"> Process Mapping XY Matrix
Company 2	<ul style="list-style-type: none"> Time spent on correcting defects. Lead time of defect correction. Amount of overdue invoices. 	
Case A	<ul style="list-style-type: none"> Identify what to measure. Evaluate the measurement system Data collection. Identify sources of variation. Calculate Sigma level. Set software reliability goal. 	<ul style="list-style-type: none"> SIPOC Diagram COQUALMO
Case B	<ul style="list-style-type: none"> Measure problem related data. Collect information. Check errors. Determine process baseline. 	
Case C	<ul style="list-style-type: none"> Measure the critical of quality Histogram factors Assess poor input variables 	

Table: Activities comparison for measure phase between four cases.

Steps in Analyze Phase

By analyzing the measure results from the above phase, we can identify the sources of the variations and develop the methods to reduce them. Following table is the comparison of all cases' activities in analyze phase.

Case Name		Activities	Tools
		Analyze problem sources.	<ul style="list-style-type: none"> 2-Proportion
Company 1		Conduct solutions.	<ul style="list-style-type: none"> Regression Analysis
			<ul style="list-style-type: none"> Two-Sample Test
			<ul style="list-style-type: none"> Kruskal-Wallis Test
		Ask why until root	<ul style="list-style-type: none"> Cause and Effect Diagram

		cause		
Company 2		found.		• Pareto diagrams
	• Process map analysis.			
	• Analyze sources of variations.		• Pareto Analysis	
			• GO Model	
Case A		Identify the correlations		
	•			
		between software factors		
		and defects.		
Case B		• Identify problem sources.		
	•	Refine process.		• Cause and Effect Diagram

	•	Conduct solutions.		
	•	Identify key problem sources.	•	Cause and Effect Diagram
				• FMEA
Case C	•	Identify relationship between variables.		
	•	List defect causes.		

Table Activities comparison for analyze phase between four cases.

Steps in Improve Phase

When the project moves to this phase, the problem and its root causes are clearly identified and discovered. Additionally, the best solution and its backups are also ready. Now it is time to make the proposal come true.

Case Name	Activities		Tools
Company 1	Design experiments to verify solution.	•	Pareto Chart
	• Apply improvements.		
Company 2	• Cost/benefit analysis.		
	• Solution alternatives.		
Case A	• Identify solution alternatives		
	• Implement improvements.		
Case B	• Apply improvements		
Case C	• Apply improvements.	•	Check List
	• Get customer feedbacks.		

Table: Activities comparison for improve phase between four cases.

Case C

Steps in Control Phase

The project will never close without this phase. The last phase aims to long term performance. Without this phase, the process will turn back to its original status, and the improvement result will not last too long.

Case Name	Activities	Tools
Company 1	• Develop strategy to avoid problem	
	happen again.	
	• Document project experience.	
Company 2	• Apply Improvements.	• Check list
	• Store lessons learnt during project.	
Case A	• Assign responsibilities.	
	• Performance view.	
Case B	• Assess performance.	
	• Conduct new goal for further improvement.	

- Calculate Sigma level.
- Spread success to other Six Sigma projects.

Table : Activities comparison for control phase between four cases.

What are the definitions of Six Sigma?

A detailed literature study is carried out to find out the definitions of Six Sigma. The literature study consist of articles, web materials books. The Six Sigma has definitions at three levels i.e. matrix, methodology and strategy. At matrix level Six Sigma is 3.4 defects per million opportunities which means 99.9997% defect free product. Six Sigma approach at methodology level is not just counting defects in a process or product, but it is used to improve processes. When we look at Six Sigma as a methodology, there are many models available for process improvement like DMADV, DMAIC etc. At strategy level, through experience, Motorola has found that using Six Sigma as a metric and as a methodology are not enough to drive the breakthrough improvements in an organization. Motorola ensures that Six Sigma metrics and methodology are adopted to improve opportunities which are directly linked to the business strategy. Now Six Sigma is also applied as a management system for executing the business strategy.

What is the condition of Six Sigma in manufacturing?

An interview 1 is conducted with company 1 in China to see the condition of Six Sigma in manufacturing. Also a real case study is conducted with company 1 to understand how Six Sigma is used to improve a process. We found that Six Sigma approach has been successfully applied in manufacturing for two decades. From the successful experiences, a successful Six

Sigma project must base on at least four foundational activities. They ensure the progress of projects from top management to human resources. They are

- Top management
- Stakeholder involvement
- Training scheme
- Measurement system

When the foundation is well settled, a specific Six Sigma project can be started. From the successful cases, some models can be borrowed to help us to run the project. DMAIC model is a formalized improvement methodology which is the most popular one from successful cases. It contains five phases – define, measure, analyze, improve, control. Each phase has a clear defined aim and an outcome. It is not very hard to follow this sequence and achieve the project goal.

The applicability of Six Sigma in software's and why software companies choose Six Sigma?

Six Sigma approach can be applied in software companies if we involve the right people, solving the right problem, and using the right method. At the same time, although using Six Sigma approach for process improvement costs a lot, it worth. Few defects, faster delivery and increased customer satisfaction will generate more potential profits than you think.

The differences between software and manufacturing are obvious and unavoidable. The main distinct factors of software are non-repetitiveness, unique input and output, cognition, visualization, and some external factors such as employee's skill and knowledge. These differences are reflected on the software product and software process. Still applying Six Sigma approach in software companies is beneficial. Firstly, all deny opinions and misconceptions are built on the misunderstanding of Six Sigma approach and unfamiliar with the software. Secondly, we never say applying Six Sigma approach in software is just the copy of manufacturing's method. The differences do exist. According to them, we need to modify the Six Sigma approach, as the same time with the software process. Change them to fit for software's processes. And that demands further research and more experiments. It can help software companies to reduce defects, improve quality, increase customer's satisfaction, and enhance market-share. That is also the answer of why software companies choose Six Sigma, especially for complex systems, mission critical systems, and legal responsibility.

What kind of tools and techniques are used in Six Sigma? Which of them are suitable for process improvement in software companies?

There is no a specific tool or technique for one specific phase in Six Sigma. Any tool that is helpful for the process improvement can be applied in Six Sigma project. However seven quality tools are most widely used in all kinds of quality improvement. They are Cause-effect Diagram, Pareto Chart, Flow Chart, Histogram, Check Sheet, Control Chart, and Scatter Plot. The other special tools are gathered from successful Six Sigma cases which include Brainstorming, Affinity Diagramming, SIPOC Diagram, MSA, VOC Method, Kano Analysis, and so on. Using the proper tool in the right place is the key factor which influences success.

What is the state-of-art for the implementation of Six Sigma in software?

Interview 2 is conducted to analyze the current state of Six Sigma in software's. Furthermore different case studies are reviewed to find out the state-of-art for the implementation of Six

Sigma in software's. In each case, the Six Sigma project starts from defining the project goal and the problem which needs to be solved, then project team. The team members are selected from all levels inside or outside of company, for instance, CEO who comes from the top of company, Team Leaders who lead the project, customers involved from outside of company, and other members come from different departments within the company.

DMAIC model divides Six Sigma project into five phases. In each phase, there is a clearly define input and output. The output of the previous phase normally is the input of the next phase. In each phase, there are several steps to achieve phase goal. Numbers of quality tools are introduced to each step. There is only one criterion for quality tool selection – fitness for use. When the Six Sigma project is terminated, gained experiences will be documented and applied in other Six Sigma projects. Sometimes the project goal cannot be achieve by only one Six Sigma project. Then more Six Sigma projects can be organized according to situation. The spirit of Six Sigma approach is towards a long-term improvement.

Steps towards applying Six Sigma in software companies for process improvement?

We have provided a method for the implementation of Six Sigma in software companies. The method was divided into two parts – environment establishment and an enhanced methodology.

The Six Sigma environment is the basis for all Six Sigma improvement projects. It provides fully support and guarantee (financial, strategy, human resources, top management, etc.) to keep project towards success. Environment establishment step contains three activities. The first one is to reform organization's superstructure. In some place, it was called top management. The main purpose is to gain top management's trust and commitment. If a Six Sigma project loses top's focus, it won't last to the end. Meanwhile, the principle of Six Sigma approach is continuous quality improvement. It needs continuous support from the superstructure. The second important activity is to establish Six Sigma education system. Long-term improvements need numbers of quality specialists. This system is built for this aim. Finally, company needs to establish some necessary standards or rules to keep continuous improvement.

DMAIC has been selected as the main model for organizing Six Sigma project. Research findings and software properties have been integrated with the selected model. Its functionality has been enhanced to meet software company requirements. Activities and quality tools were blended with each step in each model phase. By the purpose of practicability and authenticity, most of them came from interviews and case study reviews. Authors anchor their hopes on using this method to help software companies for quality improvement, and also supporting quality researcher's further research

What is the further work for Six Sigma in software?

We found a few areas during our research. These areas are related to Six Sigma and are very interesting for further research. Below is provided a list of topics.

- Comparing Six Sigma with other quality techniques.
- Blending Six Sigma with CMMI.
- Six Sigma for small sized companies.
- Lean Six Sigma.

Contributions

- Analysis of the applicability of Six Sigma in Software's.
- The state-of-art for the implementation of Six Sigma in software.
- Steps towards applying Six Sigma in software companies for process improvement.

Six Sigma and Agile Software Development

Agile software development and Six Sigma both focuses on satisfying the customer requirements. Their end goal is same. Both focus on reducing the failure rates and improving the customer satisfaction. The way an agile software development project runs, it closely parallels the way Six Sigma DMAIC approaches the project.

Agile principles align with Six Sigma

The Table below shows the Agile principles align with Six Sigma.

Agile Principles	Six Sigma Alignment
The main focus is to satisfy customer through timely quality software.	Six Sigma provides strong tools to gather requirements and measure customer values.
Business people and developers both are involved throughout the project development.	Six Sigma provides clear or more visible requirements and design so that they can be discussed between business and development people.
Attention to technical issues and good design throughout the development.	Six Sigma compares different design choices based on technical issues which drive continuous attention.
Provides simplicity means maximizing the kind of work that should not be done.	Six Sigma clarify that what is important and what is not.
Agile processes provide sustainable development.	Six Sigma helps in sustainable and long term pace development.
The most suitable method for information sharing is face-to-face conversation.	Six Sigma also subscribes to this.

Frequent delivery of working software i.e. weeks, months.	Six Sigma also stay away from the bigger deliveries.
-----------------------------------------------------------	------------------------------------------------------

Table Agile principles align with Six Sigma.

Requirements understanding

The most common reason behind the failure of a software project is misunderstanding the user requirements. Agile methods use an iterative approach for requirements understanding. In Agile software development the customer is very much involved which make it easier to understand the requirements. In Six Sigma one of the primary objectives is to align business goals with the customer requirements. The DMAIC phases focus on customers' expectations and its tools helps to achieve this goal.

After the above discussion we can conclude that Six Sigma tools together with Agile development can help in understanding the real needs of the customer. In next section, the use of some Six Sigma tools with Agile projects is presented.

Agile software project and Six Sigma tools

In an Agile software development project Six Sigma tools can bring large benefits i.e. improved quality. Following are some Six Sigma tools and their application with Agile software development projects. The examples are from the two popular methodologies Scrum and Extreme Programming.

- **Using Voice of the Customer:** In Six Sigma voice of the customer (VOC) is used to understand the customer's needs. Using this technique the customer is identified and the data is collected. In Agile software development project the customer is present in the team meetings. However, in huge projects with large organizations there are many direct and indirect customers. It is unfeasible to have everyone and discuss all the issues in the sprint review meeting (in the Scrum methodology). Using VOC before coming to the sprint review meeting will make the meeting more useful.
- **Building a Critical-to-quality Tree:** In Six Sigma a critical-to-quality (CTQ) tree is used to convert the customer requirements into specific features in the final product. It will be useful to draw the CTQ tree in the sprint review meeting.
- **Failure Mode and Effects Analysis for Design:** Failure mode and effects analysis (FMEA) design is used to keep track of the design failures with the project progress. Agile projects are iterative projects. To the iteration, design decision based on requirements can be a risk for the next iteration due to new requirements. Here FMEA can be useful. By maintaining a FMEA for iterations, the development team can analyze the failure points ahead of time.

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Yamnampet, Ghatkesar, Hyderabad – 501 301

**COURSE FILE
FOR
BIG DATA ANALYTICS**

B.Tech IV/IV (CSE) – I SEMESTER

**DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING
2018**

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

I. Mission of the Department

- II. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- III. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- IV. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development

a	b	c	d	e	f	g	h	i	j	k	l
x	x	x	x								

**Syllabus for B. Tech. IV Year I semester
Computer Science and Engineering
BIG DATA ANALYTICS**

(Professional Elective –V)

Code: 5FC17

L	T	P/D	C
3	1	-	3

Course objectives:

- Be exposed to big data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Learn the mining and clustering
- Be familiar with the visualization

Course Outcomes: After completing this course, student shall be able to

1. Work with big data platform and its analysis techniques.
2. Analyze the big data for useful business applications.
3. Select visualization techniques and tools to analyze big data
4. Implement search methods and visualization techniques
5. Design efficient algorithms for mining the data from large volumes.
6. Explore the technologies associated with big data analytics such as NoSQL, Hadoop

UNIT I

INTRODUCTION TO BIG DATA: Introduction to Big Data Platform – Traits of Big data - Challenges of Conventional Systems –Elements of Big Data , What is Big Data Analytics, Classification of Analytics, Why Big Data Analytics Important; Data Science; Data Scientist; Terminologies used in Big Data Environments; Basically Available Soft State Eventual Consistency (BASE); Open source Analytics Tools; Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools

UNIT II

DATA ANALYSIS: Statistical Concepts: Sampling Distributions – Re-Sampling - Statistical Inference - Prediction Error. Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data

UNIT III

MINING DATA STREAMS : Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time- Stock Market Predictions.

UNIT IV

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics; Points to Consider during Analysis; Understanding Text Analytics; Analytical Approach and Tools to Analyze Data: Analytical Approaches; History of Analytical Tools; Introducing Popular Analytical Tools; Comparing Various Analytical Tools.

UNIT V

FRAMEWORKS AND VISUALIZATION: The Map Reduce Framework; Techniques to Optimize Map Reduce Jobs; Uses of Map Reduce; Architecture, Storing Big Data with HBase, Role of HBase in Big Data Processing; Storing Data in Hadoop: Introduction of HDFS, Architecture, HDFC Files, File system types, commands, org.apache.hadoop.io package, HDF, HDFS High Availability; NoSQL Databases, Visualizations - Visual Data Analysis Techniques - Interaction Techniques;

UNIT VI:

Social Media Analytics and Text Mining: Introducing Social Media; Key elements of Social Media; Text mining; Understanding Text Mining Process; Sentiment Analysis, Performing Social Media Analytics and Opinion Mining on Tweets; Mobile Analytics: Introducing Mobile Analytics; Define Mobile Analytics; Mobile Analytics and Web Analytics; Types of Results from Mobile Analytics; Types of Applications for Mobile Analytics; Introducing Mobile Analytics Tools.

Textbook & Course Materials

Required Text

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. BIG DATA and ANALYTICS, Seema Acharya, Subhasinin Chellappan, Wiley publications.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.

Recommended Texts & Other Readings

4. BUSINESS ANALYTICS 5e , BY Albright |Winston
5. BIG DATA, Black Book TM , DreamTech Press, 2015 Edition
6. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
7. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
8. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
9. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007
10. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
11. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008

LECTURE SCHEDULE

S.No	UNIT	No. OF PERIODS	No. OF PERIODS & TOPICS TO BE COVERED
1	Unit-I	08	<ul style="list-style-type: none"> 1. INTRODUCTION TO BIG DATA, Introduction to Big Data Platform, Traits of Big data 2. Challenges of Conventional Systems, Elements of Big Data 3. What is Big Data Analytics and its importance 4. Classification of Analytics, Data Science, Data Scientist 5. Technologies used in Big Data Environments, Basically available Soft State Eventual Consistency (BASE) 6. Open Source Analytic Tools 7. Web Data – Evolution of Analytic Scalability, Analytic Processes and Tools 8. Analysis vs Reporting, Modern Data Analytic Tools
2	Unit-II	11	<ul style="list-style-type: none"> 1. DATA ANALYSIS, Statistical Concepts 2. Sampling Distributions, Re-sampling 3. Statistical Inference, Prediction Error 4. Regression Modeling - Multivariate Analysis 5. Bayesian Modeling - Inference and Bayesian Networks 6. Support Vector and Kernel Methods - Analysis of Time Series 7. Linear Systems Analysis - Nonlinear Dynamics 8. Rule Induction - Neural Networks 9. Learning And Generalization - Competitive Learning 10. Principal Component Analysis and Neural Networks 11. Fuzzy Logic: Extracting Fuzzy Models from Data
3	UNIT III	08	<ul style="list-style-type: none"> 1. MINING DATA STREAMS 2. Introduction To Streams Concepts – Stream Data Model and Architecture 3. Stream Computing - Sampling Data in a Stream 4. Filtering Streams 5. Counting Distinct Elements in a Stream – Estimating Moments 6. Counting Oneness in a Window – Decaying Window 7. Real time Analytics Platform(RTAP) Applications 8. Case Studies - Real Time Stock Market Predictions.

4	UNIT IV	10	<ol style="list-style-type: none"> 1. Understanding Analytics and Big Data 2. Comparing Reporting and Analysis 3. Types of Analytics 4. Points to consider during Analysis 5. Understanding Text Analytics 6. Analytical Approach and tools to analyze data 7. Analytical approaches 8. History and Analytical tools 9. Introducing popular Analytical tools 10. Comparing various Analytical tools
5	UNIT V	10	<ol style="list-style-type: none"> 1. FRAMEWORKS AND VISUALIZATION, The Map Reduce Framework 2. Techniques to Optimize Map Reduce Jobs 3. Uses of Map Reduce, Architecture 4. Storing Big Data with HBase, Role of HBase in Big Data Processing 5. Storing data in Hadoop 6. Introduction of HDFS, Architecture, 7. HDFC Files, File System Types, Commands 8. Organizing Apache Hadoop IO Package, HDF 9. HDFS High Availability, NoSQL Databases 10. Visualizations – Visual Data Analysis Techniques, Interaction Techniques
6	UNIT VI	07	<ol style="list-style-type: none"> 1. Social Media Analytics and Text Mining: Introducing Social Media 2. Key elements of Social Media; Text mining; Understanding Text Mining Process 3. Sentiment Analysis, Performing Social Media Analytics and Opinion Mining on Tweets; 4. Mobile Analytics: Introducing Mobile Analytics; Define Mobile Analytics; 5. Mobile Analytics and Web Analytics 6. Types of Results from Mobile Analytics; Types of Applications for Mobile Analytics; 7. Introducing Mobile Analytics Tools.

Total Periods: 08+11+08+10+10+07+ 4 extra = 58

QUESTION BANK

UNIT - I

1. List the main characteristics of Big Data.
2. What can you say about prediction error?
3. Define statistical inference.
4. Why do you use inferential statistics in Big data?
5. Can you list the differences between forward and backward Prediction?
6. Classify the types of web mining.
7. Define Web data.
8. What is meant by Predictor coefficients?
9. What is the relationship between sampling distribution and re-sampling?
10. What is the main idea in traditional analytic architecture?
11. Summarize the data types for Big data.
12. Compare and contrast traditional databases and massive parallel processing.
13. Can you generalize the role of analytical tools in big data?
14. How would you apply the methods of re-sampling in Big data?
15. Can you make the distinction between analysis and reporting?
16. Can you identify the different statistical concepts required for Big data?
17. Why does one choose analytical system over conventional system?
18. What is Big data? Describe the main features of a data analytical system? (8)
19. Describe in detail about the role of statistical models in Big data.(8)
20. List the main characteristics of big data architecture with a neat schematic diagram.
21. How would you describe the various prediction techniques?
22. Show how would you use the sampling distribution system?(8)
23. Illustrate the ReSampling methods.(8)
24. How would you distinguish analysis and reporting tools used in Big-data?
25. What are the best practices in Big Data Analytics?(8)
26. Elaborate the techniques used in Data analytics(8)
27. How would you show your understanding of the tools, trends and technology in big data?
28. How would you assess the difficulties faced by conventional systems? (8)
29. What are the differences that separate out big data architecture from the traditional one?
(8)
30. Summarize the modern data analytic tools in detail.

UNIT II

1. What is the role of repeated measures of data in analysis?
2. Will you interpret the joint probability density in Bayesian inference?
3. Can you list the various analysis involved in time series?
4. Define multivariate analysis
5. Classify the levels of the techniques in multivariate analysis
6. Can you assess the importance of neural networks in data analysis?
7. How do you define propositional rule learning?
8. How would you extract fuzzy models from data?
9. Can you make the distinction between learning and generalization?
10. What can you say about Hebbian learning?

11. How is genetic algorithm used in solving optimization tasks?
12. What is main idea of decision trees in fuzzy logic?
13. How would you show your understanding of delta rule in neural networks?
14. Can you point out random effects models?
15. How would you categorize the search techniques of stochastic methods?
16. Examine how would you implement regression modeling?
17. Summarize the Bayesian methods used in data analysis.
18. What is the main idea of analyzing time series?(8)
19. What are the features of support vector machines?(8)
20. Identify the kernel methods used in data analysis.(8)
21. Define rule induction.(4)
22. List the pros and cons of using neural networks in analysis.(12)
23. Can you identify the different mechanisms needed for learning?(8)
24. How do use the generalization techniques needed to illustrate neural networks? (8)
25. Can you list the types of evolution strategies in search analysis and explain in detail?
26. Explain in detail about the fuzzy decision trees.
27. Describe in detail about cluster analysis and mixture decomposition.(12)
28. How would you represent the data in propositional rule learning?(10)
29. Illustrate how would you extract fuzzy models from data?
30. How would you formulate the ideas of search methods in stochastic data analysis?

UNIT-III

1. List the main characteristics of stream sources.
2. Why do you think data stream management is relevant in data mining?
3. Define decay window.
4. Define the real-time sentiment analysis.
5. What are the issues in stream processing?
6. What is the main idea of estimating moments?
7. What would result if the cost of exact counts doesn't match?
8. Describe the stream queries.
9. What can you say about sampling streams?
10. What approach would you use to deal with infinite streams?
11. Which are the different ways to reduce the error?
12. What examples can you find for stream sources?
13. What is meant by bloom filter?
14. Compare and contrast RTAP (real time analytics platform) and
15. RTSA (real time sentiment analysis)?
16. What information would you use to substitute the view of streams over databases?
17. Describe the Big Data Stream Analytics Framework (BDSAF)with a neat architecture diagram
18. Can you assess the importance of sampling data in a stream?(10)
19. Enlist the different stream sources. (6)
20. Describe briefly how do you count the distinct elements in a stream?(10)
21. What do you meant by count-distinct problem?(6)
22. How is sentiment analysis playing a major role in data mining? (8)
23. What approaches would you use to make sentiment analysis?(8)

24. What can you say about the real time analytics platform applications?
25. Show how the mining concept used in real time sentiment analysis?
26. How is data analysis used in stock market predictions?
27. Examine is the function cost of exact counts? (8)
28. Discuss the concept of decaying window in detail.
29. Describe how you would stream data model architecture with suitable block diagram?
30. Assuming a real time stock market situation, bring out the various ideas used in prediction analysis

UNIT – IV

1. Differentiate Analytics and Big Data.
2. Compare and contrast Reporting and Analysis.
3. Give the different Types of Analytics.
4. What are the Points to consider during Analysis?
5. Explain in detail about Text Analytics.
6. Illustrate an Analytical Approach and specify the tools to analyze data.
7. Write about various Analytical approaches.
8. Show the significance of History of Analytical tools.
9. Write in detail about the popular Analytical tools.
10. Compare and contrast the various Analytical tools.

UNIT - V

1. Write about frameworks and visualization in BDA.
2. Illustrate the Map Reduce Framework with suitable example.
3. Explain the various techniques to Optimize Map Reduce Jobs.
4. What are the uses of Map Reduce?
5. Give the Architecture of Map Reduce.
6. How can data be stored in Big Data with HBase?
7. Show the role of HBase in Big Data Processing.
8. Show how data can be stored in Hadoop with suitable example.
9. What do you understand by HDFS?
10. Give the Architecture of HDFS.
11. What are HDFC Files?
12. Mention the various types of HDFC File System and give the associated Commands.
13. How can Apache Hadoop IO Package be organized using HDF?
14. Write in detail about HDFS and its High Availability for data analytic applications.
15. What do you understand by NoSQL Databases?
16. Explain the various Visual Data Analysis Techniques.
17. What do you understand by Interaction Techniques?

UNIT - VI

1. Illustrate Social Media Analytics using Text Mining.
2. What are the Key elements of Social Media?
3. Explain in detail about Text Mining Process.
4. Discuss Sentiment Analysis in detail.
5. Show Social Media Analytics and Opinion Mining on Tweets.

6. What is meant by Mobile Analytics?
7. Define Mobile Analytics.
8. Compare and Contrast Mobile Analytics and Web Analytics.
9. Discuss on various types of Results from Mobile Analytics.
10. Give the various types of Applications for Mobile Analytics.
11. Explain in detail about Mobile Analytics Tools.



Sreenidhi Institute of Science and Technology
 (An Autonomous Institution)

Regulations:
A14

Code No: 4FC22

Date: 22-Dec-2017 (FN)

B.Tech IV-Year I-Semester External Examination, Dec - 2017 (Regular)
BIG DATA ANALYTICS (IT)

Time: 3 Hours

Max.Marks:70

- Note:** a) No additional answer sheets will be provided.
 b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
 c) Missing data can be assumed suitably.

Part - A **Max.Marks:20**
ANSWER ALL QUESTIONS.

- | | | |
|----|---------------------------------------------------------------|------|
| 1 | What is Re sampling and why do we need it? | [2M] |
| 2 | Explain Fuzzy Decision tree. | [2M] |
| 3 | Explain Stream Data model. | [2M] |
| 4 | Define streams in the context of clustering. | [2M] |
| 5 | What is Hive? | [2M] |
| 6 | Explain different statistical packages. | [2M] |
| 7 | Define stochastic search method and write its applications. | [2M] |
| 8 | What is clustering and explain any two clustering strategies? | [2M] |
| 9 | Define and explain MapReduce. | [2M] |
| 10 | Explain Industry challenges and applications of analytics. | [2M] |

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

- | | | |
|---|-------------------------------------------------------------------------------------|------|
| 1 | a) Define Big Data and state the role and its importance of it. | [5M] |
| | b) Explain Analysis vs Reporting with illustrations. | [5M] |
| 2 | a) Discuss the significance of time series in the data analysis. | [5M] |
| | b) What is the difference between Principal component analysis and Neural networks? | [5M] |
| 3 | a) Explain counting oneness in a window and Decaying Window. | [5M] |
| | b) Analyze stock market predictions with one case study. | [5M] |

- | | | |
|---|----------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 4 | a) Discuss Frequent pattern based clustering method with example.
b) Write Apriori algorithm and explain it with sample data. | [5M]
[5M] |
| 5 | a) Analyze in detail about NoSQL databases.
b) Discuss about Hadoop Distributed File system. | [5M]
[5M] |
| 6 | a) Explain correlation and regression techniques in detail.
b) Define and differentiate classification and association. | [5M]
[5M] |
| 7 | a) Explain about the challenges of conventional systems and web data.
b) Define support vector machines and explain its importance. | [5M]
[5M] |
| 8 | a) Describe K-means algorithm.
b) Write in brief about correlation & regression. | [5M]
[5M] |

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Sreenidhi Institute of Science and Technology
(An Autonomous Institution)

Code No: 3FC17

Date: 09-June-17 (FN)

B.Tech IV-Year II-Semester End Examination, June-2017 (Adv Supplementary)

BIG DATA ANALYTICS (IT)

Time: 3 Hours

Max.Marks:70

- Note:** a) No additional answer sheets will be provided.
 b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
 c) Assume any missing data.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. What are the characteristics Big Data?
2. Define fuzzy decision tree.
3. Give one example on sentiment analysis.
4. Write different types of clustering algorithms.
5. What is Hive in big data?
6. What is regression?
7. Define prediction error.
8. What is meant by bloom filter?
9. What is sharding?
10. Write various examples of Big Data Analytics.

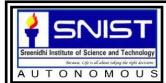
Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) What are the drawback of traditional system and Explain how to overcome in big data
b) Explain Modern data analytic tools in big data.
2. a) Explain the Bayesian methods used in data analysis.
b) Explain Regression modeling.
3. a) Explain RTAP with example
b) How data is analysis in stock market prediction.
4. a) Explain K-Means partition algorithm
b) Explain different types of clustering techniques
5. a) With an example code Explain on how Hadoop analyzes data.
b) Discuss on the different types and Formats of Map Reduce with an example.
6. a) Explain the Classification of Interaction techniques.
b) Explain about decision tree.
7. a) Explain Data stream Architecture.
b) Explain Rule Induction.
8. a) What is HDFS ?Explain the components of HDFS.
b) Explain about text analysis.

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Sreenidhi Institute of Science and Technology
(An Autonomous Institution)

Regulations:
A12

Code No: 3FC17

Date: 08-May-17 (FN)

B.Tech IV-Year II-Semester End Examination, May-2017 (Regular)

BIG DATA ANALYTICS (IT)

Time: 3 Hours

Max.Marks:70

Note: a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
c) Assume any missing data.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. What is Big data? Why we need to analyze Bigdata.
2. What Is Regression Modeling.
3. Define RTAP.
4. What are the most optimal frequent itemset mining algorithms.
5. What are the features of No SQL database .
6. Illustrate the concept of Regression analysis model.
7. Define Bayesian network.

8. Write the applications of Data Stream.
9. What is decision tree?
10. Write various example of Big data Analytics.

Part – B

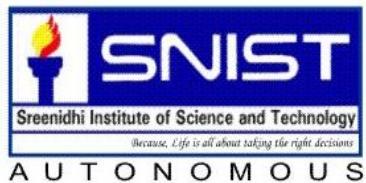
Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. a) What are the challenges of conventional system and Explain modern tool for analytics big data.
b) Explain Analysis Vs Reporting
2. a) Explain the Bayesian methods used in data analysis.
b) What is fuzzy decision tree and write different stochastic search methods.
3. a) What is click Stream and Explain stream data model and architecture.
b) How data is analysis in stock market prediction.
4. a) How to handle large data set in main memory explain with example.
b) Write various steps of Apriori algorithm and solve with one example
5. a) What is HDFS? Explain the components of HDFS.
b) Explain visual data analysis techniques
6. a) Explain with an example how to analyze the unstructured information in big data
b) Explain regression.
7. a) Differentiate linear system analysis and non linear dynamics.
b) Write short notes on ReSampling.
8. a) Explain briefly about frequent pattern based clustering methods.
b) What are the disadvantages of traditional system and Explain how to overcome in big data.

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SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
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Recipient of World Bank under TEQIP-I and II)
Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301.



COURSE FILE

FOR

SEMANTIC WEB and SOCIAL NETWORKS
(Professional Elective –V)

FOR

B.Tech - IV year - I Semester

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
JUNE 2018

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

Mission of the Department

- I. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- II. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- III. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development.

a	b	c	d	e	f	g	h	i	j	k	l
		x		x							

**Syllabus for B. Tech. IV Year I semester
Computer Science and Engineering
SEMANTIC WEB and SOCIAL NETWORKS
(Professional Elective –V)**

Code: 5EC22

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Course Objectives:

- Understand Web Intelligence and Ontology
- Learn basics of Semantic web, its representation issues and Social Network Analysis.

Course Outcomes: After completing this course, student shall be able to

1. Describe role of Web , its need and Intelligence.
2. Explain Machine Intelligence Ontology, Inference engines, Software Agents, Berners-Lee www and Semantic Road Map.
3. Describe Knowledge Representation for the Semantic Web with Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML and XML Schema.
4. Apply Ontology Engineering using Ontology Development Tools/ Methods, Ontology Libraries, Ontology Mapping, Logic and Inference Engines.
5. Explain Semantic Web Applications, Services and Technology.
6. Apply Social Network Analysis, Semantic web networks analysis and describe Building of Semantic Web Applications with social network features.

Unit I

Web Intelligence: Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today's Web, The Next Generation Web

Unit II

Machine Intelligence: Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Unit III

Knowledge Representation for the Semantic Web: Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema.

Unit IV

Ontology Engineering: Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Unit V

Semantic Web Applications, Services and Technology: Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,

Unit VI

Social Network Analysis and Semantic web: What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks, Building Semantic Web Applications with social network features.

TEXT BOOKS:

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley interscience, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

REFERENCE BOOKS:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies,Rudi Studer,Paul Warren,JohnWiley&Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers (Taylor & Francis Group)
3. Information Sharing on the semantic Web - Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web, T. Segaran, C. Evans, J. Taylor, O'Reilly, SPD.
5. A Semantic Web Primer, G. Antoniou and V. Harmelen, PHI.

SEMANTIC WEB and SOCIAL NETWORKS

(Professional Elective –V)

Lecture Schedule

UNIT-I

S.No.	No. of Lectures	Name of the Topic
1	03	Thinking and Intelligent Web Applications, ,
2	01	The Information Age,
3	01	The World Wide Web
4	01	Limitations of Today's Web,
5	01	The Next Generation Web

UNIT-II

6	01	Machine Intelligence
7	02	Artificial Intelligence,
8	02	Ontology, Inference engines
9	02	Software Agents
10	02	Berners-Lee www, Semantic Road Map,
11	01	Logic on the semantic Web.

UNIT-III

12	02	Ontologies and their role in the semantic UML.,
13	02	Ontologies Languages for the Semantic Web
14	03	Resource Description Framework (RDF) / RDF Schema
15	03	Web Ontology Web Language (OWL),
16	02	XML/XML Schema

UNIT-IV

17	01	Unit IV Ontology Engineering: Ontology Engineering, ,
18	02	Constructing Ontology

19	02	Ontology Development Tools,
20	01	Ontology Methods,
21	01	Sharing and Merging,
22	01	Ontology Libraries and Ontology Mapping,
23	01	Ontology Logic,
24	01	Rule and Inference Engines.

UNIT-V

25		Unit V Semantic Web Applications, Services and Technology: Semantic Web applications and services, ,
26	02	Semantic Search, e-learning, Semantic Bioinformatics,
27	02	Knowledge Base ,XML Based Web Services
28	01	Creating an OWL-S Ontology for Web Services,
29	02	Semantic Search Technology,
30	02	Web Search Agents and Semantic Methods,

UNIT-VI

31	01	Unit VI Social Network Analysis and Semantic web: What is social Networks analysis,—
32	02	development of the social networks analysis,
33	02	Electronic Sources for Network Analysis
34	02	Electronic Discussion networks,
35	02	Blogs and Online Communities,
36	02	Web Based Networks,
37	02	Building Semantic Web Applications with social network features.

Total Periods: 09+1012+10+09+13 = 63

UNIT - I

1. Discuss briefly the semantics of terms “thinking & intelligence in the context of Intelligent Application.
2. Discuss in brief about ARPANET and WWW.
3. Should the rapidly changing world of information age be considered a global revolutionary change on the scale of these earlier revolutions ? Explain.
4. What are the limitations of today’s web ?

UNIT - II

1. Discuss in brief about Machine Intelligence.
2. Discuss in brief about Artificial Intelligence.
3. Write short note on ontology.
4. Write short note on inference engines.
5. Write short note on software agents.
6. How do we apply Logic on the Semantic web and Explain how does it works ?

UNIT - III

1. Explain in detail about ontology based knowledge representation.
2. Discuss in detail about RDF.
3. Explain in detail about RDF / XML Schema.
4. Describe in detail the iterative approach for building ontology.
5. What are the various methods used for developed ontology.
6. List the most common editors used for building ontology.

UNIT - IV

1. Explain in brief interface rules.
2. Explain in brief conditional transformation rules.
3. Explain in brief biconditional transformation rules.
4. Write about semantic search.

5. How is E-learning enhanced in the latter stages of its evolution.
6. What are the two search algorithms available for solving tree-search problem.

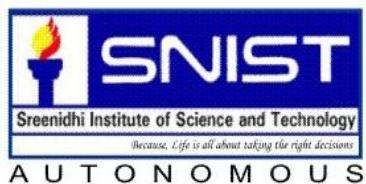
UNIT - V

1. What are the semantic web applications and services ? discuss..
2. Write a short note on semantic bio informatics.
3. What is social network analysis.
4. Discuss in brief about web search agents and semantic methods..
5. Explain in detail Jaccard-Coefficient of Co-occurrence.
6. discuss in detail about Knowledge base and XML based Web services ?

UNIT - VI

1. Explain in brief about the Social networks analysis ?
2. What are the Electronic sources for Network Analysis? discuss.
4. Explain about WWW.
5. How do you build semantic web applications with social network features ? Explain in detail.

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Yamnampet, Ghatkesar Mandal, Hyderabad - 501 301.



COURSE FILE
FOR
NEURAL NETWORKS
(Professional Elective –V)
FOR
B.Tech - IV year - I Semester

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
JULY 2018

Vision of the Department

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering with focus to produce professionally competent and socially sensitive engineers capable of working in global environment.

Mission of the Department

- I. To prepare Computer Science and Engineering graduates to be a life long learner with competence in basic science & engineering and professional core, multidisciplinary areas , with continuous update of the syllabus, so that they can succeed in industry as an individual and as a team or to pursue higher studies or to become an entrepreneur.
- II. To enable the graduates to use modern tools, design and create novelty based products required for the society and communicate effectively with professional ethics.
- III. To continuously engage in research and projects development with financial management to promote scientific temper in the graduates and attain sustainability

Programme Educational Objectives

- A. Graduates will have a strong foundation in fundamentals of mathematics, Physics, Chemistry, Computer Science and basic engineering knowledge with abilities for analysis of the problem and to design, development of solutions and to arrive at an optimal solution using modern tools which help them to be employable.
- B. Ability to work in a team/ lead a team which needs effective communication skills and knowledge of project management, finance and entrepreneurial abilities.
- C. Graduates should have abilities to conduct investigation of complex problems and attitude for lifelong learning skills which will enable them to pursue advanced studies, Research and Development.
- D. The graduates must be aware of the engineering professional ethics, the impact of engineering profession on the society and the need for environmental protection and sustainable development

The Programme Outcomes (POs) of the B.Tech (CSE) programme, which every graduate must attain, are listed below:

- a) An ability to apply knowledge of basic sciences, mathematics and engineering in the area of Computer Science.
- b) An ability to design, implement and evaluate a software or software / hardware system to meet the desired needs within realistic constraints such as space and time.
- c) An ability to use the techniques, skills, and modern engineering tools such as software testing tools, data warehousing and mining tools, necessary for practice as a CSE professional.
- d) An ability to analyze and solve open-ended problems using mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices and to arrive at an optimal solution.
- e) To understand principles of engineering, entrepreneurship with emphasis on women, and financial management through relevant management courses to demonstrate knowledge in the conceptualization and realizing group projects, mini & main projects.
- f) An ability to function effectively as individual and as a member or leader in diverse team in achieving multidisciplinary tasks.
- g) Learn to communicate effectively on complex engineering activities through report writing, experimental work, assignments, seminars, group projects, mini & main projects.
- h) To recognize the need for and have the preparation and ability to be a life-long learner through the courses such as seminars & projects.
- i) An ability to identify, formulate and analyze engineering problems.
- j) An ability to conduct investigation of complex problems in multidisciplinary areas.
- k) An understanding of professional ethics and responsibilities.
- l) An engineer should be aware of social, safety, cultural and information security issues and also responsibilities relevant to professional practice and skills.
- m) An ability to understand the impact of environmental protection and sustainable development.

a	b	c	d	e	f	g	h	i	j	k	l
x		x									

**Syllabus for B. Tech. IV Year I semester
Computer Science and Engineering
NEURAL NETWORKS
(Professional Elective –V)**

Code: 5EC21

L	T	P/D	C
3	1	-	3

Course Objectives:

Students should be able to apply Pattern Recognition for Real-life problems

Course Outcomes: After completing this course, student shall be able to

7. Understand the role of neural networks in engineering, artificial intelligence and cognitive modeling.
8. Describe Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory
9. Understand Competitive learning, Self-organizing feature maps, and be able to evaluate whether neural networks are appropriate to a particular application
10. Apply neural networks to particular applications and to know what steps to take to improve performance

UNIT I

INTRODUCTION - what is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

UNIT II

SINGLE LAYER PERCEPTRONS – Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perceptron –convergence theorem, Relation between perceptron and Bayes classifier for a Gaussian Environment

UNIT III

MULTILAYER PERCEPTRON – The XOR problem, Heuristics, Output representation and decision rule, feature detection,

BACK PROPAGATION – Algorithm and its derivation by using error minimization, back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning,

UNIT IV

SELF ORGANIZATION MAPS – Two basic feature mapping models, Self organization map, SOM algorithm.,

UNIT V

HOPFIELD MODELS – Simple Hopfield models.

UNIT VI

EXAMPLES OF APPLICATIONS OF NEURAL NETWORKS

alphabet recognition, fingerprint recognition.

TEXT BOOKS:

1. Neural networks A comprehensive foundations, Simon Haykin, Pearson Education 2nd Edition 2004

REFERENCE BOOKS

1. Artificial neural networks - B. Venuganarayana Prentice Hall of India P Ltd 2005
2. Neural networks in Computer intelligence, Li Min Fu TMH 2003
3. Neural networks James A Freeman David M S Sipser Pearson education 2004

LECTURE SCHEDULE

UNIT-I

S.No	TOPIC	No. of Lectures
1	what is a neural network	1
2	Human Brain, models of a neuron	2
3	Neural networks viewed as Directed Graphs, Network Architectures	2
4	Knowledge Representation	2
5	Artificial Intelligence & Neural networks	2

UNIT-II

	SINGLE LAYER PERCEPTRONS – Adaptive filtering problem	1
	Unconstrained Optimization Techniques	2
	Linear least square filters, least mean square algorithm, learning curves	3
	Learning rate annealing techniques	2
	Perceptron –convergence theorem	2
	Relation between perceptron and Bayes classifier for a Gaussian Environment	2

UNIT-III

	MULTILAYER PERCEPTRON – The XOR problem	1
	Heuristics	2
	Output representation and decision rule, feature detection	2
	BACK PROPAGATION – Algorithm and its derivation by using error minimization	2
	Back propagation and differentiation, Hessian matrix	2
	Generalization, Cross validation	2
	Network pruning Techniques	2
	Virtues and limitations of back propagation learning	2

UNIT-IV

	SELF ORGANIZATION MAPS – Two basic feature mapping	2
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	models	
	Self organization map	2
	SOM algorithm	2
UNIT-V		
	HOPFIELD MODELS – Simple Hopfield models	3
UNIT-VI		
	EXAMPLES OF APPLICATIONS OF NEURAL NETWORKS alphabet recognition, fingerprint recognition	4

Total Periods: $09+12+17+06+3+4 = 51$

UNIT I :

Short Answer questions:

Define the following terms:

1. Cell soma
2. Inter neuron cells and output cells
3. Axon
4. Synapse
5. Dendrites
6. Axon hillock
7. Action potential
8. Resting potential of a cell
9. Neurotransmitters

In the context of artificial neural networks define the following:

1. A processing element
2. A weighted connection
3. A linear threshold unit
4. Connection strength

5. Linear separability
6. Feature extraction
7. Feature vectors

Long Answer questions:

1. Describe single layer and multi layer neural networks.
2. What is McCulloch Pitts model? Describe.
3. Describe briefly the functioning of the Human Brain.
4. Describe the structure of the biological Neuron

UNIT II

Short Answer questions:

1. What is a perception?
2. Write down the steps of the Perception Learning algorithm.

Long Answer Questions:

1. Show that the Perceptron learning procedure will always converge if the data is linearly separable. (Give a rigorous mathematical proof).
2. Describe the LMS learning algorithm for a single Adaline.
3. What is the method of steepest descent?
4. Show how by using the principle of steepest descent one can derive the weight change equation in the LMS algorithm.

UNIT III

Short Answer questions:

1. Show by using the XOR problem that I general classification using a single layer has limitations and cannot separate data always.
2. Define the following:
 - a. (a)The Heaviside function,
 - (b)the sigmoid function,
 - (c) and the exponential functions
which are used along with the processing elements?
3. Of what use are the Heaviside, the sigmoid and the exponential functions
4. Describe what is meant by an adaptive linear element (Adaline).

5. Explain the configuration of a Madaline (many adalines).
6. Explain the generalized delta rule
7. Show how the XOR problem can be overcome by using more than one layer
8. Write down the respective expressions for the weight change equations in the following cases, as used in the Back propagation algorithm:
 - (a) when the weights belong to units in the outer layer
 - (b) when the weights belong to units in the hidden layer.
9. Explain the following concepts involved in the Back Propagation algorithm:
 - (a) The bias term
 - (b) The error function (which is minimized)
 - (c) The learning rate parameter
 - (d) The sigmoid function and its use
 - (e) The momentum parameter

Long Answer Questions:

1. Show that a classification using a single layer has limitations and cannot separate data which is not linearly separable.
2. Explain in detail the method of Back propagation training of a multi-layer neural network. Draw clear figures and explain notation. And derive the weight change equations for all cases.
3. Write down the basic steps of the back propagation algorithm as applied on a 3-layer neural network. (that is input layer, hidden layer and output layer). Draw the figures for the 3-layer network and clearly delineate the variables involved; and explain notation.
4. Write Short notes on the following with respect to Back propagation training:
 - (a) Network sizing
 - (b) Local and global minima
 - (c) Use of learning rate parameter and momentum for training
5. Describe the use of the Back propagation technique for the following applications:
 - (a) The data compression problem
 - (b) Paint quality inspection
 - (c) Character recognition
 - (d) Expert system applications (say disease diagnosis)
6. Derive the Back propagation algorithm when there are more than 3-layers (i.e. two or more hidden layers).
7. Describe the functioning of a Counter propagation Network

UNIT IV

Short Answer Questions:

1. Feature mapping
2. Mapping techniques
3. Self organization
4. SOM
5. Properties of mapping
6. Vector representations
7. Vector quantization
8. Learning in vector quantization
9. Classification
10. Pattern selection
11. Pattern Classification
12. Adaptation process
13. Adaptation in pattern Classification

Long Answer Questions:

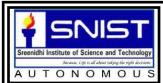
1. List out various feature mapping techniques and compare them
2. What is SOM? Derive the learning algorithm for SOM.
3. List out various properties of mapping and enumerate them
4. What is vector quantization and how is it used in learning process?
5. What is pattern classification and adaptation process? How is the adaptation process integrated with pattern classification?

UNIT V**Short Answer Questions:**

1. Hopfield networks
2. Models of Hopfield networks

Long Answer Questions

1. Describe the use of Hopfield networks in ANN.
2. List out various Hopfield models and describe each of them



Code No: 101IT10

Date:10-Dec-16(AN)

B. TECH. III-Year II-Semester Examinations, Nov/Dec 2016 (Supplementary)
NEURAL NETWORKS AND FUZZY LOGIC (ECE)

Time: 3 Hours

Max. Marks: 70

- Note:** a) No additional answer sheets will be provided.
b) All sub-parts of a question must be answered at one place only, otherwise it will not be valued.
c) Assume any missing data.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. Find the cardinality and relative cardinality for the following fuzzy set
 $t = \{1/5+ 1/10+0.8/20/0.5/30+ 20/ 40+0.1/50\}$.
2. Define classical sets?
3. Discuss about any two properties of a crisp set?
4. On what basis Kohonen's self-organizing nets work?
5. What is an activation function? Give examples.
6. Write the differences between neural network memories and conventional memories.
7. Give the applications of Neural Networks in communications.
8. Define pattern recognition in ANN?
9. Define perception with its activation equation?
10. Define input layer, hidden layer & output layer in a multilayer perception?

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. Explain hebbian (hebb's) learning rule also explain hebb's hypothesis & the covariance hypothesis?
2. Explain feed forward and feedback networks with neat diagrams?
3. Explain about various operations on Fuzzy sets with suitable examples.
4. Write the algorithm for Back propagation training and explain about the updation of weight.
5. Explain the different architectures of recurrent neural networks and its training algorithms.
6. Explain the basic structure and operation of fuzzy logic control system.
7. Explain the following logical connections of two propositions with examples.
 - i. Disjunction
 - ii. Conjunction
 - iii. Negation
 - iv. implication
 - v. equivalence
8. Explain the following with an example each. [3+4+3]

- i) Multi valued logic
- ii) Quantified prepositions
- iii) Linguistic hedges

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Sreenidhi Institute of Science and Technology
(An Autonomous Institution)

Regulations:
A10

Code No: 101IT10

Date:11-May-16

**B. Tech. III-Year II-Semester Examinations, May 2016 (Supplementary)
NEURAL NETWORKS AND FUZZY LOGIC (Common to ECE and ECM)**

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. Define cardinality of a fuzzy set?
2. Define normal fuzzy set?
3. Define DE Morgan's law?
4. On what basis Kohonen's self-organizing nets work?
5. What is an activation function? Give examples.
6. Write the differences between neural network memories and conventional memories.
7. How cardinality is defined for a power set?
8. Write short notes on synaptic link?
9. What are the draw backs of fuzzy logic controller?
10. Mention the few properties of fuzzy sets.

Part – B

Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. Explain hebbian (hebb's) learning rule also explain hebb's hypothesis & the covariance hypothesis?
2. Explain feed forward and feedback networks with neat diagrams?
3. Explain Hopfield models of Neural network and its applications.
4. Write the algorithm for Back propagation training and explain about the updation of weight.
5. Explain about the properties present in the fuzzy set? How is the excluded middle law different for the fuzzy set and the classical set?

6. How is lambda cut method employed for a fuzzy relation? Discuss in detail on the special properties of lambda cut sets?
7. Design a neuro-fuzzy controller from fundamentals, for a system of your choice, with the help of relevant block diagram, flow chart, equations and table.
8. Write short notes on the following:
 - (a) Supervised and unsupervised learning
 - (b) Neural Networks in semiconductor technology

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Sreenidhi Institute of Science & Technology
(An Autonomous Institution)

A10

Code No: 101IT10

**B. TECH. III – Year II – Semester Examinations, January 2015 (Supplementary)
NEURAL NETWORKS AND FUZZY LOGIC (Common to ECE and ECM)**

Time: 3 Hours

Max. Marks: 70

Note: No additional answer sheets will be provided.

Part - A

Max.Marks:20

ANSWER ALL QUESTIONS.

1. Define Neural Network. Draw the non-linear model of neuron and explain.
2. What is the function of Synaptic gap?
3. List out the four main steps in back propagation algorithm.
4. Explain linear separability in a 2D Vector shape.
5. What is the basis function used in RBF networks and why the name RBF?
6. Define learning rate parameter 'y'.
7. What are excluded middle laws?
8. List the application of fuzzy controllers.
9. What are the draw backs of fuzzy logic controller?
10. Mention the few properties of fuzzy sets.

Part – B

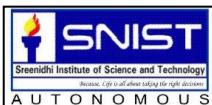
Max.Marks:50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. (a) With the help of a neat diagram, explain algorithm of ADALINE network.
(b) Explain the applications of ADALINE and MADALINE networks.
2. In detail, explain the Back propagation learning algorithm with the help of a neat sketch.

3. Explain the Hopfield network with its topology, algorithm and applications.
4. Explain feed forward and feedback networks with neat sketches.
5. What is fuzzy relation? Explain the operations on fuzzy relations and its properties.
6. Explain the basic structure and operation of fuzzy logic control system.
7. Design a neuro-fuzzy controller from fundamentals, for a system of your choice, with the help of relevant block diagram, flow chart, equations and table.
8. Write short notes on the following:
 - (a) Supervised and unsupervised learning
 - (b) Neural Networks in semiconductor technology
 - (c) Fuzzy membership function

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Sreenidhi Institute of Science & Technology
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A 10

Code No: 101IT10

B. TECH. III – Year II – Semester Examinations, MAY, 2014 (Supple.)
NEURAL NETWORKS & FUZZY LOGIC (ECE, ECM)

Time: 3 Hours

Max. Marks : 70

Note : No additional answer sheets will be provided.

Part-A (Objective Type)

Max.Marks:20

ANSWER ALL QUESTIONS.

1. Define Sigmoid function.
2. List out the differences between artificial neural network and biological network.
3. Differentiate between single and multi layer perception.
4. On what basis Kohonen's self-organizing nets work?
5. What is an activation function? Give examples.
6. Write the differences between neural network memories and conventional memories.
7. Give the applications of Neural Networks in communications.
8. What are fuzzy relations?
9. State any two properties of fuzzy sets.
10. What are fuzzy measures?

Part – B

Max. Marks: 50

ANSWER ANY FIVE QUESTIONS. EACH QUESTION CARRIES 10 MARKS.

1. (a) What are the relevant computational properties of the Human Brain?

- (b) Write short notes on neural approaches to computation.
2. (a) Single layer perception cannot classify non-linearity separate vectors - Justify.
(b) Discuss the benefits of neural networks.
3. Explain Hopfield models of Neural network and its applications.
4. Write the algorithm for Back propagation training and explain about the updation of weight.
5. Explain the different architectures of Recurrent neural networks and its training algorithms.
6. Explain the basic structure and operation of fuzzy logic control system.
7. (a) State the properties of fuzzy sets.
(b) Given fuzzy set A & B as
$$A = 0.3/1 + 0.6/2 + 0.7/4 + 0.2/5$$
$$B = 0.5/10 + 1/11 + 0.5/11$$

Prepare
1. Fuzzy addition.
2. Fuzzy subtraction.
3. Fuzzy multiplication.
4. Fuzzy division.
8. Explain the stochastic optimization methods for weight determination.

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